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Transit Era Hartford: Using the Past to Plan the Future

Adam Polinski

University of Connecticut - Storrs, adam.polinski@uconn.edu

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Transit Era Hartford: Using the Past to Plan the Future

Adam Polinski

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ABSTRACT

The past several decades have been accompanied by a growing concern regarding the viability of auto-centric planning as it relates to environmental, social, and economic sustainability. Research has shown that dense, multimodal urban development has many benefits over the sprawling land use patterns that are so common today. As there are few modern places that are free of automobile-oriented development, historic cities often act as great sources of this information. Unfortunately, it is difficult to fully explore and understand Pre-Automobile Era cities because of a lack of accessible data.

Through GIS digitization of maps of Hartford, Connecticut around 1920, it was possible to quantify characteristics of an historic American city built for pedestrians and compare it to modern-day development patterns. Initial results show that the trolley system of 1920, while not significantly superior to the modern bus system, was effective in moving residents from their homes to the downtown commercial center and moving people throughout the Greater Hartford region. The 1920 system was also accompanied by more multimodal streets and residential land use development that employed a small-scale, uniform building pattern.

This research is a starting point for developing a more advanced analysis of the significant changes to Hartford’s urban fabric as it has gone from transit-oriented to auto-oriented. It is believed that by using tangible data to describe the urban form of the American city before it was dominated by the automobile, important insights can be gained in the push for safer, more sustainable, and more vibrant places.
INTRODUCTION

The first cities were built for foot traffic. Housing was dense, streets were narrow, and land use was diverse. When streetcar lines were installed in many places around 1890, development moved out along the rails and transit corridors were created. With streetcars came the first specialized downtowns and the first suburbs. This separation of commercial and residential areas was augmented in the automobile era, which started around 1920 in many American cities. Growth took place between transit lines and also continued to move outward from the central business district. The highway era, starting around 1945, enabled vast suburbanization and cemented the role of the automobile as the primary source of transportation for most Americans.

The reasoning behind the reconfiguration of so many American cities is complex, but it is partially based around the idea of the car as a way to cure social ills and improve the quality of life for those who could afford one. This work uses Hartford, Connecticut as a case study to understand the urban form of an American city as it began the transition from transit-oriented development to automobile-oriented development. At a time when research is showing that there are many drawbacks to the latter style of development, it is crucial to understand how cities were transformed.

After exploring the existing literature on the social aspects of the Transit Era, this study quantifies some of the characteristics of Hartford in 1920 and compares it to modern development. It draws on historical maps, planning and municipal reports, and various transportation records to determine what a pre-Automobile Era American city looked like and how it functioned. A number of previous studies at the University of Connecticut have looked at how cities changed between the beginning of the Highway Era and today, assessing the impact of land use changes on factors like mode choice or municipal finances. It has been found, however, that Hartford and other cities were being altered to accommodate automobiles as early as 1920 by widening roads, removing on-street parking, and dismantling the trolley
system. For this reason, the assessment extends even further back in time to capture the true essence of a Transit Era city.

Analysis reveals that Hartford was still built for foot travel in 1920, the trolley having spurred transit-oriented development for almost 30 years prior. The first residential neighborhoods had begun to develop along the trolley lines to allow relief from the congestion of the central city while still providing easy access to the downtown. Thirty minute access maps show that this system did not provide significantly better citywide access than the modern bus system, but that it was effective in moving residents from their homes to the CBD. It was also a significant part of the regional public transportation system that extended into neighboring cities. In addition to having the better overall service, the 1920 system supported a different style of street layout, one in which all modes could mingle safely. These streets were lined with small, primarily two-story buildings in residential neighborhoods and almost all parking was on-street. Commercial activity in these neighborhoods was also typically housed in mixed-use buildings.

This document consists of two separate papers. The first, “The American City in the Transit Era: The Case Study of Hartford, Connecticut”, provides the reader with background information on the effect of transportation on the urban fabric of Hartford as it began the transition from transit-oriented to automobile-oriented development. It also quantifies characteristics of the trolley system that once existed in Hartford and documents the rapid rise and decline of this system. The second paper, “A Virtual Reconstruction of Transportation and Land Use in Transit Era Hartford, Connecticut”, continues to explore the measurable characteristics of urban form in 1920s Hartford and compares it to modern transportation and development.

Some of the most common conceptions of historic American cities are proven to be true in this work, while other findings serve to enlighten us with respect to the actual form and function of a Transit Era city. By studying Hartford around 1920, there is an opportunity to better understand transit-oriented development on a citywide scale and in the American context. As
the need to support sustainable modes of transportation becomes greater, Pre-Automobile Era
cities can provide professionals with useful insights for working towards safer, better connected,
and sustainable transportation systems.
THE AMERICAN CITY IN THE TRANSIT ERA: THE CASE STUDY OF HARTFORD, CONNECTICUT
INTRODUCTION

Cities have always been directly impacted by transportation. The land use that has resulted from large-scale changes to transportation infrastructure can be categorized into four general eras: the walking era, the streetcar era, the automobile era, and the highway era. (1) When the first cities were built, they were built for foot traffic. (2,3) Housing was dense, streets were narrow, and land use was diverse. (2,3) When streetcar lines were installed in many places around 1890, development moved out along the rails and transit corridors were created. (1-3) With streetcars came the first specialized downtowns and the first suburbs. (2,3) This separation of commercial and residential areas was augmented in the automobile era, which started around 1920. (1) Growth took place between transit lines and also continued to move outward from the center of the city. (2,3) The highway era, starting around 1945, enabled vast suburbanization and cemented the role of the automobile as the primary source of transportation for most Americans. (1-3)

Research has shown that the changes that took place in the automobile and highway era have negatively impacted the quality of life in cities for a host of reasons. (4) Neighborhoods were razed to accommodate freeways and other automobile-related infrastructure (5) The fine-grained urban fabric, mixed-use, and pedestrian-scale environments that are so essential to cities was often destroyed. Furthermore, the automobile and freeways enabled widespread suburbanization, a form of development that is now understood to be largely unsustainable from social, economic, and environmental perspectives. (6-8) Planners focusing on creating places that are more sustainable recognize that many of the elements that promote sustainability can be found in both walking and streetcar era cities. Looking back at the infrastructure that existed during these pre-auto eras can provide important insight into replicating the characteristics of these cities that helped them function in a more sustainable way.

A number of studies have looked at how cities changed from the beginning of the highway era (around 1950) to the present. (9-11) That research has involved quantifying
changes in land use and assessing how they impacted factors like mode choice or municipal finances. (9-11) This new study extends this assessment further back in time to the start of the automobile era. Planners were altering cities to accommodate automobiles as early as 1920 by widening roads, removing on-street parking and dismantling the trolley system. As a result, land use and transportation initiatives had already begun to transform the character of what were once vibrant mixed-use neighborhood centers even before the highway era began around 1950. Accordingly, to more fully understand how cities were transformed to accommodate the automobile, it is necessary to learn how cities functioned before any changes were made.

This research draws on historical maps, planning and municipal reports, and various transportation records to determine what the 1920s era city looked like. The case study is Hartford, Connecticut, a city that has featured prominently in previous University of Connecticut research studies. The ultimate goal of this work is a virtual reconstruction of Hartford in the 1920s and its evolution over time. This will provide important new insight into how cities like Hartford functioned in the pre-automobile era. The knowledge and insight gained from this virtual reconstruction could prove valuable as cities around the country work to restore urban vitality, transportation diversity, and sustainable land use patterns.

BACKGROUND & LITERATURE REVIEW

The Dawn of the Motor Age

Before the physical changes that took place in Hartford are analyzed, it is necessary to understand the attitudes and social pressures present at the time that ultimately drove these changes. Today it is assumed that cars have had a right to the road for as long as they have existed, but this is a common misconception. Peter Norton discovered that a paradigm shift had to occur in order for traffic to dominate city streets. (12) In 1910, automobiles were just starting to become popular. Conflicts between pedestrians and motorists were growing more frequent, and the definition of a street was changing for different users. Norton points out the importance of language in this contestation. For example, the term "jaywalker" was coined by advocates for
motoring and used to shame pedestrians into obeying “the rules of the road”. (12) At first it had little effect. Supporters of pedestrians, including parents, streetcar riders, and policemen, were the majority. (12) They believed that the street was a place for human interaction and did not welcome the regulations needed to accommodate automobiles. (12) This notion was also upheld in the courts. Grievances that ended up in the courtroom tended to favor the pedestrian over the motorist. (12)

Slowly, though, “motordom” (the term used to describe those who supported automobiles) began to change the discourse. (12) The process began with jaywalkers (pedestrians who fail to look both ways or not cross in designated areas) being ridiculed. (12) Motordom also appealed to Americans’ desire for freedom, arguing that suppressing motor vehicles was a violation of free market principles. (12) Further inroads were made by educating children that the street was a dangerous place where the automobile was the rightful user. (12) Using tactics such as these, motordom eventually succeeded in convincing society that streets were used to move traffic.

**Building a “Functional” Future**

The changes to the urban fabric that took place in the first half of the 20th century, which ultimately came to be seen as normal by the public, were largely a product of the birth of the city planning movement. Many cities in 1900 were perceived as chaotic and congested. (13) People loved the technology and wealth of the city that was created as a result of the Industrial Revolution, but hated the social conflict, crowding, and pollution that also occurred. (14) Planning visionaries fantasized a perfect future made possible by technology and order. (14) These typically middle or upper class white male novelists were particularly entranced by the car, which seemed to be present itself as the perfect solution to the early 20th century city’s problems. (14)

The theories of these utopian fantasists were first given realistic consideration in New York, Boston, and Chicago, where some of the most prominent architecture and city planning
firms were located. (14) These cities, which all had strong urban utopian followings, were under the impression that the car had the ability to solve most urban issues. (14) As part of the City Beautiful movement, these planners wanted to build wide, straight boulevards with imperial vistas and ample room for motorists to speed through the city. (14) In many cases, these streets also had parks and open space on either side of the concourse to give drivers a pleasant riding experience. (14) It was hoped that these roads would provide suitable access to and from the rapidly growing suburbs, which many at the time thought would help to relieve congestion in the city. (13) The theory was that redistributing the middle class to outlying areas would open up opportunities for better housing for lower-income residents, therefore lowering city density and establishing social and economic stability. (13) New developments emerged inspired by the Garden City ideal and several Haussmann-style boulevards were built, but high cost prevented many of these projects from being realized. (13,14)

In the 1920s, the City Beautiful movement began to give way to the City Functional movement. Standardization, order, and control were becoming the mottos for economic success. (14) One faction of these efficiency-minded planners was deemed the Modernists, the most influential of which was the Swiss architect Le Corbusier. In his piece “The City of Tomorrow and its Planning” (15), Le Corbusier focuses on the idea of the city as a machine. He recalls a time when “the road belonged to us… we sang in it and argued in it, while the horse-bus swept calmly along”, but that by the 1920s the streets were filled with fast-moving automobiles. (15) He does not appear to miss the days of old, however, stating that “an enthusiastic rapture” filled him as he witnessed the power and speed of the motor age street. (15)

Le Corbusier believed that with the automobile, a new day was dawning on society. His vision was to rebuild the city with huge skyscrapers and triple-decker streets. With geometric uniformity and efficiency as his goals, he pictured prefabricated, uniform high-rise dwellings with ample open space at the street level- ‘towers in the park’. His “Radiant City” resembled a
complicated machine that could only function on the basis of strict order. (13) This plan was attempted in many American inner cities in the 1950s and 1960s as part of Urban Renewal, but the impracticality of it was quickly realized. Le Corbusier, despite his intricate theories, lacked a fundamental understanding of human nature and social behavior. (13) Nevertheless, examples of his vision are still found in cities all across the country and around the globe.

**Rebuilding the Urban Fabric**

Several research projects have captured the oftentimes dramatic evolution of cities through a variety of mediums. A study at the Georgia Institute of Technology used historical photographs to build time-varying 3D models of cities, allowing them to be seen from a variety of perspectives and with temporal variations. (16) In “60 Years of Urban Change”, researchers at the University of Oklahoma have created interactive tools to show the viewer changes in the composition of the urban fabric before and after 1950s era urban renewal with the help of aerial photographs. (17) These projects have served as a basis for developing a visual component to this research, with street-level photographs, trolley maps, Sanborn maps, and aerial photographs all playing a part in reconstructing historic Hartford.

Less literature has focused on using quantitative data to rebuild historic cities. One exception is the NYU Stern Urbanization Project, which has used historic maps and remotely-sensed data to create time-lapse videos that illustrate sprawl over the course of the last century in cities across the globe. (18) Providing the building blocks for making these kinds of comparisons would allow for a more concrete assessment of the transformation in a city’s characteristics over time. Visual comparisons can be very revealing, but they cannot be measured. Producing data that show how specific land use and transportation characteristics have changed will provide a better sense of how traditional cities functioned before automobiles were introduced.
HARTFORD: A CASE STUDY

The city of Hartford, Connecticut provides a case study on documenting changes to transportation and the urban fabric over the course of the 20th century. Hartford was a wealthy city in 1900, having claimed the title of “richest city in America” in terms of corporate wealth just a couple decades prior. (19) It was diverse and vibrant, as evidenced by photo collections of the unique architecture and busy streets. (20) It also possessed an extensive transit system, the exact metrics of which will be discussed in further detail in the results section. The population was 80,000 in 1900 and 138,000 by 1920; a trend that many thought would lead to a population of 400,000 by as early as 1980. (21,22)

The Hartford of today is dramatically different. The population is actually lower than it was in 1920 at 125,000 residents, one-third of whom live below the poverty line. (21) The median income is less than half of that of the entire Hartford County, suggesting that much of the wealth is held in suburban towns. (21) Struggling cities like Hartford are attempting to revitalize neighborhoods to attract investment and people. The goal of this paper is to better understand how traditional cities functioned to provide insights that can be used to create neighborhoods that are once again functional and vibrant.

Hartford’s Fight for the Street

The first transit infrastructure was built in Hartford in 1863, which consisted of trolley cars powered by a team of horses. These were eventually replaced by electric cars, the first of which began operating in 1888 along Wethersfield Avenue. (23) By the turn of the century, Hartford’s streets were busy but highly functional. Pedestrians, bicycles, trolleys, carriages, and wagons all moved about without much conflict. (24) Peter Baldwin found that “people commonly crossed the street without bothering to look both ways, and they crossed wherever they wanted to except when muddy seasons made it worth using the stone crosswalk at the corner. Even the major intersections at City Hall Square were quiet enough that pedestrians could stand in the street conversing or waiting for trolleys without danger from the passing traffic.” (24)
By building at a manageable density and supporting smaller neighborhood centers away from the downtown, Hartford had effectively avoided the congestion that had started to plague nearby cities like New York and Boston. Street safety was also a top priority at this time, as evidenced by the 6 mph speed limit that existed until 1896. (24) As automobiles began to appear in the streetscape, however, both the speed limit and tensions began to rise. (24)

The rapidly increasing speed limit, which was 20 mph by 1905 and completely abolished in 1927, was a product of a changing attitude in the way streets should be used. (24) According to Peter Norton, the fight for the street was taking place in cities across the country, and from our research Hartford was no different. As more cars began filling the streets in the 1910s, the number of traffic fatalities increased rapidly. In 1902, not one person in the city was killed by vehicles or horses. (24) In contrast, in a twelve-month period between 1916 and 1917, there were 26 victims, most of whom were pedestrians (24). Citizens voiced their concerns to local newspapers, remarking that “not a day goes by but lives are jeopardized by speed fiends”. (24) The Hartford Automobile club had initially tried to maintain an elite, exclusive image by screening out undesirable members. (24) This changed quickly, though, when they made the astonishing discovery that they were considered snobs and baby killers by a significant portion of the population. (24)

As more order and regulation began to occur on the streets, many pedestrians began to question their independence. One citizen likened the masses of pedestrians moving along the crosswalks to a flock of sheep, asking if “we are coming to be a lot of imbeciles, not knowing enough to take reasonable care of ourselves.” (24) Others attempted to take a stand, only to be arrested by impatient policemen for jaywalking, an action that was outlawed in 1921. (24) It is around this time that the scales began to tip in favor of the automobile.

**Carrere, Hastings, and the City Beautiful**

While the attitudes of Hartford’s residents underwent reconstruction in the 1910s and 1920s, officials were already in the process of accommodating the automobile. The first
permanent Planning Commission in the country was established in Hartford in 1907 (25) With limited power, the Commission self-admittedly accomplished little in its first year. (25) In 1908, however, it was successful in hiring the New York architectural firm of Carrere and Hastings. (25) The two Frenchmen from New York City were tasked with producing a city plan for future development in Hartford. (25)

The map and report of recommendations that Carrere and Hastings presented in 1912 contained many of the utopian City Beautiful ideas that were popular at the time. It was also extremely ambitious. Most of their work was dedicated to changes in the street pattern under the assumption that private motor vehicle traffic would greatly increase in the years to follow. (24) The suggested changes were extensive, involving not only widening and extending streets but completely redesigning the network in several places and splitting the city into commercial, residential, and industrial zones. (24)

Very little of the plan was adopted due to economic concerns, but the spirit in which they made their recommendations was mostly well received, especially by The Commission on the City Plan. This is not to say that everyone was convinced. Isles of Safety were installed as downtown trolley waiting areas in an attempt to cater to pedestrians and transit users. (24) In 1911, a group of members of the Municipal Art Society had put forth a proposal to limit the height of buildings throughout the business district. (25) A few years later, a Trinity College professor submitted plans for a subway in the city. (25) Neither the building height limitation nor subway proposal was acted on by the commission, but they represented a portion of the population that still believed that the car was not the solution to all of the city’s problems. This idea, however, was quickly losing out to the proponents of motordom.

The Transition to the “City Functional”

The first zoning ordinance in Hartford was enacted in 1923 amidst growing turmoil and congestion in Hartford’s streets. By this time, businessmen and bureaucrats had gained greater power over city planning, inevitably moving towards a system that supported economic
efficiency above all else. One member of the Hartford Commission on the City Plan, W.A. Graham, wrote, “When the city planning movement was young, too much emphasis was laid upon the usefulness of beauty. Now-a-days the emphasis is laid on the beauty of usefulness.” (24) Graham’s beliefs, part of the City Functional movement, were the same as those trumpeted by Le Corbusier, and early zoning in Hartford reflected the order and economic efficiency that were so valued by this style of planning. Interestingly, the preamble to the ordinance emphasized that it would help prevent overcrowding, ensure adequate light and air, and promote a higher quality of urban life. (24) The ordinance itself, however, seemingly ignored these goals in many ways. It allowed housing densities of up to 140 families per acre in most of the city and permitted all but the most offensive heavy industries in many working-class areas. It gave businessmen free reign in development while still protecting their own upper-income residential neighborhoods from industry and commercial activity. (24)

Shortly after the zoning ordinance was enacted, the city hired another expert to produce a traffic report and city plan to help guide future development in Hartford. Herbert Swan, like so many planners at the time, believed that easing congestion and providing ample space for cars was of the utmost priority. His reports, released in 1926, called for a host of street widening projects and the automation of downtown intersections signals. (22) He suggested that the city transition from on-street parking to lots and garages to allow for greater capacity and higher speeds along main thoroughfares. (22) In regards to streetcars, he wrote, “The disastrous effect of the trolleys upon the traffic capacity of the street is particularly noticeable [on a few downtown streets]. Were it not for the trolleys on these thoroughfares, their ability to care for moving traffic would be very considerably increased.” (22) He went on to remark that “One trolley car is equivalent to several motor cars in limiting the capacity of the streets”, a statement that failed to recognize how much space those trolley riders would take up were they all in private motor vehicles. (22)
This approach encapsulated the emerging attitude that cars were the transportation of the future. Swan even admitted in his report that there was no obvious solution to the problem of parking provision, yet never once considered limiting automobile use as a potential remedy. (22) Nonetheless, the majority of his recommendations were readily enacted. (24) His plan was ultimately more successful than the one produced by Carrere and Hastings, partially because his recommendations were cheaper and more economically feasible, and partially because more of the planning community held the same auto-centric ideals by the mid-1920s. (24) It is through this plan that Hartford began its decline from a wealthy, vibrant city to one filled with parking lots and intersected by freeways.

The Transformation of a City

In the 1930s, the process to accommodate exponential growth in automobile use began. Per Swan’s population estimates and subsequent recommendations, streets were widened and on-street parking was removed in many places, particularly the downtown. Yards were replaced with off-street parking, and the trolley lines were ripped up and replaced with motorbus routes. The changes that were taking place were exacerbated by Urban Renewal and the Federal Aid Highway Act of 1956. As federal funding for slum clearance and freeway construction became abundant, Hartford quickly began the construction of Interstate 84, Interstate 91, and the Constitution Plaza office park in the downtown.

A study by McCahill and Garrick shows how parking in Hartford changed between 1960 and 2007, and describes in greater depth the forces at play during this time period. (9) In addition to starting the construction of Interstates 84 and 91 in the early 1960s, parking began to consume urban space at a rapid rate. In 1957, parking lots covered 3.1% of the land area of Hartford, which provided 0.26 parking spaces per resident. (9) By 1995, these numbers had ballooned to 8.4% of land coverage and 0.93 parking spaces per resident. (9) Also in 1995, Cambridge, MA, a city that had taken initiative to limit parking provision, possessed only 0.39 parking spaces per resident. (9) Cambridge has also seen higher rates of population,
employment, and economic growth, which appears to be correlated to parking implementation. (9)

A look into the parking policies at the time reveal that many people in the city still held to the idea that they had to plan Hartford in a way that would provide for a continuing increase in automobile use. (9) City planners and officials seemed to recognize the negative effect that auto-oriented planning was having on the city, yet providing ample parking remained a priority. (9) Because of this mindset, the Hartford downtown was transformed by Corbusier-style skyscrapers, highways, and a tremendous increase in parking lots and garages. (9) It is this transformation that makes a rebuilding of historic Hartford so essential, as the contrast between the current and historic city can be more closely studied. The fundamentally different use of space in the city, coupled with a dense and reliable trolley system, is indicative of a Hartford that functioned in a much different way than the Hartford of today.

STUDY METHODOLOGY

A large part of what helped historic Hartford function so well was its network of streetcars. Sanborn maps (26), which document fine-grained land use and transportation information in historic cities, indicate that these trolley lines supported high building densities before widespread use of the automobile. They also point to mixed-use neighborhood centers where several trolley lines intersect. Because of their evident impact on the urban fabric of Hartford, the detailed function of the transit network between 1910 and 1940 was explored in-depth.

Some of the information regarding the trolley system was available online, but much of it was stored in paper format in the archives of Hartford Public Library, the Connecticut State Library, and the University of Connecticut’s Dodd Center. Materials that were uncovered ranged from articles noting fares increases in trolley journals to engineering drawings of street railway cross sections. The most useful information, however, came in the form of booklets containing trolley schedules and maps of the trolley network itself.
Maps dated between 1911 and 1933, and showing either a stylized or geographically accurate layout of trolley tracks, were found from several sources. (27-30) Using these maps, track routes were input into a geographic information system. With the aid of a history of the Connecticut Company (31), which detailed every change in the operations of the Hartford Division’s street railway, it was possible to document the exact layout of Hartford and its surrounding cities’ trolley routes at the turn of each decade between 1910 and 1940. Were it necessary, a map of the trolley routes at any point in this timeframe could be created based on cross-referencing the physical maps and historical documentation.

Once the route locations were put into the GIS, peak and off-peak frequencies were added to each line for 1910, 1920, 1930, and 1940. In cases where multiple lines ran along the same segment, the most frequent line took precedence. In addition to the benefit of being able to visualize the density and frequency of the trolley network that once dominated Hartford’s streetscape, having this information in a GIS provides the building blocks for future quantitative analysis and comparison to today’s system.

RESULTS

The regression of the trolley network between 1910 and 1940 (Figure 1) coincides directly with the planning mindset that developed during this period. In 1910, the majority of Hartford’s population was still dependent on the trolley for inner-city trips, which is supported by the presence of many lines that ran on 5, 10, or 15-minute frequencies for 18 hours per day in most cases. The consistency of the frequencies throughout the day, combined with the simple, intuitive routes (Figure 2), also shows that the trolleys were easy to use. In 1920, when the trolley was nearing its peak in Connecticut and attitudes regarding the automobile were still very much undecided, the network was at its densest. The effects of Swan’s recommendations and the growing presence of the automobile in the 1920s are seen in the 1930 map, where some of the inter-city lines have been discontinued and midday frequencies were reduced. In the 1930s, trolley tracks were systematically removed and replaced by motorbus routes. In many cases
these busses ran at lower frequencies, and could not carry as many passengers. (27-29, 31) By 1940, the trolley is a mere shell of what it once was, and it is clear that by this time Hartford is well on its way to an auto-centric transportation system.

![Hartford Trolley Frequency Maps](image)

**FIGURE 1.** Hartford trolley frequencies between 1910 and 1940 at the AM peak and noon.

The infrastructure that once existed in Hartford was also extensive. It was found that over 1000 miles of streetcar track and over 1700 passenger cars were in use in Connecticut in 1922. If the state chose to rebuild the entire system that once existed, it would cost over $17 billion. Hartford alone boasted almost 60 miles of track within the city limits, which would cost around $1 billion to construct today. In comparison, Portland, Oregon, which currently possesses one of the largest and most popular modern streetcar systems in the country, operates on just 14.7 miles of track and spent $0.25 billion in capital construction. (32) Portland is also much larger than Hartford in terms of area, so the network in Hartford covered a greater
portion of the city. Coupled with the frequency and reliability of Hartford’s trolley network at the
time, this sort of transit infrastructure has not been matched in any U.S. city since the 1940s.

FIGURE 2 A stylized depiction of Hartford’s trolley routes in 1920.

The Hartford Division of the Connecticut Company, which controlled all of Hartford
County’s streetcars between 1907 and 1941, extended outside the city limits. Figure 3 shows
that some lines operated as far as 3 or 4 towns over. The furthest-reaching routes were found to
have 60 minute frequencies and ran from 6 A.M. to 12 A.M. Trolley trips to West Hartford and
Wethersfield, which border Hartford to the west and south, respectively, ran as frequently as every 10 minutes from downtown Hartford. These inter-city connections provide evidence of the ability of the trolley to connect the entire Hartford region without highways or substantial parking.

FIGURE 3 Extent of Hartford Division trolley lines.

At its peak, the streetcar network in Hartford was dense. Figure 2, which is reminiscent of a modern transit map, depicts the streetcar routes at the system’s peak. This image is intended to give a more comprehensive idea of just how dense the network was using present day graphic techniques. This sort of qualitative approach was found to be an important aspect of the project, as visual differences between automobile era Hartford and present-day Hartford can be very powerful. For example, the difference in the way people lived and moved in Hartford can be clearly seen in Figure 4.
While this stage of the research does not include quantifiable land use characterization, Figure 4 displays the potential results of further study in this realm. These images suggest that a multimodal network, built around the trolleys and pedestrian- and bicycle-friendly, changed the very nature of life in Hartford in the early 20th century. They depict a vibrant urban landscape in which the form and function of Hartford is nothing like the kind that exists today. Sanborn maps (26) and aerial photographs (33) have revealed significant changes to land use around trolley lines and in several neighborhood centers that no longer function as such. As part of the shift toward an auto-oriented landscape, zoning, street widening, and parking accommodations removed much of the activity in these areas and instead focused it in the downtown. With further study, backed by the knowledge of the density and frequency of the trolley network at this time, it will be possible to quantify these land use changes in historic American cities.
FIGURE 4 Photographs of Historic and Present-day Hartford. Main Street in 1905 (a) and 2015 (b). Aerials from 1934 (c) and 2014 (d) of the area surrounding what was once Hartford High School but has since been replaced by Interstate 84. (33,34)

DISCUSSION

Le Corbusier, in his “City of Tomorrow and its Planning”, describes briefly how his ideal city would function. “Our programme of town planning might well be expressed thus in regard to a city of three million inhabitants: in the centre, but only for purposes of daily toll, there would be 500,000 to 800,000 people; each evening the centre would be empty. The residential quarters of the city would absorb part, the garden cities the rest. Let us postulate then half a million citizens (round the centre) and two and a half millions in the garden cities.” (15)
In Hartford, commuters from the surrounding suburbs flock into the downtown each morning and exit promptly each evening, both migrations accompanied by heavy vehicular traffic. The residential area of the city has lost significant population, and many remaining residents suffer from poverty and poor housing conditions. At night, the downtown has very little activity. Hartford’s current form and function is eerily similar to that envisioned by Le Corbusier, but the state of the city hints at the impracticality of implementing such a vast reconstruction with no regard for the space needed to house thousands of cars that flood into the city each day. Le Corbusier also failed to realize that it was the culture and diversity found in transit era neighborhoods and streets that made cities like Hartford so vibrant.

A look at maps and photos of Hartford before 1920 is proof enough of a city that functioned in a different way than the Hartford of today. By assembling documents from pre-automobile Hartford and comparing them to the present, much can be deciphered from the changes to the urban fabric. For instance, street-level photos show an abundance of trolleys and pedestrians against a hardly recognizable backdrop of buildings. Aerial photos reveal the replacement of front lawns, buildings, and entire blocks with pavement. Maps of the trolley network depict a system that touched every corner of the city. Historic documents expose the social and political pressures that led to the eventual transformation of the urban fabric. However, while very important, these resources can only tell so much.

This study has improved upon strictly qualitative comparisons by also analyzing changes to the transportation system of Hartford before automobile use altered the urban fabric. This quantification of changes in urban form has already been done at the University of Connecticut as far back as 1960, but this work builds on prior study by assessing the changes that took place in transit era Hartford (around 1920). When the transit era gave way to the automobile era, it was accompanied by a systematic dismantling of trolleys, increased parking, and a host of street widening projects. In 1920, however, trolleys were still an integral part of the transportation system. The city possessed nearly 60 miles of track just within its borders, with
many routes that ran on 10 or 15-minute frequencies from 6 AM to midnight. Residents could also get to neighboring towns on trolleys that ran at least hourly, and at one point could even get as far as Boston or New York using streetcars alone (in addition, there was an extensive heavy rail system that connected all the larger towns in the state and extended into the surrounding states and beyond). Using the trolley was also very simple, as frequencies rarely changed throughout the day and routes were straightforward and consistent over time.

Planners and city officials at the time felt, however, that there was a need to accommodate widespread automobile use, and began to change the form and function of the urban fabric in response. Along with a redefinition of the street, neighborhoods that had once been mixed-use activity hubs began to lose their diversity and character to parking and zoning policies. As a result, the city that existed in 1920 no longer looked or functioned in the same way by the 1950s and 1960s. Once freeway construction and urban renewal began in the 1950s, the changes to the city accelerated and the once-vibrant cities were almost completely unrecognizable. Given these changes, this research highlights the importance of a more careful study of early 20th century American cities in order to gain insight and inspiration from their pre-automobile organization and function. This is particularly important as cities around the country are working diligently to restore their transit system and to rebuild a land use pattern that is more supportive of transit use.
A VIRTUAL RECONSTRUCTION OF TRANSPORTATION AND LAND USE IN TRANSIT ERA

HARTFORD, CONNECTICUT
INTRODUCTION: PRE- AND POST-AUTOMOBILE URBAN FORM

There is much that can be learned from historic American cities. Prior to the 1920s, the urban landscape was denser and more diverse. Walking was expected, not simply encouraged. Extensive trolley networks connected neighborhoods to the downtown and each other. Two and three-story buildings lined the edges of every major street. Speed limits rarely exceeded 10 mph, and traffic fatalities were rare enough to warrant a front-page newspaper appearance.

The reasons for the drastic change in Hartford’s urban form are numerous and the narrative is complex, but Peter Norton found that cities all over the country had a large resistance to the automobile for some time (Norton, 2007). In Hartford, Peter Baldwin made the same realization, uncovering that a battle for the street took place before fast-moving automobiles were accepted (Baldwin, 1999). For policymakers, the car was seen as a tool that could be used to cure the social ills plaguing the city. This is why, when automobile use intensified and congestion became a serious problem, the only viable solution seemed to be to reconfigure the city to better support this new means of travel.

Instead of considering alternatives that would benefit all travel modes, most American cities began to cater to the private motor vehicle. Streets were widened and painted, trolley lines were gradually removed and replaced with motor coaches, and stand-alone commercial buildings with ample off-street parking began to appear along major thoroughfares. The urban fabric was quickly transformed by the automobile, and the character of the Transit Era American city was forgotten for some time.

Today, recognition of the benefits of dense, mixed-use development has resulted in more urban areas that are desirous of accommodating walking, biking, and public transportation use. This study quantifies some of the characteristics of Hartford in 1920 and compares it to modern development. It draws on historical maps, planning and municipal reports, and various transportation records to determine what a Pre-Automobile Era American city looked like and how it functioned.
Analysis reveals that Hartford was still built for foot travel in 1920, the trolley having spurred the growth of residential neighborhoods that allowed relief from the congestion of the central city while still providing easy access to the downtown. Contrary to expectations, it was found that this system did not provide significantly better citywide access than the modern bus system. It was effective, however, in moving residents from their homes to the CBD. It was also a significant part of the regional public transportation system that extended into neighboring cities.

In addition to having the better overall service, the 1920 system supported a different style of street layout, one in which all modes could mingle safely. These streets were lined with small, primarily two-story buildings in residential neighborhoods and almost all parking was on-street. Commercial activity in these neighborhoods was also typically housed in mixed-use buildings.

Some of the most common conceptions of historic American cities are proven to be true in this work, while other findings serve to enlighten us with respect to the actual form and function of a Transit Era city. By studying Hartford around 1920, there is an opportunity to better understand transit-oriented development on a citywide scale and in the American context. As the need to support sustainable modes of transportation becomes greater, Pre-Automobile Era cities can provide professionals with useful insights for working towards safer, better connected, and sustainable transportation systems.

**METHODOLOGY**

The majority of the work required in assessing the characteristics of 1920s Hartford consisted of finding historic documents and converting them into a digital format through the use of a GIS. Some resources, such as the Sanborn Maps, had already been scanned and uploaded by the Yale University Library to allow for easy online access. Most documents,
however, came in print form and were acquired from the Dodd Center at the University of Connecticut, the Hartford Public Library, and the Connecticut State Library in Hartford.¹

Public Transportation

Maps of the trolley system and reports documenting line closures have allowed for an accurate rebuilding of the system as it existed in 1910, 1920, 1930, and 1940, complete with AM peak and midday headways as acquired from historic trolley schedule booklets. This evolution can be seen in Figure 1. After the timeline was created, the next step was to get a sense of the quality of this historic system and compare it to the modern public transportation system in Hartford. To do this, a network analysis was performed on the trolley network of 1917 and the bus network of 2014, both of which were the primary source of local public transportation in each time period.

Figure 1. Trolley line extent in the Hartford Metro Area: The evolution between 1910 and 1943.

After selecting three key neighborhoods centers, access maps were created by calculating the area of the city that could be reached within 30 minutes of each trip origin using midday-frequency transit. This was done by assigning a time cost to each segment of the road network, incurring turn penalties to account for wait times and transfers, and then determining the resulting area with the aid of the service area function within the network analyst extension of ArcGIS. The base road network in 1920 was created by referencing the Sanborn Index Maps for Hartford in 1922. Due to a lack of historic traffic data, a speed of 10mph was assumed for

¹ Specific documents and collections of archival data can be found in the reference section.
both the 1917 and 2014 network. Both systems provided stops at every intersection, so stops were not included in the model except as a consideration in the average travel speed along each segment. A ten minute maximum was used for walking portions to simulate more realistic behavior and to better show the structure of the public transportation system.

**Land Use and Development**

To analyze land use, three neighborhoods and the downtown were digitized based on 1922 Sanborn maps of the city and assigned both a building height and type. The neighborhoods were chosen based on their separation from the downtown, location along major thoroughfares in the city, and moderate development prior to 1922. Current land use data for the neighborhoods was acquired from the Hartford GIS data site and building heights were adjusted using Google street view. The Sanborn maps did not include information regarding characteristics of the street or the location of parking lots, so aerial photos were used to collect this data. The aerial photographs that were used were taken in 1934 at a 1:14000 scale and provided enough resolution to discern accurate parking and street dimension measurements. Unfortunately, the extent to which this data is representative of the situation in 1920 is questionable, as most of the major thoroughfares in the city had already begun to change in favor of increased vehicular capacity by this time (Baldwin, 1999; City of Hartford, 1921).

**RESULTS**

**Public Transportation**

Initial findings suggest significant differences in the layout of the 1917 versus the 2014 public transportation network, some of which can be seen in Figure 2. The 1917 system consisted of 35 route miles within the city limits and the vast majority ran at the same 15-minute frequency for 18 hours per weekday within the city limits. The entire Hartford County division housed over 800 trolley cars at this time and could carry 120,000 people in and out of Hartford each day, a number that jumps to 200,000 if passenger rail lines are also included. As a point of reference, Interstate 84 at the Bulkeley Bridge, which is the major highway route into Hartford,
carries 140,000 vehicles per day (CDM Smith, 2013). Local routes of the 2014 bus system
double that of the 1917 system at 70 route miles, but frequencies vary widely throughout the
day and most lines either offer hourly or no service after the PM peak period. The Hartford
County fleet consists of approximately 250 buses today.

Figure 2. Local public transportation routes in Hartford in 1917 (trolley) and 2014 (bus).

Figure 3 displays the differences in the area accessible by foot or transit in 1917 and
2014 for the three chosen neighborhood centers. Contrary to expectations, access by trolley in
1917 was not significantly superior to that by bus in 2014, particularly in the Upper Albany and
South End neighborhoods and between 6 A.M. and 6 P.M. At midday, the area of the city that
was accessible in thirty minutes was 22% less in 2014 for Upper Albany, 53% less for the West
End, and 21% less for the South End. Under the assumption that the overall speed of the trolley
car and bus are the same, the decrease that occurs can be attributed to the less frequent
headways associated with the 2014 system. Given that the 2014 route network is much denser,
however, the ability of the 1917 network to provide a better service becomes a more significant finding. Without the frequency to match the increased number of routes, the modern bus system falls short of the trolley network, which was able to provide more consistent frequencies on all of its routes (between 10 and 15 minute headways in most cases). The difference between the two would also be larger if frequencies were averaged across the entire day, as the very poor evening headways of the 2014 system significantly reduces the average daily frequency. The 1917 system would be largely unaffected by this calculation.

**Figure 3.** Thirty-minute midday transit access for three neighborhood centers.

The general shape of the accessible area has remained similar over time, which is partially a product of the modern bus routes having evolved from the trolley lines that they replaced in the late 1920s and 1930s. Neither system has many routes that do not start or end in the Central Business District (CBD), nor are the crosstown routes that do exist frequent enough to be relevant in this assessment. The shape also suggests that many of the important, high-frequency routes are the same now as they were in 1917.
Street Layout

Table 1 depicts changes to the physical layout of major thoroughfares in the three neighborhoods being studied. Prior research on Hartford suggests that these streets were already being modified to better suit high speed vehicle travel by 1934, the time at which the aerials used to collect the data were taken, which may explain why the differences are fairly minor (Baldwin, 1999). Street-level photographs of Hartford from the 1910s (Figure 4) do indicate, however, that major streets may not have been significantly less wide at the time, but that they were used differently than post-1920 streets. These photos suggest that the strict speed limits and lack of delineation encouraged pedestrians, bicyclists, trolleys, and automobiles to mingle and share the space in the street. This type of design, now known as shared space, has been shown to promote safer, more vibrant, and multimodal transportation systems while also improving both pedestrians and vehicle travel times in congested areas (UK Department for Transport, 2011; Wargo & Garrick, 2015). Because most 1920 Hartford streets functioned as shared spaces, it is difficult to quantify just how much space was taken from non-auto modes when streets were redesigned to accommodate increased vehicle flow.

Table 1. Street Characteristics along four major thoroughfares in select neighborhoods.

<table>
<thead>
<tr>
<th></th>
<th>1934</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Street Width (ft)</td>
<td>49</td>
<td>52</td>
</tr>
<tr>
<td>Average Sidewalk Width (ft)</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Average Curb Radius (ft)</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>
Figure 4. View looking northwest at the intersection of Albany Avenue and Blue Hills Avenue in the Upper Albany neighborhood in 1913 (a) and 2014 (b), and the view looking north at the intersection of City Hall and Main Street in downtown in 1905 (c) and 2015 (d). (Hartford History Center, 2014)
Land Use and Development

The development that took place prior to 1920 in Hartford has been heavily altered since that time, particularly along the major thoroughfares. Figure 5 shows the micro-scale change in land use in each of the residential neighborhoods under study between 1922 and 2014. One noticeable difference is that each of the neighborhoods has more commercial and office development in 2014 than it did in 1922. With this increase, however, has come a clear separation between the commercial area along the main thoroughfare and the surrounding residential. In 1922, the commercial enterprises in these neighborhoods were more often in mixed-use than stand-alone buildings. By 2014, there were more mixed-use buildings, but there was also much more commercial development in squat, one-story buildings accompanied by a significant amount of off-street parking.
Figure 5. Development by building type in three Hartford residential neighborhoods in 1922 and 2014.
Table 2. Building characteristics averaged across all three residential neighborhoods.

<table>
<thead>
<tr>
<th></th>
<th>1922</th>
<th>2014</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Building Height (stories)</td>
<td>2.06</td>
<td>2.00</td>
<td>-3</td>
</tr>
<tr>
<td>Average Building Footprint (ft²)</td>
<td>1491</td>
<td>1886</td>
<td>26</td>
</tr>
<tr>
<td>One-Story Buildings as a Percentage of Total Building Area</td>
<td>12.4</td>
<td>23.2</td>
<td>87</td>
</tr>
<tr>
<td>Off-Street Parking as a Percentage of Study Area</td>
<td>1.0</td>
<td>11.2</td>
<td>1020</td>
</tr>
</tbody>
</table>

While the amount of activities that can be reached by foot has increased in these neighborhoods, the environment along the major thoroughfare has changed substantially, particularly for pedestrians. A statistical analysis, the results of which are shown in Table 2, has revealed that, on average, buildings are shorter, have a larger footprint, and have much more off-street parking today than in 1922. The distribution of building heights as a percentage of total building area is displayed in Figure 6, where the change in character of each neighborhood can be seen. The Upper Albany and South End neighborhoods have both gone from having a two-story building majority to a considerable increase in one-story building area. The West End has also lost its two-story building majority, but this has instead gone to three, four, and five-or-more story buildings, including an 8-story apartment complex. The overwhelming majority of one-story buildings that are not private garages are located along the busiest street in the neighborhood in all cases and tend to have a large footprint, characteristics that were rare in 1922 (Table 3).
Figure 6. Distribution of neighborhood building heights (in number of stories) as a percentage of total building area.

Table 3. Characteristics of the buildings removed or added in each neighborhood since 1922.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Buildings</th>
<th>Average Height (stories)</th>
<th>Average Area (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Removed</td>
<td>Added</td>
<td>Removed</td>
</tr>
<tr>
<td>Upper Albany</td>
<td>28</td>
<td>19</td>
<td>2.23</td>
</tr>
<tr>
<td>West End</td>
<td>38</td>
<td>47</td>
<td>2.54</td>
</tr>
<tr>
<td>South End</td>
<td>45</td>
<td>32</td>
<td>3.32</td>
</tr>
</tbody>
</table>
Off-street parking has had a particularly detrimental effect on Hartford’s urban fabric, both in the downtown and in the residential areas. Previous studies have captured the impact of auto-centric parking policy on Hartford and other cities as far back as 1960, showing that minimum parking requirements and a reluctance to use street space for on-street parking have led to higher auto mode share, poor use of space in both social and economic terms, and a downtown that lacks land use diversity and pedestrian activity (McCahill & Garrick, 2010; McCahill & Garrick, 2012; McCahill et al., 2014). Extending this assessment back to the 1934 (the time of the earliest available aerial survey of Hartford) and including residential neighborhoods (Figure 7) has shown that the perceived need to provide off-street parking has affected everything from sense of place to synthesis between a neighborhood’s major thoroughfare and its side streets. In accommodating an increase from a negligible 1% of the neighborhood area to an average of over 11% in 2014, Hartford has changed the character of its neighborhoods and promoted the transformation of the major thoroughfares running through these residential areas into corridors designed to maximize vehicle flow.
Figure 7. Off-street parking in three Hartford residential neighborhoods in 1934 and 2014.
DISCUSSION

As the benefits of mixed-use, transit-oriented development become clearer, it is essential to study and understand American cities before they were permeated by auto-centric planning. Hartford, Connecticut is used here as a test study to assess the potential for using historical documents to quantify characteristics of the transportation system and urban fabric at the end of the Transit Era, a critical point in transportation history. After obtaining some of these historic documents and importing data to a GIS, comparisons were made between Pre- and Post-Automobile Era Hartford. These quantitative comparisons have presented a clearer picture of Transit Era cities, confirming some ideas about urban form and function in this time period while amending others. This historic information has also revealed some of the reasoning behind why American cities began to change and how that evolution took place.

In 1920, downtown Hartford was the hub of activity for the entire region. An extensive trolley system allowed frequent passage between the various urban centers in the area while also catalyzing the growth of residential areas along the lines. The neighborhoods that developed in these transit corridors provided relief from the congestion of the central city while still being dense and well-connected. As auto-oriented development began in the 1920s, the character of the entire city began to change. Prior research at the University of Connecticut has shown that downtown Hartford has lost a considerable amount of activity and limited its potential for economic development by adopting auto-centric parking policies going back to at least 1960 (McCahill & Garrick, 2010; McCahill & Garrick, 2012; McCahill et al., 2014). This assessment shows that Hartford had actually begun the transformation to an auto-oriented city even earlier-as early as the 1920s, confirming the need to study Transit Era Hartford so that Pre-Automobile Era cities may be better understood.

While the results show that neighborhood trolley service was not as well connected as was expected, there is still a lot to learn from Transit Era Hartford. The trolley was the primary means of travel within the greater Hartford region, providing at least hourly service to adjacent
cities and towns and potentially carrying up to 120,000 people in and out of Hartford on a daily basis. Each of the neighborhoods in 1922 had a more uniform development pattern, and major thoroughfares connected residents to the CBD via the trolley. Safety on the streets was a priority, and it was shared by a variety of users. However, as off-street parking replaced buildings and these major thoroughfares became designated commercial strips, the function of the major corridors in these neighborhoods became more about moving cars and less about accommodating all modes of travel.

This research has shown that it is possible to make tangible comparisons between Pre- and Post-automobile cities by locating the necessary historic data and converting it to a useable digital format. Having this information is a necessary step in understanding what Pre-Automobile Era cities looked like, how they functioned, and why they changed. The work from this research sets the stage for a more in-depth analysis of the neighborhoods and the downtown of the city on a number of fronts, encompassing the environmental, social, and economic life of the city in the 1920s and beyond. The documentation of the transition from trolley to bus will also provide better insight into the nuances of the changes that have taken place over the last hundred years, so that the evolution of transportation and its relationship to the surrounding land use may be more fully understood.
CONCLUSION

A look at maps and photos of Hartford before 1920 is proof of a city that functioned in a different way than the Hartford of today. By assembling documents from Pre-Automobile Hartford and comparing them to the present, much can be deciphered from the changes to the urban fabric. Street-level photos show an abundance of trolleys and pedestrians against a hardly recognizable backdrop of buildings. Aerial photos reveal the replacement of front lawns, buildings, and entire blocks with pavement. Maps of the trolley network depict a system that extended 15 miles in every direction. Historic documents expose the social and political pressures that led to the eventual transformation of the urban fabric. However, while very important, these resources can only tell so much.

This study has improved upon strictly qualitative comparisons by analyzing the transportation system and land use patterns of Hartford prior to auto-oriented development. This quantification of changes in urban form has already been done at the University of Connecticut as far back as 1960, but this work builds on prior study by assessing the changes that took place in Hartford around 1920. These quantitative comparisons have presented a clearer picture of Transit Era cities, confirming some ideas about urban form and function in this time period while amending others. This historic information has also revealed some of the reasoning behind why American cities began to change and how that evolution took place.

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As a result of the auto-oriented development that began to take place in the 1920s, Hartford no longer looked or functioned the same way by the 1950s and 1960s. Once freeway construction and urban renewal began in the 1950s, the changes to the city accelerated and Hartford became almost completely unrecognizable. These changes highlight the importance of a more careful study of early 20th century American cities in order to gain insight and inspiration from their pre-automobile organization and function. This is particularly important as cities around the country are working diligently to restore their transit system and to rebuild a land use pattern that is more supportive of transit use.

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