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Pedestrian-Oriented Street Design: Measuring Whether It Affects Downtown Employment and Housing Growth

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A dissertation submitted in fulfillment of the requirements for the degree of Doctor of Public Administration

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1.0. Introduction

1.1. Abstract

Urban design is hard to measure. Unlike the bottom line in a financial pro forma, the quality of urban design cannot yet be calculated in a simple manner. The urban design quality of a development project, a public space, and a place contains multiple combinations of dozens of inter-connected design attributes. Furthermore, each unique geographic place and their specific characteristics add another layer of complexity to quantitative measurement. However, planning and economic development researchers continue to chip away at developing metrics of a place's urban design environment because it is an important component in a project, a public space or a place's success in terms of public perception of vibrancy, attractiveness, and safety. Regardless of whether the average person can articulate the presence or absence of certain design elements, all people can point to places they like and are attracted to and those places that they instinctively avoid. Investing, developing, and maintaining places that people are attracted to is an important topic for policy makers and public development officials to understand as this is a factor in maintaining and growing the tax base in terms of housing and jobs as well as providing a justification of public investment in the public realm.

This research project used 2010, 2014, and 2015 data from the U.S. Census and 2010 NAVSTREETS pedestrian-oriented street segment data via the U.S. Environmental Protection Agency's Smart Location Index to test whether there is a correlation between the presence of pedestrian-oriented street segments and growth in employment and housing units in all downtown census tracts for the 383 Municipal Statistical Areas (MSA's) in the United States over time. The use of the MSA dataset will provide a large,

consistent data baseline from which future measurement can then be consistently conducted for pedestrian-oriented street segments and impact on employment and housing growth.

1.2. Research Problem

A vibrant urban downtown is composed of a complex number of elements including points of interest, pleasing visual environment, amount of park or green space, activity at the street level, and pedestrian comfort and safety. There is no one element or characteristic that solely makes a place inviting and yet a critical blend or mix of a number of these elements need to be present in a place for it to be attractive to people.

While historically, the urban downtown has been a primary location for large-scale office and commercial employment, high-density residential housing units have been growing in the downtown core over the last twenty years. This evolution of the urban downtown into a full-fledged residential neighborhood has led to a greater range of consumer needs and desired mix of goods and services that extend beyond that of the 9-5 office worker. Downtown residential population is steadily increasing due to an influx of down-sizing baby boomers and the millennial generation looking to live as well as work in the downtown core (Brookings Institution, pg. 33). This increasing downtown residential population is driving the private market in the creation of neighborhood-serving retail services as well as driving public investment in public realm investments like additional green space, parks and enhanced pedestrian amenities.

What is and is not good urban design is a very difficult thing to measure because so many different variables contribute to a downtown's urban design characteristics. This research will attempt to home in on measuring whether the presence or increase in pedestrian-oriented street segments in a downtown has a positive effect on the economic base over time. Being able to measure the investment value of pedestrian amenities in a quantifiable manner gives more weight behind the argument for excellent site and building design for new developments. It gives a grounded basis for public sector decisions to invest in pedestrian-oriented public realm.

> **Question 1:** Is there a correlation between pedestrian-oriented urban design and an MSA's (Municipal Statistical Area) downtown economic growth in terms of employment?
>
> **Question 2:** Is there a correlation between pedestrian-oriented urban design and an MSA's (Municipal Statistical Area) downtown economic growth in terms of number housing units?

1.3. Advancing the Scientific Knowledge Base

a. How does this study relate to other research?

There is a growing body of research that is looking at being able to measure the economic value of amenities like parks, green space, walking paths, and bicycle and pedestrian amenities. This is an important topic for public administration as the expenditure and implementation of public realm is primarily done by public entities like cities or counties. As local budgets continue to be reduced and constrained, public investment in public realm often is seen as less important than other local priorities. Does public investment in pedestrian-oriented public realm result in increased economic activity and tax base in the area in which the investment has been made?

Research to date has been a case-study approach that focuses on applying a set of design attributes or criteria to a particular park, area, or a single building. I am interested in testing whether pedestrian street design attributes – the pedestrian-oriented street segment and intersection design – has any effect on housing and employment growth across all 383 downtown Municipal Statistical Area (MSA) census tracts as defined by the U.S. Census.

b. So what?

If I am successful in testing these pedestrian-oriented street design attributes across a large set sample of data across the country and find that there is a positive correlation, other design attributes or combinations of design attributes can also be tested using the same large data set by other researchers in the future. This research sets a baseline across a large, consistent data set that can be measured, compared, and built upon in the future.

c. Who cares?

It adds to a growing body of knowledge and data that allows public development entities to measure the design efficacy and value of pedestrian-oriented street investment. This research will either disprove or support the argument that public investment in pedestrian-oriented public realm improvements yields a lasting effect to the economic health of a city’s downtown area by increasing tax base through increased employment and housing units.

2.0. Literature Review

2.1. Theoretical Foundation

City planning and urban design theory and the application of that theory to the role of the street have evolved over time. Distinct time periods in history influenced some theories to be viewed more favorably than others along the theoretical continuum. The first two sections of this literature review are organized to give a chronological overview of city planning and urban design theory evolving over time and how that theory applies to the concept of the neighborhood street; the third section of the literature review focuses specifically on how planning and urban design research has delved into developing specific measurements on the effects of good and bad urban design.

a. The birth of city planning and urban design in the United States and the role and the context of the street during that time period.

Garden Cities of Tomorrow, Ebenezer Howard, 1898.

An Introduction to City Planning, Democracy's Challenge to the American City, Benjamin Marsh, 1909.

Town Planning in Practice, Sir Richard Unwin, 1909.

Cities have existed for centuries but the development of formalized city planning as a profession and urban design theory began in earnest at the turn of the 20^{th} century with Ebenezer Howard and his theory of a new pattern of city growth called 'Garden Cities'. The Garden City movement proposed the decentralization of the city into the English countryside into limited growth chunks of population at a maximum of 40,000 residents. Within the Garden City, each of its uses (residential, industrial, commercial) would be self-contained from one another. The exterior perimeter of the Garden City was to consist of a publicly-owned green space (Richert, Lapping, pg. 2). The separation of uses from one another as a form of protection is a theoretical basis to modern-day, use-based zoning.

Richard Unwin, a disciple and practitioner of Howard's theory, proposed an idea that overcrowding in English cities was the result of poorly-designed city building and form and that this poor planning and design was a detriment to the health of its residents (Mumford, pg. 496-498). As opposed to the organic, informal city development of old-world Europe, Unwin proposed that formal, ordered city layouts could better foster the development of beauty, character, and welfare for a community than cities that were laid out haphazardly through organic growth (Unwin, pg. 126-136). Modern city planning, under this school of thought, should stop trying to re-make existing developments in cities and focus on the new, undeveloped spaces on the fringe. Green-field development is a building philosophy that persists today as farm land continually gets converted into new residential subdivisions while the inner-city core experiences disinvestment.

Nelson Lewis, an engineer and proponent of all things new and efficient at that time, discusses the attraction that American city planners had at this time in planning history for the plan and layout of old-world cities. Lewis was frustrated by the American desire to create similar places because he saw old-world cities in terms of street width and traffic accommodation as being inefficient and therefore obsolete. The 'modern city' should be efficient with a street system that provides for unobstructed movement of traffic (Lewis, pg. 220).

This theory that building form affects public health started to take shape as well in the United States through the City Beautiful movement. A big impetus for the beginning of city planning and urban design in the United States was rooted in the City Beautiful movement which had its height of popularity during the last decade of the 19th century and the first decade of the 20th century. Like Unwin's theory, the City Beautiful movement was a reform effort to improve the health and safety of cities through beautification projects and through the development of grand public buildings and parks (Wilson, pg. 316). Architect Daniel Burnham's plan to transform the Chicago lakefront into the grand White City as part of the World's Fair Chicago Columbian Exposition in 1893 is a good example of the City Beautiful movement in action. Burnham and Frederick Law Olmstead created lush public buildings surrounded by formal gardens and park space. While most of the buildings built for the Chicago World's Fair were temporary and destroyed at the end of the Fair, some building designs, such as the Museum of Science and Industry, were replicated as permanent structures and remain today. Burnham's grand plan is present and visible today in the large amount of public park space that runs along the lakefront and is one of Chicago's most popular attractions (Hines, pg. 100).

Along with the City Beautiful movement, a formalized theory on city planning and urban design began to gain traction to address health, safety, and welfare of city residents. Population growth in the urban core at this time led to conditions of overcrowding and subsequent overbuilding of properties. The problem of urban overcrowding and inadequate living conditions encouraged the spread of disease and was the foremost public health issue of its time. Unwin and Marsh proposed the need for all cities to have a formalized city plan to guide growth and property development to ensure that residents had access to adequate air, sunlight, and privacy to preserve the health of the population (Unwin, pg. 138; Marsh, pg. 13).

A key component of the formal city plan was an early concept of land use zoning that called for the regulation of building dimensions in terms of height, width, building set-back from street, and building set-back from property lot lines. The purpose of this early form of zoning practice was to ensure proper light, privacy and air between properties to foster improved health of the population (Marsh, pg. 29). Cities did not gain the regulatory power to impose formal zoning controls until the 1922 Supreme Court case, Euclid v. Ambler (Barnett, pg. 32).

The street at this time was viewed as a means for transportation circulation and narrow streets were viewed as detrimental to commerce and society. A major concept was the idea that residential streets and commercial streets needed to be designed according to the level of traffic they should carry, an early foreshadowing of the traffic engineering-based functional roadway class system that would rise in the 1940's and 1950's. Using this rationale, commercial streets should be wider than less intensive residential streets and should carry a greater amount of traffic at a higher speed. All streets, however, should be able to accommodate significant foot traffic via the adjacent sidewalk (Marsh, pg. 31).

The Planning of the Modern City, Nelson P. Lewis, 1916.

Between 1900 and 1930 there was an emerging trend in public administration, city planning, civil engineering, and political science that focused on analyzing public issues and problems through the application of the scientific method. This push for using rational, scientific methods of data inquiry and analysis was driven by a desire by public sector practitioners to make decisions using the most objective, rational, efficient means possible. Nelson P. Lewis, a civil engineer engaged in the city planning profession, was a good example of a theorist who championed efficiency in the practice of city planning. At the time, the field of city planning in America was consumed with the City Beautiful movement. The City Beautiful movement frustrated engineer-focused planners like Lewis because it was perceived as an attempt to re-make existing development in American cities as replicas of old-world European city centers. The 'modern city' should be efficient with a street system that provides for unobstructed movement of traffic (Lewis, pg. 220). While the street is viewed as a utilitarian component of cities that should provide convenience to the movement of traffic, Lewis does allow that the pedestrian realm should not be ignored. Sidewalks should include attractive lighting, street trees and quality paving materials. Furthermore, Lewis makes a distinct point in creating places that connect to the greater street grid system (Lewis, pg. 245).

As with Unwin and Marsh, Lewis' work pre-dates the explosion of the growth of the automobile and the construction of the federal interstate highway system. Ironically, the disruption of the traditional street grid for construction of the interstate highway system, the ultimate traffic mover, created significant barriers for both cars and pedestrians in major cities across the United States that were not clearly anticipated at the time of their design and construction.

The growth of modernist International architectural design in the 1920's also heavily influenced city planning by denouncing old architectural styles and traditional urban patterns as outmoded. The International school put forth a theory that the city of the future embraced industrial technology and efficiency and required a clearing out of the old, haphazard buildings and patterns, starting over with a clean slate. The modern city included high-density skyscrapers laid out in an orderly pattern, surrounded by open space and arranged on super-blocks ringed with arterial roadways. The functions of housing, work, play, and transportation were deliberately placed into separate locations within the modern city. Automobile transportation was viewed as the primary means of transport in the future. Le Corbusier, a French-Swiss architect and planner, was a leader of this theory and implemented this concept with the building of the new cities - Brasilia in Brazil and Chandigarh in India. City planning under modernist theory was to be scientific, socially all-encompassing, economically classless, and above all, ordered and efficient (Zipp, pg. 374).

For modernist planner/designers like Le Corbusier, streets were a function of efficient automobile transport and not a place where life was lived. The modernists' practice of using super block configurations ringed by high capacity arterial roadways resulted in a big reduction in the amount of street segments available to people, particularly pedestrians (Zipp, pg. 376). People inhabiting modernist developments were envisioned to be embracing the newest technology by driving automobiles as opposed to walking and using mass transit.

Summary and Critical Analysis – Early Planning Theory and the Role of the Street

At its historical beginning, city planning and urban design theory was very much an exercise in grand sweeping ideas. Likewise, in turn, city planning and urban design practice required large-scale implementation to carry out said grand sweeping ideas. The focus of the profession was on the larger, grander sum of all parts and not how the smaller parts affected the larger scheme. It seems natural that the burgeoning city planning movement would embrace large concepts over specifics given that the push for formalized city planning practice was driven by a desire to 'correct' the ills of the organically-grown city like overcrowding and unsanitary conditions.   Ebenezer Howard and Le Corbusier were two urban design theorists who proposed drastically different visions as to how cities should be planned and implemented.

Ebenezer Howard and his disciple Richard Unwin sought to create a utopian city development theory that escaped the problems of the organically-developed central city by purposely constructing new, small cities out in the countryside away from the city. Howard and Unwin's theory were that small villages be created, encircled by gardens with a population capped at 40,000. Did implementing the Garden Cities development theory demonstrably solve the problems that were occurring in organically-grown cities of that time? No. Did it allow an alternative to people who were living in the crowded conditions occurring at that time in the organically-grown city? Maybe, if one had the means to relocate away from the central city to a new life in a different geographic location that included good proximity to employment. Looking back at the history of urban, suburban, and exurban development, Howard can most likely be credited with starting a development pattern that we now commonly refer to as suburban sprawl, the creeping concentric spread of development away from the urban core into perpetuity.

Whether the Garden Cities theory is deemed good or bad, the idea of measuring the efficacy of this theory was not a consideration. At this time in city planning and urban design practice, ideas and theories were espoused by scholars and practitioners and taken on their face for truth without providing evidence that their theories were relevant and valid. Howard and Unwin did not have to produce measurable evidence that validated that what they proposed was right or correct. All they had to do was propose the theory for it to gain credible validity within the profession.

On the other end of the spectrum, Le Corbusier proposed curing societal ills through urban design that sought to erase the current urban form and replace it with a new utopian ideal – the Radiant City via mass-produced, uniformly-designed, high-rise housing. Le Corbusier's theory for city planning and urban design focused on remaking urban communities by embracing scientific methods and the most modern technology to create an egalitarian, classless society. This meant clearing the existing urban form away and starting over with a clean slate to be replaced with precisely-designed, unadorned, mass-produced concrete structures (Fitting, pg. 70).

As with Ebenezer Howard, Le Corbusier articulated his theory and vision for how cities should be planned and designed and the concept of Design Influencing Social Practice (DISP) was embraced without critical questioning as to its legitimacy and its validity. DISP is a concept that espouses that architecture and infrastructure can influence a person's social or behavioral choices (Almeida, pg. 3). Le Corbusier's urban design theory ignored the parts that make up the whole for a vibrant, urban community. The combination of unadorned concrete buildings, complete separation of residential land uses from commercial areas, and prioritization of auto use over the pedestrian made for an isolating existence for people residing in his developments. In Le Corbusier's view, people living in his non-descript, concrete high-rises, isolated from the rest of the neighborhood, with little physical linkage to commerce and amenities should be happy and content because the building and site design eliminated perceptions of residents' different levels of wealth, status, and class and placed them all on a level playing field. In reality, residing in one of Le Corbusier's developments resulted in extreme levels of disenfranchisement, isolation, poverty, and crime which were the antithesis of Le Corbusier's original intention (Fitting, pg. 74; Almeida, pg. 6-7).

The importance or effect of the individual street component did not factor into planning theories during this time period. The street and its qualities were treated as an ancillary part, a utilitarian function that served the development as opposed to being viewed as an important, contributing part of the development. Building orientation towards the street was seen as inefficient and wrong. Le Corbusier's purposely ignoring the importance of the street as an important connection to the greater community contributed significantly to his housing projects' effect on residents' disconnectedness and alienation (A. Jacobs, pg. 311).

b. *Evolution of city planning and urban design - planning and urban design practices of the 1940's, 1950's, and 1960's*

The post-WWII years brought dramatic change to the building of cities and the transport of people. The housing finance policies of the Federal Home Administration (FHA) combined with the GI Bill through the Veteran's Administration (VA) fundamentally changed land use patterns by encouraging population dispersion away from the central city and out towards the suburban ring. New single-family housing developments were being developed in suburbia, driven mainly by FHA and VA loan program policies that encouraged development outside of the central city. FHA and VA loan financing available to first-time homebuyers and veterans favored single family houses over other housing types and pushed those populations and their families to settle on the outer ring as opposed to the central core of the city (Schwartz, pg. 55).

During the same historical period, the application of urban renewal planning and development practices through the clearance of slum and blight as authorized by the Housing Act of 1949 were being repeated over and over in the inner core of cities (Schiesl, pg. 139). Urban renewal was commonly characterized by massive demolition and clearance of traditional mixed-use commercial and residential properties. It was a time in which the planner was the big thinker and the idea generator and the community's viewpoint was not a consideration in vetting ideas let alone contributing to them (Bacon, pg. 1168-1169).

Urban renewal practices frequently sought to disrupt the street grid to create larger redevelopment sites through the creation of large super-blocks of land. In the case of multi-family housing development, the building form most commonly developed during the urban renewal period was tall, concrete, high-density residential towers located on large superblock sites. The combined effect of these urban renewal practices wreaked havoc on the traditional form of urban neighborhoods, displaced existing communities, and heightened racial tension (Laurence, pg. 148; Mollenkopf, pg. 257).

The dispersion of population farther away from the walkable street grid and transit system directly led to the growth in the use of the automobile, extension and expansion of roadways, and facilitated the construction of the Interstate highway system (Ellis, pg. 252). In the 1940's and 1950's, the recognized best practices at that time for the building industry and for roadway design and construction showed a clear, dominant preference for automobile-oriented building and auto-oriented street design over traditional, mixed-use buildings and street designs that accommodated cars, pedestrians, and transit (Ellis, pg. 259). Ironically, this sweeping dominant development trend, built around cars and single-family homes in the suburbs along with the wholesale slum and blight clearance in the cities under urban renewal, ignited a shift in the planning profession around the importance and complexities of urban design (Laurence, pg. 155).

The Image of the City, Kevin Lynch, 1960

Kevin Lynch's seminal 1960 work, The Image of the City, was one of the first attempts to measure or gauge the urban design qualities of cities. The work represented a theory that small elements grouped together collectively can have a large effect on how and why cities are perceived in certain ways. Lynch took a different approach in that he asked people about their perceptions or images of certain cities and parsed out specifics on why people viewed cities in particular ways.

Lynch looked at three different cities – Boston, Massachusetts; Jersey City, New Jersey; and Los Angeles, California. Each city was measured for legibility, visual image, structure, identity and meaning by verbally asking interviewees in each city questions about their city around each urban design concept. Boston was universally viewed as a highly-defined place in that people had strong places within the city that they identified with as uniquely Bostonian. Boston Common, the view from the St. Charles River, and Beacon Hill were all places that made a strong impression on the people interviewed and were a clear visual image for people when they thought of Boston. Boston streets are relatively narrow aside from major thoroughfare streets such as Beacon Street, Commonwealth Avenue, Massachusetts Avenue and Boylston Street. The major streets, particularly those connecting to the bridges crossing the Charles River were identified as highly recognizable, orienting streets by both visitors and inhabitants (Lynch, pg. 16-25).

Conversely, Jersey City, New Jersey had little to no visual definition or sense of place for people, including for the residents who live there. Jersey City, being located between Newark and New York City, was described as having no truly distinguishable features over and above the skyline views of Newark and New York City. The most distinguishable visual landmark features about Jersey City as identified by interviewees were two visual components that were not even located in Jersey City. Streets were easily seen as interchangeable paths around the city because there was nothing memorable about any of them to make them stand out. Jersey City, New Jersey's identity literally had no sense of place for people. Its orientation in the public's mind was based on the two adjacent cities, Newark and New York City, places that did evoke a sense of place and image-ability (Lynch, pg. 26-31).

Los Angeles, California had more visual definition for people than Jersey City, New Jersey but considerably less so than Boston, Massachusetts. While Los Angeles had a defined downtown area based on a grid system and was a retail center, it was noted that there were many other retail centers located outside of the downtown that were viewed as preferable to downtown. Los Angeles is a newer city than Boston or Jersey City and, as such, is more oriented to automobile travel. This auto orientation has caused the growth pattern of Los Angeles to be sprawling as opposed to compact and the large spread of the city dilutes a sense of major visual components that make it a memorable place (Lynch, pg. 32-42).

Lynch proposes that cities can establish or improve their visual image and memorability by focusing on the urban design elements of paths, edges, districts, nodes, and landmarks. The path in this context can serve as a street, bikeway or the sidewalk. Edges are the breaks in continuity between areas. Rivers, railroad tracks, freeways, cemeteries, and large parks can all serve as edges in a city. Some edges are barriers that may need mitigation (freeways) and some are merely lines of division (large parks). Districts are large sections of the city that have a distinct feeling of entry when one enters or when one leaves. Architecture, predominant building forms or even ethnicity are some of the components that can make an area into a district. Nodes are small, intense areas of activity and in some cases are present within a larger district, serving as point of attraction for people. Landmarks are large visual structures that help people to organize the structure of a city and to orient themselves within the city in relation to that structure (Lynch, pg. 49-81).

The street, or path as Lynch commonly refers to streets in visual imagery terminology, plays a predominant role in the image of a city. It serves as a basic element of spatial organization and way-finding for people. The physical elements of the street in its width and traffic volume, the sidewalk space allotted for pedestrians, the distance of buildings from it, the variety of the building facades and the presence of activity occurring along it are just some of the pieces that contribute to whether a street is memorable and make it a place that attracts people or causes them to flee.

The Death and Life of Great American Cities, Jane Jacobs, 1961.

Jane Jacobs' masterwork on how and why cities thrive, or die is grounded in the life of the neighborhood street. In Jacobs' view, the activity and vibrancy that comes from having a variety of active mixed uses on the street is what attracts people and, therefore, keeps the street healthy and alive. The design of the street and the elements that frame the street - buildings, trees, building entrances, presence or absence of windows – all affect whether a street is viewed as inviting or a place to be avoided.

Jacobs' book was a direct attack on and a point-by-point refutation of the large-scale, urban renewal planning and design movement that had gained momentum in major cities in the 1950's and 1960's, most notably Robert Moses' redevelopment plans for lower Manhattan. Urban renewal planning and design commonly embraced Le Corbusier's International design principles, focusing on high-density, high-rise building forms surrounded by auto-oriented design at the street level. A majority of urban renewal housing projects resulted in super blocks of land populated with large residential high-rises surrounded by vast expanses of underutilized green space, physically separated from other land uses, isolated from the existing neighborhood, and with connections that emphasized the automobile over the pedestrian. Jacobs broke down urban design elements like sidewalks, parks, streets, building orientation, and block lengths into common everyday language and described each in detail in how they can contribute to success or failure for an urban area.

The premise of urban renewal planning and implementation, as demonstrated by the New York City Housing Authority, fully embraced Le Corbusier's idea of 'tabula rasa' – clearing the slate and starting over. As with other housing authorities across the country, the New York City Housing Authority sought wholesale clearance of portions of the traditional urban core so that the area could be redeveloped as modern, large-scale developments. Entire urban neighborhoods were torn down and their residents displaced.

Small-scale neighborhood commercial uses that served the neighborhood were displaced and not incorporated into the new developments. The result of urban renewal left many central cities gutted with monolithic architecture, a disrupted street grid due to large super block configuration, prohibition of commercial uses, automobile orientation, and isolated open space (Zipp, pg. 376).

> "The city itself is outdated and the traditional gridiron block is fundamentally an antiquated 19th-century invention that…is an excessive waste of space and makes no provision for getting quickly and easily from one part of the city to another." - Joseph McGoldrick, New York City Comptroller and proponent of the 1940's-era monolithic super block housing redevelopment projects (Laurence, pg. 154).

Federally-funded public housing projects being constructed at this time were a perfect example of the new urban renewal planning and design aesthetic - Cabrini Green and Robert Taylor Homes in Chicago, Illinois; Pruitt-Igo in St. Louis, Missouri; Queensbridge Houses in Queens NY; and Jordan Downs in Watts, California. Ironically, all these projects became notorious for crime, poor living conditions, and concentrated poverty; all have since been demolished.

The urban renewal planning and design projects of this time created places that established and fostered isolation for the residents within these complexes as well as between these complexes and the greater neighborhoods with which they were located. The lack of connection was both physical and social and a direct result of their design and their placement in context to the existing, surrounding neighborhoods. Urban renewal projects ignored the importance and value of the street as a gathering place and a point of context for social interaction. Jane Jacobs vehemently believed that streets and sidewalks were key building blocks for successful neighborhoods. Jacobs' work helped to elevate qualitative assessment of specific urban design elements into a common language and showed that the little components of urban design collectively added up to have a large impact (Laurence, pg. 154).

Urban Design as Public Policy, Jonathan Barnett, 1973.

Barnett's work is vastly different from the changing perspective for the planning and urban design profession during this time period. Barnett is surprisingly supportive of large-scale urban renewal planning and development at a time when there is a noticeable shift proposed by other contemporary planning theorists to move away from that theory. In his book, Barnett describes how he and several architects and planners became part of New York City Mayor John Lindsay's political agenda to redevelop the city. Barnett's position may be a direct result of being invited into and made a part of the political environment realm and, in return for that access, being a proponent of the status quo theory was required.

Barnett demonstrates how he and other architects functioned as political insiders under the Lindsay administration and were able to influence the design and implementation of both public and private real estate projects. Barnett outlines how Lindsay supported planning staff in creating special zoning districts and development entities for geographic areas of the city whose sole focus was to implement the development laid out in planning documents (Barnett, pg. 16). Barnett and his group of insiders developed the plans and worked with special insider entities to implement the plans with little to no community input. Success was measured in getting the plan and subsequent projects implemented and not so much in whether the surrounding neighborhoods saw the development as a positive addition to the community.

Community engagement was not considered a part of the development process during this time period.

As an urban designer, Barnett embraces the notion that the city must actively compete with the suburbs by replicating many of the components that suburban areas offer in the city. These components include development of enclosed shopping malls and expanded automobile access and circulation to the area through the building of large-scale highways (Barnett, pg. 121). This theory of cities competing with suburbia by trying to imitate suburban design forms has not been successful in practice in cities across the country over time. A local anecdotal example of this practice can be seen in both Minneapolis and Saint Paul downtowns. Both Minneapolis and Saint Paul created enclosed shopping malls in their downtown cores in the 1980's attempting to compete directly with suburbia. Similarly, both malls have since converted their space to office and the only commercial retail uses present in the space are food and service-related.

<u>Life Between Buildings, Using Public Space</u>, Jan Gehl, 1987.

Jan Gehl advances the idea that the quality of public space can be the tipping point in whether an urban space feels lively and vibrant or vacant and uninviting. According to Gehl, people use public space in three different, distinct ways – necessary activities, optional activities, and resultant or social activities. An example of necessary activities would be the downtown worker that must use the sidewalk to walk to their parking ramp or transit stop to travel to and from work and home. If the route is devoid of activity or interesting sights, the journey is a point-to-point trip – the worker uses the sidewalk only as a necessary means to get to their desk on time and to reach their car, bus, or train as quickly as possible, so they can get home. There is no stopping or lingering because there is nothing along the route that encourages one to stop (Gehl, pg. 10).

Optional activities are the types of activities that a person walking along a street might choose to participate in given time and interest. A temporary, seasonal farmer's market in a vacant parking lot or concerts in an adjacent park are good examples of optional activities that can entice the pedestrian to stop and visit. The downtown worker, who is rushing to get to their parking ramp or transit stop, may make the time to stop off at the farmer's market if the setting is accessible and inviting along the pedestrian route (Gehl, pg. 11).

Another finely-grained category of activity that can occur in public spaces is the resultant or social activity. Resultant or social activities occur in public spaces between people such as kids playing games, or two people engaged in a conversation. However, it can also be as simple as just being in a public square sitting amongst and observing other people (Gehl, pg. 12). At this level of activity, the quality of the public street adjacent to the public space directly affects the quantity of social activities. For example, as automobile traffic increases along a street, the amount of resultant social activities decreases because the quality of the experience is diminished (Gehl, pg. 34). The dimension requirements of the public space change as the speed of the automobile traffic increases. A greater amount of automobile traffic moving at a high rate of speed requires that signs be bigger because the orientation of the street is geared towards a driver in a car as opposed to a person walking along the street (Gehl, pg. 71).

The size of a public space can assist or hinder the assembling and dispersing of people. Larger spaces with fewer activities or with activities spread farther apart will draw less people than smaller spaces with more activities or activities placed closer together (Gehl, pg. 91). At a site planning level, the assembling of people between a building and the street are important. Short distances between building entrances and narrow building widths to create shorter lengths of building façade give the street more opportunities for people to come and go, and in turn attract more people, as opposed to a building with a long façade and a single entrance (Gehl, pg. 93-94). Multi-level public spaces at the street and building level have a dispersing effect because people are pulled away from the activity of the street and are to be avoided (Gehl, pg. 97).

Pedestrian routes are typically governed by the shortest and most direct route to the destination, especially if the destination can be viewed in the horizon. Pedestrian behavior is only altered by very large physical obstacles that are hard to cross, extremely high amounts of pedestrian traffic, or high, unsafe levels of vehicular traffic. Street segments that have high traffic volumes, high traffic speeds, and few street crossings adversely affect pedestrian movement (Gehl, pg. 137-141).

Gehl focuses on the smaller parts of the urban landscape that, when put together collectively, have a big impact on the feel of a street. The ability for a person to walk comfortably and to have a positive experience while moving through an environment is a core principle that causes that person to perceive a street as pedestrian-friendly or not pedestrian-friendly. Furthermore, the street-level experience of the pedestrian in the downtown urban core of a city also greatly affects how that person perceives whether the downtown is vibrant and successful or derelict and depressed.

<u>The New Urbanism</u>, Peter Katz, 1994.

Evolution of theories on development and urban design continued to evolve in the 1990's with the advent of the "New Urbanism" movement. New Urbanism is a re-affirmation of Jane Jacobs' theory that traditional urban form creates the strongest streets and neighborhoods because it creates and sustains activity at the street level and fosters a sense of community missing from dispersed edge development. Literally, multi-story buildings with a mix of uses and orientation to the street, an urban design form once considered "old and outdated" by the modern, technologically-focused planning theorists of the 1910's and 1920's, was suddenly "new and desirable" again. Older, existing cities began viewing its traditional urban form as an asset. Suburban communities started implementing developments that borrowed the traditional design elements of mixed-use, multi-story buildings, sidewalks instead of parking in front of buildings, and windows on the street (Katz, Moule, Polyzoides, pg. xxi-xxii).

The New Urbanism school argued that the rise in the use of land use zoning controls combined with highly engineered, car-oriented transportation improvements in the 1940's and 1950's resulted in the creation of places that caused dispersion of communities and resulted in a disconnected built form pattern. New Urbanism development seeks to correct that pattern by encouraging multi-story, mixed-use developments as well as de-emphasizing cars in favor of pedestrians in terms of public realm (Katz, Bressi, pg. xxviii-xxx).

New Urbanism as applied in a suburban environment has had mixed levels of success because New Urbanism developments are often developed as islands unto themselves that are dropped in the middle of the typical sprawling suburban environment.

What often results is an attractive mixed-use, multi-story development that residents and visitors may walk around when they are within the development but will primarily drive to and from the surrounding area because the rest of the community's assets (shopping, jobs, parks, etc.) are geographically dispersed. The integration of transit improvements and walking and biking amenities between New Urbanism developments and other points of interest within the suburban community seem to have improved their image of success. Over the last twenty years, the desire to show proof that New Urbanism was working in the suburban environment drove the demand for specific measures of success. Specific measurement of whether more people bike and walk and use their cars less as a result of a New Urbanism development has now become one benchmark to measure success or failure of that development (Garde, pg. 40; Lund, pg. 427).

Happy City: Transforming Our Lives Through Urban Design, Charles Montgomery, 2013.

Charles Montgomery's premise is that urban design can have a profound effect on a person's happiness in that it can contribute to or subtract from social interaction. Early urban development in the United States occurred in cities and population growth exploded. Alongside this population growth, overcrowding and poor living conditions increased in turn. Fixes to these problems included separation of uses (i.e. zoning) and starting over outside of the urban core by moving development outward (Montgomery, pg. 64-65).

Zoning gave cities a way to regulate uses for the health and welfare of its residents by regulating building mass, height, and use to ensure proper air, sunlight, and appropriate population density. At the same time, the separation of uses through zoning perpetuated the dispersion of the city over more distance causing a development pattern of suburban sprawl. This sprawl was helped along by the policies and practices of federal housing lending institutions that steered housing lending toward the fringes of the city and encouraged new, low-density development instead of reinvestment of the existing, denser housing stock within the urban core. The premise of starting anew in a new suburban single-family home away from the problems of the city served as a backbone of the American dream. The construction of the Interstate highway system coupled by a concerted effort by the automobile manufacturers and American Automobile Association to increase the sales and usage of cars played on the idea that the urban core was old and decayed and, therefore, unrecoverable, causing an even greater push for the population to move to the new, fresh fringes of the city (Montgomery, pg. 74).

The result of this spatial dispersion of new development further and further from the urban core has caused daily commute times from home to work to increase dramatically over the years. The long arduous commute itself takes a serious toll on people's health and happiness, ironically the very happiness that people sought to gain as a result of moving so far out. But Montgomery proposes that the long, daily commute is only the beginning of the misery for people. The commute times for people living so far out eat so much time away that they have little time left over to spend with their families let alone get to know their neighbors or develop connections with their communities. Furthermore, edge communities are often a collection of single-family subdivisions with little commercial goods and services that are within a distance that do not require a trip in the car. Commercial uses this far out are a collection of big-box stores that draw from a variety of suburban communities and, therefore are designed and oriented to automobiles.

What results are people who live very far away from their daily lives with a lot of social isolation and little access or time for social connectivity and happiness (Montgomery, pg. 95).

How does Montgomery's urban design and happiness premise pertain to the street or the value of pedestrian-oriented street segments? The street is a building block in creating places that give people a sense of connectedness and small-scale that allows people to create and maintain social connection. The design quality of streets is important in providing people with more choice. Streets that provide accommodation for bicyclists, transit users, pedestrians, and cars provide people more choices for how they will move and interact as they travel down that street (Montgomery, pg. 216).

Summary and Critical Analysis – 1940's, 1950's, and 1960's Planning Theory

In my view, the 30-year time span between 1940 and 1970 were a pivotal and catastrophic time for city planning and urban design in cities across the United States. The federal government's push for municipalities to clear blocks and blocks of the inner city, eliminating whole neighborhoods and disrupting the traditional street grid, is a lasting, negative legacy that the planning profession comes up against the general public's collective memory every day. Large, high-rise superblock development from this time period is easy to spot in any mid-to-large-size city in America. The community's fear of tall buildings and high-density development is directly born out of this era, when large-scale redevelopment projects were put into motion with little to no public input and no understanding of how these behemoth developments could or should integrate into the surrounding community. Today, when a community hears of a proposed new development that has height or density, people automatically think that an urban renewal-style building is what will be built and are immediately fearful of the perceived negative effects that the new development will create in their community.

It was only towards the end of the 1960's and the early 1970's that the real impacts of urban renewal design started to be recognized as its' negative secondary effects started to emerge in the form of societal problems like crime, drugs, concentrated poverty, and racial segregation. The isolated design of these buildings coupled with the lack of physical connectivity to the existing neighborhood was a primary cause of the social isolation that people who lived in these developments experienced. The backlash against the urban renewal approach to development caused the planning profession's pendulum to swing back to noticing and recognizing the importance of the quality details that make for a pleasant urban environment.

Kevin Lynch and Jane Jacobs played a large, visible role in getting the planning pendulum to shift back to the urban design details and back to a recognition that the role the street plays is very important. While urban design elements seem simple to identify and discuss in today's world, Kevin Lynch's work was revolutionary in that he identified urban design elements and dissected the specific how's and why's as to their contribution to a city's image through the general public's eye. In three very different urban places (Boston, Jersey City, and Los Angeles), Lynch asked the ordinary person on the street what they did or did not associate with a particular place and asked them to explain why they thought that way. His work illustrated that a person's sense of place is heavily affected by the unique grouping of different urban design elements in cities that collectively give cities a unique structure, image, and identity.

Jacobs' work also focused on calling out the specific pieces of the urban design realm that come together to make a unique neighborhood. The sidewalk, as part of the street, is a major focal point in that it creates a place of daily social contact and a source of safety. The visual presence of people walking along a sidewalk causes more people to choose to walk along that sidewalk. This is because a pedestrian who encounters a greater number of people also walking along the sidewalk can feel a greater sense of security simply due to more eyes and ears being around them. The greater the natural surveillance, the greater the sense of comfort by the pedestrian. The sidewalk as part of the street is but one of many variables that Jacobs describes as the organized complexity that is the problem of a city.

Jan Gehl in his 1980 book Life Between Buildings parsed out the urban design details that comprise a street but highlighted the human interaction that occurs out on the street as a result of the type of urban environment around people. Urban design and planning at the human scale that allows for or even encourages human interaction was a major focus of Gehl's work. The planning of the 1940's, 1950's, and 1960's tried to implement planning and urban design in terms of function and efficiency but completely ignored the social aspects of city life as lived out in the public. Walking as both a transportation mode or as a casual activity requires a minimum level of human-scale urban design features in order to ensure both safety, passive or active social interaction, and aesthetic enjoyment. The quality of the urban design components can make the difference between a pedestrian who travels as quickly as possible to get to their destination because the environment is poor or a pedestrian who chooses to undertake a number of activities (shopping, coffee, etc.) while on the way to their destination because the environment is pleasant.

The New Urbanism movement that took off in the 1990's was another nod to the importance of the sidewalk and street and a reaffirmation of the traditional building form that had naturally occurred in cities over time. Planning in the 1940's through the 1960's had sought to eliminate traditional building form because it was viewed as old and dated and, therefore, bad and undesirable. The modern, auto-oriented building form of the 1940's through the 1960's was heralded as new and futuristic and, therefore, good and desirable. By the 1990's, first-ring suburban communities that had sprang up in the post-World War II era were beginning to experience decline as they lost population to the outer-ring suburbs. New Urbanism-style development was directed at these first-ring communities as a way to make-over the dispersed, auto-oriented suburban environment into a more walkable urban-style community.

Compact, mid-rise, mixed-use developments with strong connection to the street and sidewalk are key components of New Urbanism. Early New-Urbanist-style developments had mixed results as they were plopped down in the middle of very dispersed suburban environments. New Urbanist-style developments as part of urban redevelopment have fared better because of their location within the traditional city environment where there is already a pedestrian network in place. As similar developments have been completed over time in suburban communities that have really embraced New Urbanism, there has been a slow evolution towards creating a more walkable environment, but most of suburbia remains auto-dominated and un-walkable. For the suburban environment to improve around New Urbanist developments, wider sidewalks, improved attractiveness of walkways, and separation of pedestrians from cars and heavy auto traffic are key to changing the overall environment (Robertson, pg. 279-280).

Charles Montgomery's work about the Happy City brings this earlier work together by explaining about the importance of urban design in people's lives and how it can influence one's personal happiness. His premise is simple – living close to work, school and the functions of your daily life encourages a greater degree of happiness than living hours away from those things because you have more time to live daily life and connect with people on a consistent, meaningful basis. Historical development patterns have repeatedly driven new development to the outer fringes time and again. People, repeatedly in search of affordability, safety, and security that the suburban environment proposes to offer, move farther and farther out from their place of employment only to have the bulk of their lives spent commuting with no time for outside activities, family, or friends. When these folks are home, the design of suburban communities with its inward focus and auto-oriented design perpetuates the social isolation. The sidewalk and street are especially important in fostering that everyday sense of connection in a community.

c. Details matter – urban planning and design moves towards discrete measurement

The failure of government-led urban renewal planning and design of the 1940's – 1960's fundamentally changed how the general public viewed the planning and design profession in that grand city planning visions were not necessarily going to be welcomed or widely-embraced by the public as they once had been earlier in the century. People became more skeptical and mistrustful about city planning and development initiatives. Just because a famous architect or designer believes a building design, or a comprehensive land use plan will produce an intended, positive outcome does not mean that the result is deemed positive by everyday users or occupants. Nor does it preclude the chance that there could be a potentially negative, unanticipated effect that results from the development or plan.

Increasingly, public policy makers and constituents are no longer willing to accept assertions without concrete, measurable data to support it. Now, more than ever before, people want to see proof that a plan or project will have a positive effect on their lives before they are willing to support it. As a result, the planning and urban design profession recognized that there was a need to develop quantifiable metrics for urban design concepts and elements that are often highly qualitative. The literature review from this point forward specifically highlights how measurement practices and techniques in the planning field have evolved to date.

Measuring Overall Architectural Quality: A Component of Building Evaluation – Robert W. Marans and Kent F. Spreckelmeyer, Environment and Behavior, 1982 14:652 DOI: 10.1177/0013916582146002

As noted above, measuring success in terms of qualitative urban design features began to take on a heightened importance as skeptical policy makers and their constituents wanted tangible data to support design and investment decisions. This study examined a newly-constructed Federal building in Ann Arbor, Michigan that received several architectural design awards from the perspective of the building's occupants and on-site visitors. Marans and Spreckelmeyer were interested in understanding what elements made the building design attractive or unattractive to average people occupying or visiting the building.

The research team asked occupants and on-site visitors to rate the building's external and internal attractiveness. Internal attractiveness of the building's space by occupants was heavily influenced by ambient factors like air quality and noise; whereas on-site visitors gauged the building's internal attractiveness primarily on aesthetics (Marans, Spreckelmeyer, pg. 657-661).

Occupants and on-site visitors were asked what specifically they liked about the building in terms of external attractiveness. Building occupants viewed the exterior design of the building positively due to its plaza, landscaping and stairs, overall building design, and windows and skylights. On-site visitors were positively influenced by the building's external design in terms of the spaciousness of the building's interior and the ability to see that spaciousness from outside of the building. Building attributes that were viewed negatively by both groups were the bland color scheme and barren walls (Marans, Spreckelmeyer, pg. 664-665).

While this study focused on the architectural attributes of a single building and not on an overall street, it demonstrates that external design elements from both a building and public realm aspect have an impact on whether people view a space negatively or positively. It shows that positive or negative view of a space is dependent on whether the individual is an occupant or user of the space as opposed to a casual observer.

<u>Great Streets</u>. Allen B. Jacobs, 1993

Allen Jacobs delves into the pattern of great streets across the world and identifies a list of 'required elements'. Streets provide geographic order and spatial comprehension to people visiting a city and give a person a sense of where they are in relation to their neighborhood, key destinations, and the larger region.

According to Jacobs, a key required element is a street that feels safe and encourages leisurely walking. Sidewalk widths vary but should be wide enough to accommodate seven to nine people walking per minute at any given time. A comfortable street is another key requirement in that there should be adequate shade along with sun. A street should never be permanently shaded by tall buildings nor should it be so exposed that it is only in sun. Building scale, at the street level, needs to be in scale to the pedestrian in that buildings should not exceed a height of 48 feet and a width of 21 feet. Buildings can be taller than that as long as the building face steps back as it increases in height (Jacobs, A. pg. 273-278).

Another requirement of a great street are elements that engage the eyes but do not overwhelm. There needs to be enough variety in the realm of a pedestrian's vision to make the walk visually interesting but not so cluttered that the eye cannot focus on any given item. Street furniture, landscaping, and interesting buildings with transparent windows and access from the sidewalk are all examples of visual interest (Jacobs, A. pg. 282).

A great street requires that there is a sense of complementarity of the buildings that line it in that there is compatibility between heights and styles. Buildings along great streets represent a diverse number of architectural styles with a variety of heights;

however, the heights do not vary dramatically from building to building such as from a two-story building to a fifty-story building. Building (Jacobs, A. pg. 287-288).

A great street requires maintenance and that the sidewalks and buildings along that street be maintained as well. Crumbling sidewalks and garbage do not attract people; likewise, boarded and vacant buildings detract from a person's overall view and experience of a street. Quality of construction and design are another essential for a great street. A street's pedestrian realm and the buildings that line it must be of good design and consist of high quality materials (Jacobs, A. pg. 289-291).

Allen Jacobs lays out key essentials and other contributing factors that make urban streets desirable and successful. The examples that Jacobs gives of great streets from around the world are all varied and diverse, meaning that there is no one set combination of design elements that have to be followed.

Zacharias, J. (2001). Pedestrian behavior and perception in urban walking environments. *Journal of Planning Literature, 16*(1), 3-18. doi:10.1177/08854120122093249

John Zacharias looked at whether there are elements of pedestrian behavior that can be predictable or manipulatable. With most cities based on a grid or graph spatial layout, pedestrians move through space via channels known as an open-space network. The higher the number of intersections, the greater the pedestrian connectivity through a city. Modeling aggregate pedestrian movement shows that a highly accessible or central path location with connection to other destinations will have higher volumes of people (Zacharias, pg. 8).

Overall, pedestrians are prone to want to reduce their trip length by taking the shortest route possible. As a result, people prefer regular spatial forms such as a grid system because it allows for predictability in determining direction and in finding the shortest route while limiting the risk of getting lost. Climate, lighting and sound are all elements that affect pedestrian behavior. Pedestrians prefer to walk in a moderate climate (55 – 75 degrees Fahrenheit) and in areas that have adequate lighting, and which have lower ambient noise (Zacharias, pg. 10-11).

My research focused on quantitative street data for downtown census tracts in 383 MSA's but pedestrian behavior is an important consideration when looking at the larger whole and what it means in for pedestrian infrastructure.

Measuring Urbanism: Issues in Smart Growth Research – Emily Talen, Journal of Urban Design, Vol. 8, No. 3, 195-215, October 2003

Emily Talen's research examined how the planning profession has measured smart growth urban design ("new urbanism") in the past and gives forth a framework for a more consistent way to do so in the future. Three methods of urban design measurement are typically used – functional, decision, and normative.

Functional measurement of urban design is centered on providing predictability and explanation and looks at the 'how's' and the 'why's' a city has developed into its current urban form and how the current urban form affects its' surroundings. An example of this would be the development of a suburban-style, auto-oriented, drive-through restaurant along a traditional commercial street. The function of an auto-oriented, drive-through restaurant will allow us to predict and measure the amount of traffic in and around the site and will increase in the surrounding neighborhood due to the nature of the restaurant being geared towards auto users as opposed to pedestrians. Patterns of development occur over time as a result of the functions of the specific land use (Talen, pg. 196-197).

Decision-based measurement of urban design is most commonly used in the making and justification of city development decisions. A city's applied use of zoning districts to regulate and control land use is a good example of decision-based measurement. For example, a suburban community currently has a busy arterial street within its borders that houses several large, big-box commercial uses. There is a desire by the policy makers and the community to encourage a different vision of the area for the future by changing land use to be more traditionally urban in character (i.e. multi-story buildings located on the arterial street as opposed to being set back from the street and separated by parking lots). Rezoning the area from auto-oriented commercial to traditional neighborhood zoning would preclude new big-box developments from locating along this arterial street as well as prohibit expansion or alteration of the big-box developments currently located there as well.

Normative measurement of urban design is centered on an ideal or set understanding for how a city 'ought' to be. For example, new urbanism has a set of prescriptive standards for how a development meets the definition of being a new urbanism development (mixed-use, multi-story buildings, building placement up to the street, presence of sidewalks along the street, etc.). Cities or developments can be measured against these design criteria in order to categorize the design of a city or place as 'urban' or 'suburban' and 'pedestrian-oriented' or 'auto-oriented'.

Measurement of cities can be divided into different types of classifications – aggregate, surface, geographical and elemental. Aggregate city measurement uses the largest source of data across a geographic area at the lowest level of representation to demonstrate urban form (i.e. developed versus undeveloped). Aggregate cities present measurement as an either/or scenario. Land is shown as developed and, therefore, urban or land is shown as undeveloped and, therefore rural. Aggregate data does not reflect the differences between highly dense urbanized places as opposed to sprawling suburbanized areas (Talen, pg. 197).

Surface city measurement is like aggregate measurement in that it shows data over a large continuous area but focuses on presenting data over time in order to show how the city changes over time. A good example of surface city measurement is to see how suburban sprawl grows over time from the original boundaries of the central city (Talen, pg. 199-200).

Geographical city measurement is more specific in that it focuses on a place's geographical attributes and looks at measuring those attributes in terms of number per square mile. Examples of the geographical attributes measured include population density, concentration, compactness and proximity. A good demonstration of this would be two cities with a population of 100,000; however, city #1 is 20 square miles in land size and city #2 is 10 square miles in land size. In measuring each city's population density, city #1 would calculate a much lower population density than city #2 because its total population is spread out over a larger geographic area than city #2 (Talen, pg. 200).

Elemental city measurement is the most specific of methods in that it looks at a city in-depth for a specific set of urban design attributes. An example of this would be to measure a single city on whether its public realm contributes to a pedestrian-friendly street experience. A good city example of the use of this method is Portland, Oregon which attempted to measure the quality of its pedestrian environment by looking at every single street within its border and rating it against four discrete urban design criteria that represented pedestrian-oriented design (Talen, pg.200-201).

Talen asserts that there needs to be a commonly-accepted language in terms of urban design and that the measures listed above need to be more clearly defined and applied. Talen proposes eight urban design attributes and attempts to define specific measures that represent those attributes.

1. Enclosure – lineal feet of streets bordered by buildings or lines of trees.
2. Lost Space – acreage of land solely dedicated to the driving and parking of vehicles, vacant land, and undefined open spaces.
3. Undefined Public Space – acreage and lineal feet of public areas that are undefined such as public parking lots.
4. Spatial Suitability – the amount of uses that are incompatible. (i.e. the number of single-family homes facing an intense auto-oriented arterial roadway).
5. Proximity – measuring the distances between residential population and the goods and services that they need, essentially the trade area.
6. Mix – measuring the spatial mix of goods and services in relation to the residential population.

7. Centers and Edges – measuring the number of major draws or centers in an area. Measuring the amount of well-defined edges between neighborhoods and areas such as parks, trails, or arterial roadways.
8. Divisions – measuring the number of physical divisions that physically separate urban spaces (i.e. freeways) (Talen, pg. 205-211).

The research that I conducted included both the geographical and elemental types of measurement. The measurement is geographical in that the research focused on the downtown census tracts that comprise the central business district for all 383 MSA's in the United States. The measurement is also elemental in that it takes specific, discreet urban design attributes – the pedestrian-oriented street segment, intersections with three streets and intersections with four streets – and use them to test whether the presence or increase of pedestrian-oriented street segments in downtown central business districts has any positive correlation on economic growth through an increase in jobs and housing units over time.

Krizek, K. J. (2003). Operationalizing neighborhood accessibility for land use-travel behavior research and regional modeling. *Journal of Planning Education and Research, 22*(3), 270-287. doi:10.1177/0739456X02250315

Krizek's article focuses on the best measures for gauging neighborhood accessibility. Neighborhood accessibility in this case is characterized as higher residential density, a mix of land uses and an inter-connected circulation system for cars, pedestrians, and bikes. The article summarizes the current methods for operationalizing and measuring neighborhood accessibility variables and makes suggestions for improvement using a neighborhood accessibility index.

The typical variables used in measuring neighborhood accessibility are residential density, land use mix, and the circulation framework/urban design. Residential density is defined as the number of housing units by amount of land. High residential density results when there are many housing units located on a smaller tract of land; at the other end of the spectrum, low residential density occurs when there are single-family houses located on large land tracts.

Land use mix is defined as a mixture of different and varied land use types present in a neighborhood. A high land use mix would be an urban environment in which there is residential, office, commercial, institutional, and recreational uses present within close proximity to one another. A suburban residential subdivision is a good example of an area with little mix of land uses because the area is solely single-family residential.

The circulation framework/urban design variable is defined by the level of streets, sidewalks, pedestrian and bicycle paths, right-of-way width, parking, building setbacks, varied housing design, presence or absence of building orientation to the street, and tree canopy and green space present in a neighborhood. The circulation pattern can be inter-connected, based on a grid or it can be circuitous and curvilinear. The grid street design is typically found in older cities while the curvilinear street pattern is typically found in mid-century and newer suburban communities. The street pattern sets the stage for the other components identified in terms of urban design. A grid street pattern lends itself to smaller blocks with uniform lots, shallow setbacks, sidewalks, on-street parking and boulevard trees. A curvilinear street pattern lends itself to larger, non-uniform lots, deeper setbacks, and fewer sidewalks (Krizek, pg. 271).

In measuring the design of streets, the presence of a grid street system is often used as a measure of connectivity. However, Krizek notes that it is more than just the presence of a grid street pattern that indicates accessibility. A grid street pattern combined with high intersection density are a better measure for neighborhood accessibility because multiple crossing points indicate more opportunities for pedestrians to cross. A grid street pattern with many intersections means that the block face is typically shorter in distance, which provides more comfort to a pedestrian than long blocks with few points with which to cross.

Krizek's study sought to develop a single measure of neighborhood accessibility in the Seattle metropolitan area by analyzing existing regional data on housing density and land use mix along with identified pedestrian-oriented street segments. Krizek used GIS technology and U.S. Census Tiger file data to determine intersection densities across the metropolitan area and developed an index to measure neighborhood accessibility down to the 150-meter grid level. The scores that Krizek calculated for different areas within the Seattle metropolitan area were then compared against subjective ratings of those same areas by a review panel that used detailed aerial photos to rate neighborhood accessibility. Regression analysis was calculated using the subjective ratings against density, block size, and land use mix and all three variables were found to have significance. Likewise, Krizek's neighborhood accessibility index scores were analyzed against the subjective ratings and a high level of correlation was found between the two measures.

The research that I conducted uses an intersection density data set collected by NAVSTREETS and available through the U.S. Environmental Protection Agency's

Smart Location Index. I used ArcGIS, geographic information systems mapping product, to take the 383 MSA's and select out the census tracts that comprise each MSA's downtown urban core. The Smart Location Index includes 2010 census data across all MSA's which helps to simply the data collection effort. I was able to isolate downtown census tracts for all MSA's and then conduct a test of the hypothesis. I was able to compile and work with a large, nation-wide data set with enough refinement to be able to see if pedestrian-oriented street segments have any positive economic significance to downtowns.

Measuring Patterns of Urban Development: New Intelligence for the War on Sprawl – Gerrit-Jan Knaap, Yan Song, and Zorica Nedovic-Budic, Local Environment, Vol. 12, No. 3, 239-257, June 2007.

Knapp's research measured sprawl in five metropolitan areas – Portland, Oregon; Minneapolis-St. Paul, MN; Maricopa County, Arizona; Orange County, Florida; and Montgomery County, Virginia. The urban design measures chosen to test these areas at the neighborhood level included street network design, land use intensity, and land use pattern.

Street network design measures included connectivity within a neighborhood geographic area as well as connectivity outside of a neighborhood to other neighborhoods. Land use intensity was measured by lot size and floor area at the parcel level for single-family residential uses. Land use pattern or mix was measured by a calculated land use diversity index that factored in proportions of five land use types – single-family residential, multifamily residential, industrial, public and commercial uses, the median distance to the nearest commercial use and the percentage of single-family residences with a quarter-mile of a commercial use (Knaap, pg. 244).

Internal and exterior connectivity were measured. Internal connectivity was measured as the number of streets that do not end in cul-de-sacs. Exterior connectivity was measured as the distance between access points between neighborhoods with greater distance resulting in a lower degree of connectivity. Pedestrian accessibility was measured as the percentage of homes within a quarter-mile of commercial use along the roadway network (Knaap, pg. 246).

Knaap's research showed that street segments that have a high level of internal connectivity, external connectivity, and pedestrian accessibility are more likely to be deemed pedestrian-oriented street segments because people feel confident that they will not hit a dead end, are able to easily get from one destination point to another, and the environment that the pedestrian experiences while walking along the street is safe and comfortable. Connectivity and pedestrian accessibility are important pieces of the pedestrian-oriented street and, while my research focused on downtown census tracts for MSA's which are not typical examples of urban sprawl, the degree of connectivity and pedestrian accessibility present in these downtowns will affect the degree to which pedestrians will choose to walk down a particular street.

Forsyth, A., & Southworth, M. (2008). Cities afoot - pedestrians, walkability and urban design. *Journal of Urban Design, 13*(1), 1-3. doi:10.1080/13574800701816896

Forsyth and Southworth note that pedestrian access has cumulatively suffered with every technological advancement in transportation history since the advent of the horse-drawn streetcar. The preference for the latest and greatest in transportation technology has resulted in transportation and street design standards that give preference to the automobile over the pedestrian time and again. It has only been through health concerns around activity and the rising rate of obesity and environmental considerations around reducing one's carbon footprint that there has been a renewed focus on designing walkable communities.

Walkable can have a lot of different meanings and Forsyth and Southworth take the time to outline the differences. Walkable can mean physically close by means of distance or that walking is easier or cheaper than driving. Being walkable can also mean that the environment is barrier-free in that there are no large obstacles like a freeway or rail yard bisecting an area. It can also mean safe in terms of real or perceived crime or automobile traffic level. Walkable can also be defined as the identified pedestrian infrastructure components – sidewalks, pedestrian-scale lighting, planted boulevards, etc. Another meaning for walkable is that the neighborhood or area is upscale and caters to a higher economic class who can make the conscious choice to walk over other modes of travel. Defining walkability in a way that allows it to be operationalized and measured in a consistent manner is needed but difficult (Forsyth, Southworth, pg. 2).

Forsyth, A., Hearst, M., Oakes, J., & Schmitz, K. (2008). Design and Destinations: Factors Influencing Walking and Total Physical Activity. Urban Studies, 45(9), 1973-1996.

Forsyth, Hearst, Oakes & Schmitz surveyed people residing in the Minneapolis-St. Paul metropolitan area on how people's walking and physical activity is affected by street pattern, pedestrian-oriented infrastructure and amenities, and mixed-use destinations. Participants kept a 7-day travel journal for their transportation and leisure walking, used the International Physical Activity Questionnaire to self-report overall physical activity and wore step counters (Forsyth, Hearst, Oakes, Schmitz, pg. 1983).

The researchers found that there were positive correlations between travel walking and social land uses, sidewalks, transit, litter/graffiti and connected street patters; however, for leisure walking, there was a negative correlation for sidewalks, transit, street lights, connected street patterns, social land uses, and tax-exempt land uses (Forsyth, Hearst, Oakes, Schmitz, pg. 1985). Design features or elements that are viewed as preferable for travel walking proved to be unpreferable for leisure walking meaning that pedestrian behavior is impacted by public realm in different ways depending upon the type of pedestrian a person chooses to be on a given day.

Agrawal, A. W., Schlossberg, M., & Irvin, K. (2008). How far, by which route and why? A spatial analysis of pedestrian preference. *Journal of Urban Design, 13*(1), 81-98. doi:10.1080/13574800701804074

Agrawal, Schlossberg, and Irvin's research looked at pedestrian behavior in terms of how far pedestrians are willing to walk to a key destination like a rail station and what environmental factors affect their choice of routes. The research geography focused on one San Jose, California train station (Japantown), one San Francisco, California train station (El Cerrito Plaza) and three Portland, Oregon train stations (Hollywood, Gresham, and Rockwood). Pedestrians in those areas were asked to identify on a map the route they took to get to the station and then to answer why they chose that route (Agrawal, Schlossberg, Irvin, pg. 86).

The most important factor in choosing a route was shortest time and distance from home to the station with the second most important factor being safety in relation to automobile traffic (presence of signalized intersections, safety of crossings, separation from automobiles). Survey participants reported walking distances between a quarter mile to a mile to get to their respective station which were farther than what researchers expected. Convenience and attractiveness were the next highest-rated factors but were low percentage-wise when compared to factors like shortest distance/time and safety (Agrawal, Schlossberg, Irvin, pg. 91).

This research highlights that there are differences in pedestrian behavior depending on the trip focus – walking as a transportation mode as opposed to walking as a recreational endeavor. Of the participants surveyed, 90% were traveling to and from home to work or school and the survey was conducted between 6:00 a.m. and 10:00 a.m. The factor of fastest time and shortest distance is more important to people who are traveling on a tight time schedule. Agrawal, Schlossberg and Irvin suggest that the survey results on the routes and most important factors could be very different if it focused on different segments of the population (non-workers, elderly, etc.) at times that are outside of the peak a.m. rush hour (Agrawal, Schlossberg, Irving, pg. 96). While my research uses street segment and intersection density data by downtown MSA census tracts to analyze growth in housing units and jobs, it does not look at the underlying reasons for pedestrian behavior. The underlying reasoning behind pedestrian preferences as to why they choose certain routes over others is a factor that needs to be considered even if it may not be able to be measured.

Baran, P. K., Rodríguez, D. A., & Khattak, A. J. (2008). Space syntax and walking in a new urbanist and suburban neighbourhoods. *Journal of Urban Design, 13*(1), 5-28. doi:10.1080/13574800701803498

Baran, Rodriguez, and Khattak's research focused on testing the relationship between walking behavior and the connectivity of the street design layout using three space syntax variables – control, local integration, and global integration in a traditional suburban neighborhood and a New Urbanist neighborhood in the Chapel Hill, North Carolina metropolitan area.

The definition of control under space syntax means the level or degree to which a street is a necessary link to other streets. A street that is essential for getting to other key routes would have a high level of control; a street that may have only a few access points and results in a dead end is considered to have a low level of control. Integration is defined as how easily one can reach a specific street with local integration meaning the immediate vicinity and global integration meaning the surrounding community (Baran, Rodriguez, Khattak, pg. 9).

The hypothesis was that people living in a neighborhood with streets deemed as having a high level of control (more street connectivity) would be more likely to walk than residents who live in neighborhoods where there is a lower level of control (less street connectivity). Similarly, those people living in a neighborhood with well-integrated streets, both locally and globally, were expected to walk more than those who lived in a neighborhood with less-integrated streets (Baran, Rodriguez, Khattak, pg. 11).

Residents of the two neighborhoods received mail surveys and travel diaries for participants to track their leisure and travel walking trips. The researchers found that higher control values and higher global integration positively correlate to the number of walking trips and show that people are travel walking to destinations. Higher local integration negatively correlates to leisure walking meaning that some residents may choose to purposely walk in areas with less vehicular traffic (Baran, Rodriguez, Khattak, pg. 21).

New Urbanist neighborhoods have a greater number of streets with higher control and higher global integration than traditional suburban neighborhoods. It is easier for walkers to walk to a larger number of destinations outside of the neighborhood and therefore the level of travel walking is greater in New Urbanist neighborhoods. Traditional suburban neighborhoods with lower local integration are attractive to leisure walkers walking within their neighborhood who want less interaction with vehicular traffic.

"Measuring the Unmeasurable: Urban Design Qualities Related to Walkability" – Reid Ewing and Susan Handy, Journal of Urban Design, V. 14, No. 1, 65-84, February 2009

Measuring Urban Design: Metrics for Livable Places, Reid Ewing, 2013.

This study and accompanying book attempts to operationalize urban design qualities in order to measure subjective perceptual design qualities of the walking environment. Ewing and Handy looked at fifty-one urban design qualities and selected nine to study. Of those nine urban design qualities, five urban design features could be operationalized and therefore measured – image-ability, enclosure, human scale, transparency, and complexity. The urban design quality of linkage associated with the physical and visual connections from building to street, building to building, space to space, or one side of the street to the other in the form of marked crossings was tested but found to be a poor candidate for operationalization and therefore unmeasurable (Ewing, 54).

The means for testing and measuring the five urban design qualities was conducted using a panel of professionals throughout the process. A panel of urban design and planning professionals was assembled to conduct the visual assessment rating of filmed street scenes across twenty-two U.S. cities. In total, there were 200 filmed street scenes that mimicked the movements of a pedestrian walking down a sidewalk.

Image-ability as a physical urban design quality is defined as the shape, color, or arrangements of a place that makes it easily identifiable. A landmark building or distinctive structure can give an area a sense of memorable identity and visual orientation. Image-ability elements give a sense of place to a location. The vernacular architecture is a large contributing element in a place's image-ability.

Operationally, image-ability can be measured by:

Positive effect on image-ability

- number of people on the same side of the street
- proportion of historic buildings on both sides of the street
- presence of outdoor dining on the same side of the street
- number of courtyards, plazas and parks on both sides of the street
- number of buildings with non-rectangular silhouettes on both sides of street
- number of major landscape features on both sides of the street
- number of buildings with identifies on both sides of the street

Negative effect on image-ability

- noise level on the same side of the street

Enclosure in an urban design context means the enclosure of outdoor space through the interruption of the visual sightline. The width of a street and the placement of buildings closer to the street define and enclose the outdoor space and give it a definite shape. Prominent visual termination points like landmarks or monuments can also provide enclosure for outdoor spaces. Enclosure gives a person a sense of definite set of boundaries and, in turn, a sense of comfort. Enclosure can be undermined by dead spaces along the street wall such as surface parking lots, vacant lots, or large building setbacks.

Operationally, enclosure can be measured by five components:

Positive effect on enclosure

- proportion of street wall on the same side of street
- proportion of street wall on the other side of street

Negative effect on enclosure

- proportion of sky across street
- number of long sight lines ahead and to either side
- proportion of sky straight ahead

Human scale is an urban design quality that relates directly to building height and width. Buildings over 4-6 stories at the street level overwhelm the pedestrian. Buildings taller than 4-6 stories can and should occur if there is an effort made to step the building back as the height increases so as to not detract how the building feels to a person on the street. Likewise, buildings that are wider in proportion to their height also create disparate human scale. Use of street trees, architectural features, building fenestration, lighting, paving, street furniture, and the presence of a parking lane along the street can help create a more human scale for taller or wider buildings.

Operationally, human scale can be measured by these components:

Positively effect on human scale

- number of pieces of street furniture and other items on the same side of the street
- proportion of first floor with windows on the same side of the street
- number of small planters on the same side of the street

Negatively effect on human scale

- number of long sight lines
- building height on the same side of the street (over 4-6 stories with no articulation)

Transparency is an urban design quality that translates literally into eyes and ears on the street. Buildings with clear windows at street-level that allow people to see in from the outside and out from the inside, outdoor café seating, public courtyards, and street-level entryways are all examples of transparency.

Operationally, transparency can be measured by these components:

Positive effect on transparency

- proportion of first floor with clear windows on the same side of street
- proportion of active uses on the same side of the street
- proportion of the street wall on the same side of the street

Complexity is an urban design quality that means the number of noticeable differences to which a viewer is exposed to over time. Pedestrians need a high level of complexity to keep their interest while the same level of complexity for a motorist would be too chaotic for them to tolerate. Streets that are attractive to pedestrians have a high level in complexity in that there are a lot of varied things to look at as the pedestrian moves along the corridor. These streets also seem shorter in distance to the pedestrian as opposed to a street of the same distance with little complexity.

Operationally, complexity can be measured by these components:

Positive affect on complexity

- number of people on the same side of the street
- presence of outdoor dining on the same side of the street

Neutral to positive affect on complexity

- number of dominant building colors on both sides of the street
- number of buildings on both sides of the street
- number of accent colors on both sides of the street
- number of pieces of public art on both sides of the street

Results showed that urban design measures are not equal to common indicators of urban design such as population density and a mix of land uses. As I noted earlier, Ewing concluded that the urban design quality of linkage associated with the physical and visual connections from building to street, building to building, space to space, or one side of the street to the other in the form of marked crossings was a poor candidate for operationalization and, therefore, was found to be unmeasurable.

The urban design quality of linkage is illustrated by streets and sidewalks. Ewing was not able to measure the quality of linkages in his work. My research aimed to see if there is a positive correlation between the presence of a pedestrian-oriented street segment (a linkage) and an increase in employment and housing in downtown MSA's across the United States. While it was not my intent to parse out the quality of the pedestrian-oriented street segment, I was able to see if the presence or absence of pedestrian-oriented street segments has any correlation

on the growth of employment and housing in downtowns across the country.

Six Assessments of the Same Places: Comparing Views of Urban Design – Ann Forsyth, Justin Jacobson, Katie Thering, Journal of Urban Design, Vol. 15. No. 1, 21-48, February 2010

Ann Forsyth's study selected six urban design measurement tools and applied them to three different transit-oriented development station areas – 1.) Clarendon Station – Arlington, Virginia; 2.) Emerson Park - East St. Louis, Illinois; and 3.) Fruitvale Station - Oakland, California. The study provides how the three different areas measured up when evaluated using each of the six urban design measurement tools and notes each tool's strength and weaknesses.

The six tools applied to the three transit-oriented development areas included an urban design feature checklist score sheet, a comprehensive design feature inventory, participatory design workshops with both architects and designers and community-based leaders, a GIS map-based analysis that compared street patterns with business activity, and a visual contrast assessment of photographs that scored color, form, line, texture, scale, and special dominance.

The methods described above vary greatly in terms of the level of detail and complexity of the data gathered. There is also great variation in the level of assessment or evaluation of the data in that it can range from a simple observation of an urban design attribute to a rating or classification of an urban design attribute as being low or high quality. Finally, the time period in which some of the tools were applied to the three transit-oriented development station areas can affect both the data gathered as well as the level of assessment or evaluation in that, for example, a street located in a northern city that enjoys a lively sidewalk café scene in the summer would not have that same level of activity in the winter months due to colder, inclement weather.

The urban design score sheet tool assigned scores on five elements – image-ability, enclosure, human scale, transparency, and complexity. The score sheet measured ten street segments in each of the three station areas. When applied to the three different areas, the scores were very similar to one another across all three places. However, the scoring is refined enough to differentiate small differences. For example, Emerson Park, a newer, lower-density residential station area, scored lower than Clarendon Station, a more-established, higher-density, mixed-use station area, in the measurement of enclosure. The taller buildings and more established feel of Clarendon Station provides a greater sense of enclosure than the lower height buildings and newly planted street trees at Emerson Park.

The Irvine Minnesota Inventory is a 160-question audit that measures the presence of urban design, environmental features, and their attractiveness. The questions ask if a design element is present or absent and asks the rater to note the number present at that location. For the three station areas, the same ten street segments evaluated with the score sheet were also evaluated using the inventory. Like the score sheet, all three station areas had similar scores. The presence or absence of an urban design feature, however, does not provide an indication of the quality of that design feature. For example, Emerson Park, the lower-density residential station area scored highest of the three areas for architecture and attractiveness over Fruitvale and Clarendon Station which are equally attractive architecturally.

The participatory design workshops were held with two different groups, architect practitioners and community representatives, for each of the three station areas. Each design workshop consisted of 7-10 participants who were asked to answer seven questions about the station area. The design workshop for each station area for the two different groups was organized by the American Institute of Architects (AIA). The first group was comprised of professional architects and designers. The second design workshop consisted of non-architectural professionals such as community representatives, public officials, transit advocates, real estate agents and housing specialists.

Overall the participatory design workshops provided a focused and expanded amount of information about the three station areas. The architect's group tended to focus on specific building design as opposed to place; whereas, the community representatives group tended to focus on place with architectural uniqueness being less of a focus. A drawback to this type of assessment is the lack of random selection of the participants and the risk that the participants are prone to opinion versus objective assessment.

The fifth urban design measurement tool used GIS-based mapping to compare street patterns with business activity in each of the three station areas to capture economic activity. One square mile of each station area was analyzed. Within the square mile, the density of intersections and block sizes were calculated. This information was then compared with spatial information on the number of businesses within the square mile. The results of this analysis showed that the three station areas had very similar street patterns in terms of the number of intersections and block length but that they differed greatly in terms of economic activity. For example, Emerson Park, the lower-density residential station area, showed considerably lower business activity than Clarendon Station, the high-density mixed-use station area.

The final urban design measurement tool that Forsyth and her team investigated was the visual contrast assessment. The visual contrast assessment used photographs and asked a single rater to look at each of the three station areas for seven urban design components and rate each along a scale of a high level of variety to a high level of similarity. The seven urban design components were color, form, line, texture, scale, scale dominance, and spatial dominance. The rater had two photographs from each of the three station areas to review and assess. Of the three station areas, Fruitvale was scored as having the highest amount of visual variety while Emerson Park was found to have a lower level of visual variety or a high level of visual similarity. Clarendon Station had a high level of visual variety in one photo and a high level of visual similarity in a second photo. High levels of similarity for Clarendon Station in one geographic area were the result of a collection of older, historical buildings; high levels of similarity for the Emerson Park station area were the result of a geographic area that contained large house-style apartments similar in style and scale.

Overall, Forsyth found that while each measurement tool had their strengths and weaknesses, a combination of measurement tools would work well depending on the specific situation. For example, combining the score sheet with a mapping tool that measures business activity can provide a more complete measurement of the urban design character of the street. For a more residential station area like Emerson Park, a combination of the Irvine Minnesota inventory tool with a community-based design workshop tool can provide a clearer assessment of the area than a combination of other tools.

The Economic Benefits of Open Space, Recreation Facilities and Walkable Community Design, Active Living Research, Robert Wood Johnson Foundation, May 2010.

This article reviewed and summarized studies that focused on the economic value of open space and parks around development. Open space and parks are a component of urban design and contribute to the pedestrian realm. Being able to assign or measure the added economic value of open space and parks to adjacent properties supports the idea that increased investment in pedestrian-oriented realm can also add measurable economic value over time.

The researchers proposed five key findings. 1.) Well-maintained, safe open spaces such as parks and recreation areas can have a positive effect on nearby residential property values and can lead to proportionately higher property tax revenues for local governments. This would lend credence to an argument that public investment in parks or other types of amenities can result in a more robust tax base.

2.) The economic impact that parks and recreational areas have on residential home prices depends on how far the home is from the open space, the size of the open space, and the characteristics of the surrounding neighborhood. A review of the studies found that home prices were more expensive the closer their location to the park or open space. Furthermore, the size of the park also had an effect in that large parks close to many homes had a positive effect on home values.

3.) Open space in urban areas will increase the level of economic benefits to surrounding property owners more than open space in rural areas. Urban residents in dense neighborhoods located near downtowns placed substantial value on proximity to parks or open space; suburban and rural residents tended to not place as much value on parks and open space in that the presence of parks and open space in suburban and rural areas had less of an economic effect on home values.

4.) Open space, recreation areas, and compact developments may provide fiscal benefits to municipal governments in terms of lower infrastructure costs. This finding primarily relates to new developments in green field areas along the fringe of suburbia in that government must extend roads and sewers out to a new development. For the urban core, the infrastructure cost is the ongoing maintenance of the existing asset borne by existing urban residents which is distributed over a higher population.

5.) Compact, walkable developments can provide economic benefits to real estate developers through higher home sale prices, enhanced market-ability, and faster sales or leases than conventional development. This finding also primarily relates to new developments in green field areas along the suburban fringe as opposed to urban redevelopment.

Compact, walkable environments are part of a group of elements that positively affects real estate value. My research proposed to show that economic growth as measured by an increase in housing units and jobs in the central business district is positively affected by the presence and/or increase in pedestrian-oriented street segments over time.

Walkability: A Review of Existing Pedestrian Indices, Praveen K. Maghelal, Cara Jean Capp. URISA Journal, Vol. 23, No. 2, 2011

Maghelal and Capp reviewed twenty-five pedestrian indices in order to compile a comprehensive list of environmental measures that are associated with walking, categorized these measures into built environment constructs, and developed a normative framework for future study.

The review produced a list of eighty-five variables that were distilled and classified into four dimensions (design, density, diversity and quality) and ten built environment constructs (distance, sidewalk, road, intersection, vehicle, lateral separation, demographic, land use, and safety and comfort/convenience). The eighty-five variables were separated into three different classifications based on whether the variables could be measured - objective, subjective, and distinctive.

Of the objective, measurable variables, the design dimension consists of six constructs and focuses specifically on the attributes of a street corridor – the distance of the walking trip, the characteristics of the sidewalk, the roadway characteristics, intersection qualities, vehicles in terms of speed allowed on the roadway and location of vehicle lanes in proximity to pedestrians. The density dimension consists of the demographic construct - the number of people living, working or commuting along the pedestrian route. The diversity dimension consists of the land use construct and pertains to the mix of uses along the route, the compactness of building forms, parcel size, and the presence of multi-modal facilities. The quality dimension consists of the safety, comfort, and convenience construct. Safety and security include both personal safety as well as safety from traffic and lighting. Comfort and convenience include pedestrian amenities like pedestrian-scale lighting, planted boulevards, benches, buildings that are built up to the street, shade, and climate (Maghelal, Capp, pg. 9, 18-19).

This study compiled measurable variables across twenty-five different pedestrian indices and identifies intersection density along street segments as a design element that can be measured to gauge walkability. The NAVSTREETS data set that I used in this research is consistent with Maghelal and Capp's research and is available U.S.-wide through the U.S. Environmental Protection Agency's Smart Location Index. The three specific data elements from NAVSTREETS that I used in my research were: 1.) network density in terms of facility miles of pedestrian-oriented links per square mile; 2.) intersection density in terms of pedestrian-oriented intersections having three legs per square mile; and 3.) intersection density in terms of pedestrian-oriented intersections having four or more legs per square mile.

Design and Pedestrianism in a Smart Growth Development – Julie Brand Zook, Yi Lu, Karen Glanz, and Craig Zimring, Environment and Behavior, 2014 44:216 DOI: 10.1177/0013916511402060

This study looked at how site and building design might affect pedestrian access into and through a site. Zook, et al. took pedestrian counts at five locations in and around a new, 138-acre smart growth development in Atlanta, Georgia called Atlantic Station. The Atlantic Station mixed-use development occurred on the site of a former large brownfields site and included large-scale retail, neighborhood-serving retail, and office uses atop a 7,000-space parking ramp. Medium-density multifamily housing was developed on the western portion of the site as well with a man-made lake separating residential uses from the commercial and office uses.

The study focused on the pedestrian behavior of employees working in the development and collected two types of data – pedestrian distribution within the mixed-use development and pedestrian movement between the primary retail area and the surrounding areas, both inside the development and from the greater neighborhood. Pedestrian counts were taken at five ‘gates’ which were along roads with continuous sidewalks of varying physical conditions. Each gate was observed for thirty minutes for eighteen sessions and was divided between morning and afternoon sessions, weekdays only. Behavior mapping was used to establish a one-mile route through the primary mixed-use area. The route was walked twice for each of the eighteen sessions by a researcher who would note the pedestrian density of each route segment.

The results showed that few pedestrians accessed the Atlantic Station mixed-use area by foot. Rather the pattern of use was more like that of a traditional, enclosed shopping mall with most users arriving by car, walking around to different retail shops within the development, and then departing the development by car.

This research is important in the context of the downtown core street system in that it informs us that it is important to have pleasant, walkable areas within a downtown but that it is equally important to have pleasant, walkable connections between those areas of interest. A pedestrian in a downtown urban core environment should experience a street system that makes it easy and enjoyable to walk from one area to the next. In contrast, a downtown urban core with blank segments of street connections between areas of interest make the pedestrian journey between those points seem longer and, in some cases, encourages people to drive rather than walk. A good, local anecdotal example of this phenomenon at work is downtown Saint Paul, Minnesota. Saint Paul's downtown is a compact urban core and yet there are many downtown workers and residents who will drive from one side of it to the other because the blank, windowless building walls, and vacant lots at the street level reinforce the perception that the trip is too long in terms of distance to walk.

Hajrasouliha, A., & Yin, L. (2015). The impact of street network connectivity on pedestrian volume. *Urban Studies (Sage Publications, Ltd.), 52*(13), 2483-2497. doi:10.1177/0042098014544763

Hajrasouliha and Yin looked at how street network connectivity impacts pedestrian volume in Buffalo, New York by using a combination of metric-based and geometric-based measurements to gauge both physical and visual connectivity. A street can be physically well-connected because it is free from barriers such as fences or walls; whereas, visually well-connected means that the street can be easily seen from a variety of different points and makes the pedestrian feel more comfortable (Hajrasouliha, Yin, pg. 2486).

Intersection density was the metric used to measure physical connectivity. Visual connectivity was measured using two space syntax elements: integration and choice. Integration is how close each segment is to all others under each definition of distance; choice is how many distance-minimizing paths there are between every pair of street segments. In simpler terms, a destination that is two blocks away from a pedestrian but is within that person's clear viewshed is deemed to be geometrically closer than a secondary destination that is one block away from a pedestrian but is located around the corner and outside of the person's line of sight (Hajrasouliha, Yin, pg. 2485-2486).

Job density, population density, and land use mix were used as mediator variables between physical and visual connectivity and pedestrian volume. Researchers found that job density contributed to higher pedestrian volumes when there was greater physical connectivity (intersection density) and visual connectivity (integration and choice) while residential density was shown to be adversely impacted by physical and visual connectivity. Physical and visual connectivity was shown to have a positive effect on pedestrian volumes when applied to land use mix (Hajrasouliha, Yin, pg. 2492-2493).

Sung, H., Lee, S., & Cheon, S. (2015). Operationalizing Jane Jacobs's urban design theory: Empirical verification from the great city of Seoul, Korea. *Journal of Planning Education and Research, 35*(2), 117-130. doi:10.1177/0739456X14568021

Sung, Lee, and Cheon's research took some of the key urban design concepts espoused by Jane Jacobs in *The Death and Life of Great American Cities* and operationalized them to see if they could be tested and verified as to encouraging walking over driving using Seoul, Korea as the testing area. The pieces of Jacob's theory that the researchers wanted to operationalize were as follows:

- Streets should contain a mix of land uses that allowed for pedestrian activity at all times of the day.
- City blocks needed to be short in distance in order to create smaller-scale developments which encourage pedestrianism.
- Diversity of building ages and form along a block was necessary to create visual variety as well as contribute to the land use mix.

- There needs to be a concentration of buildings within an area in order to attract people (high-density housing, as well as commercial and offices).

Sung's research looks at the choice between driving and walking with the hypothesis that walking is directly influenced by the built environment. One of the urban design features thought to promote pedestrian activity is small block length because it creates more opportunities for pedestrian linkages. Small block size was one of the five urban design features that was operationalized using street intersection density, ratio of four-way intersections, and the average distance of buildings to the nearest intersection. These variables were then tested at five set time periods within a twenty-four-hour period. Sung's research results for block size showed a correlation between intersection density and increased walking behavior. Smaller blocks encouraged more walking than longer blocks, especially when there was a greater mix of land use diversity present along the block.

My research focused geographically on downtown MSA census tracts. Downtown areas typically have a high density of people and uses along with grid patterns that result in smaller blocks. While Sung's research focused on whether urban design features affected or influenced walking, my research tested to see if there was a correlation between whether having pedestrian-oriented linkages has an impact on attracting investment through an increase in housing units and jobs across a large, diverse dataset.

Ewing, R., Hajrasouliha, A., Neckerman, K. M., Purciel-Hill, M., & Greene, W. (2016). Streetscape features related to pedestrian activity. *Journal of Planning Education and Research, 36*(1), 5.

Ewing's focus in this study was to test multiple streetscape features to see if any had a significant effect on pedestrian volumes. This research builds on his work from 2013 in which he operationalized and measured multiple urban design qualities (complexity, transparency, image-ability) across a 588-block data set in New York City. Ewing uses the same 588-block data set but this time measures urban design concepts as applied streetscape features such as presence and amount of street furniture, presence and number of sidewalk cafes, presence and number of buildings with windows, number and presence of active land uses, etc. The study sought to see if specific streetscape features affect pedestrian counts.

Ewing used a set of variables – development density, land use diversity, street network design, destination accessibility, distance to transit and household size along with some specific streetscape features to see if they affected pedestrian counts. The results showed that specific streetscape features such as proportion of windows on a building, the presence and number of active land uses along the street, and the number of pieces of street furniture do influence pedestrian activity. While street network design, most notably intersection density, does affect whether a person chooses to walk as a mode of transportation in the form of walking trips, this variable was not found to directly affect pedestrian counts.

My research looked at the pedestrian-oriented street segment variable from a different perspective to see if the presence and number of pedestrian-oriented street segments and intersection density within a downtown has any correlation with economic growth. Many factors affect economic growth and there are many types of urban design features present in a downtown and no one variable determines success. However, isolating three pedestrian-oriented street design features and testing them for correlation across 383 MSA's could lead to testing the effect of other features against this large, consistent data set for the future.

Summary and Critical Analysis – Discrete Measurement

The planning and urban design profession has experienced an evolution over time in that it has had to start providing more and more pieces of concrete data to support its claims and theories. There has been increased attention on the concept that urban design and connectivity plays a role in public health and increased activity levels, improved overall public safety due to more eyes and ears on the street, and greater community vibrancy through more activity. Making the statement that more people feel more comfortable walking along a crowded, mixed-use street than an empty street in an industrial park makes sense anecdotally, especially among planners; however, the general public and policy makers generally want to be shown the hard data to support that claim as a justification for spending resources on public realm investment. It would be easy if all places contained streets that exhibited the exact same type, amount, and combination of urban design attributes to be measured but that is not the case. Measuring the combination of urban design elements that comprise a street is not easy but not impossible (Saelens, Sallis, Frank, pg. 88-89).

Measurement of urban design attributes is not an easy task, so the planning profession for years often categorized urban design as being too subjective to be measured and, therefore, left it up to the eye of the beholder. The literature shows that fact with only a handful of articles focusing on the topic into the 1980's. An early article from 1982 sought to measure the architectural quality of a Federal building in Ann Arbor, Michigan through both occupants' and visitors' eyes. The verbal survey showed that occupants viewed design attributes differently than visitors in that occupants positively viewed design elements according to their function and that visitors viewed design elements more for aesthetics.

It was not until the rise of New Urbanism theory and the start of Smart Growth development in the 1990's that urban design measurement started to get more attention. After decades of growth in suburbia and development centered around the car, New Urbanism pushed development of the mixed-use, traditional building form and site design to create more 'place' out of the often generic, non-descript suburban environment. The planning practitioners of the New Urbanism movement quickly realized that they would have to start collecting data to support their theory that New Urbanism's traditional building and site design with a mix of uses was a better alternative to typical suburban-style development in encouraging walking and use of transit. Figuring out which pieces to measure, how to measure consistently, and against what other variables continue to be hurdles in measuring the impact New Urbanist development projects have on communities.

So far, it has been difficult to measure New Urbanism against traditional urban neighborhoods because they are apples and oranges in that they exist in different physical contexts (urban vs. suburban). Also, measuring New Urbanist developments against the existing suburban environment is tough because New Urbanist development projects tend to be stand-alone places within the typical, sprawling suburban environment. It is not clear if the New Urbanist development movement has enough critical mass at this point in terms of number of completed development projects to influence increasing walking and transit use and decreasing reliance on automobiles.

Developing a common nomenclature around urban design features in terms of definitions, a way to operationalize urban design features into variables, and a consistent manner of measurement were all identified as areas that needed improvement. References to Kevin Lynch's earlier work in describing and defining urban design features – enclosure, image-ability, complexity, edges, linkages, land use intensity, and land use pattern – start to be discussed in the literature in terms of how to operationalize these urban design features into discrete units of measurement.

Some of the most extensive urban design measurement tools yield valuable, detailed information on multiple urban design features but can only be practically-applied on a place-by-place basis because of the time involved in collecting and in analyzing the data. A good example of this is Ann Forsyth's work in applying six different urban design measurement tools to three different transit station areas in three different parts of the country. The six design measurement tools consisted of 1.) an urban design checklist scoresheet, 2.) an urban design feature inventory, 3 participatory workshops with architects and planning professionals, and 4.) participatory workshops with community-based leaders and lay people, 5.) GIS-map analysis of street patterns with business activity, and 6.) a visual contrast assessment. Except for the GIS-map-based analysis of business activity, all the applied urban design measurement tools required extensive field data collection and the participation of review panels to assess and rank the data. These tools can be used to provide great in-depth information and measure multiple urban design elements within specific places but are difficult to use consistently over a very large set of data.

Reid Ewing has contributed the largest body of work around translating urban design features into metrics for the measurement of subjective perceptual design qualities of the walking environment. Ewing extensively reviewed fifty-one urban design features and pared those down to nine – 1.) image-ability, 2.) enclosure, 3.) human scale, 4.) transparency, 5.) complexity, 6.) coherence, 7.) linkage, 8.) legibility, and 9.) tidiness. Of those nine urban design features, Ewing determined that only five of those features could be successfully operationalized (1. Image-ability, 2. Enclosure, 3. Human scale, 4. Transparency, and 5. Complexity).

The design feature of Linkage did not make Ewing's final cut in his research work because the statistical analysis indicated a lack of clarity in terms of its influence and there were other urban design features that had a stronger correlation. Ewing's model to represent linkage consisted of 1.) street connections to elsewhere, 2.) visible doors, 3.) proportion of recessed doors, 4.) common building heights, and 5.) outdoor dining. However, I still think that linkage in the form of the pedestrian-oriented street plays a role in investment and economic growth in urban downtowns.

In my review of the literature, all the research studies tested operationalized urban design variables using place-based, case studies. In other words, urban design features were analyzed for their ability to be converted into operationalized variables that could then be tested. Once those variables were identified, they were applied to a place or small group of places for testing. My research proposed to isolate three variables – the number of pedestrian-oriented street segments per square mile, the number of three-legged intersections per square mile, and the number of four-legged intersections per square mile – to see if the presence of these variables had any correlation with increases in housing units and jobs in all 383 downtown MSA's across the United States. I wanted to use this large, established data set because I suspected that the research could show that there is a smaller subset of MSA's for which pedestrian-oriented street segments had a positive effect on numbers of housing units and numbers of jobs in downtowns. If that is true, I want to be able to figure out if there are discrete commonalities between the MSA's that may explain why.

Ewing has already determined that linkage is a difficult urban design element to be operationalized for testing, but I was hopeful that I could see a pattern emerge amongst MSA's that have had an increase in the number of pedestrian-oriented street segments over time. There was the distinct possibility that I would find that the presence of pedestrian-oriented street segments in downtown MSA's were not significant as to an increase in housing units and number of jobs but I could find that it is a distinct combination of variables (pedestrian-oriented street segments per square mile, three-legged intersections per square mile, four-legged intersections per square mile and other variables) that may turn out to be significant in having an impact on housing and jobs.

2.2. Contribution to Theory

There are many variables that comprise urban design and past research has focused on identifying which variables influence defining the image of a particular place, albeit positively or negatively. My contribution to theory is to take a single element of urban design such as pedestrian-scale road segments as defined by NAVSTREETS data as part of the U.S. Environmental Protection Agency's Smart Location Database and apply it to a large, set sample of U.S. downtown census tracts for the 383 Municipal Statistical Areas (MSA's) and test whether there is a correlation between the increase in the number of pedestrian-scale road segments and economic growth as defined by an increase in employment and housing units.

If this research finds that there is a positive correlation between an increase in pedestrian street segments in the urban core and an increase in economic growth in that urban core over time, it will provide a quantifiable, measurable basis from which to gauge the economic value of public realm investment across a large, nation-wide data set.

It will begin to create a consistent large dataset across all regions that should make it easier for public officials to make an argument for increasing pedestrian amenities in an urban downtown because it will demonstrate that those public funding investments generate measurable economic value over time. If there is a positive correlation between an increase in the number of pedestrian-scale road segments and an increase in economic growth in a city's downtown as a result of that public realm investment, it will prove that there is a sound basis to the argument that smart public investment in pedestrian-scale public realm translates into a tangible increase in tax base.

2.3 Research Questions

Question 1: Is there a correlation between pedestrian-oriented urban design in the form of pedestrian-oriented street segments and an MSA's (Municipal Statistical Area) downtown economic growth in terms of employment?

Question 2: Is there a correlation between pedestrian-oriented urban design in the form of pedestrian-oriented street segments and an MSA's (Municipal Statistical Area) downtown economic growth in terms of number housing units?

2.4. Definition of Terms

1. Pedestrian-Oriented Design

Land use activities that are designed and arranged in a way that emphasizes travel on foot rather than by car. Elements include compact, mixed-use development patterns with facilities and design that enhance the environment for pedestrians in terms of safety, walking distances, comfort, and the visual appeal of the surroundings. Pedestrian-friendly environments can be created by locating buildings close to the sidewalk, by lining the street with trees, and by buffering the sidewalk with planting strips or parked cars, small shops, street-level lighting and signs, and public art or displays (http://www.qaca.org/planning_101/planning_jargon.html).

2. Pedestrian-Oriented Street Segment Design Variables – NAVSTREETS Through the Smart Location Database

The D3 variables measure urban design in terms of street network density and street intersection density by facility orientation (automobile, multimodal, or pedestrian).

- D3APO - Network density in terms of facility miles of pedestrian-oriented links per square mile.

- D3BPO3 - Intersection density in terms of pedestrian-oriented intersections having three legs per square mile.
- D3BPO4 - Intersection density in terms of pedestrian-oriented intersections having four or more legs per square mile (https://edg.epa.gov/metadata/catalog/search/resource/details.page?uuid=%7BBCE98875-BED3-4911-8BEA-32220B3E15E7%7D).

Pedestrian-oriented facilities are characterized as:

- Any arterial or local street having a speed category of 6 (between 21 and 30 mph) where car travel is permitted in both directions.
- Any arterial or local street having a speed category of 7 or higher (less than 21 mph).
- Any local street having a speed category of 6 (between 21 and 30 mph).
- Any pathway or trail on which automobile travel is not permitted (speed category 8).
- For all the above, pedestrians must be permitted on the link.
- For all of the above, controlled access highways, tollways, highway ramps, ferries, parking lot roads, tunnels, and facilities having four or more lanes of travel in a single direction (implied eight lanes bi-directional) are excluded (https://edg.epa.gov/data/Public/OP/SLD/SLD_userguide.pdf).

3. **Auto-Oriented Design**

Land use activities that are sited, designed and arranged in a way that emphasizes car travel to and from the site.

4. Transit-Oriented Design

Land uses that are sited, designed and combined adjacent to or in close proximity to transit stations to maximize use of transit, particularly rail ridership (http://www.qaca.org/planning_101/planning_jargon.html).

5. New Urbanism

The process of giving form, shape and character to the arrangement of buildings to whole neighborhoods, or the city with an emphasis on compact, mixed-use development with good pedestrian and public transportation access. Urban design blends architecture, landscaping and city planning concepts together to make an urban area accessible, attractive and functional (http://www.qaca.org/planning_101/planning_jargon.html).

6. Downtown

A central area of a city or town that contains the central business district (Sohmer, Lang, pg. 2).

7. Smart Location Database

A nationwide geographic database compiled by the U.S. Environmental Protection Agency (EPA) that measures location efficiency and the built environment with ninety different attributes summarizing characteristics such as housing density, diversity of land use, neighborhood design, destination accessibility, transit service, employment and demographics. The Smart Location Database summarizes this data for every U.S. Census tract in the United States.

(https://www.epa.gov/sites/production/files/2014-03/documents/sld_userguide.pdf).

8. U.S. Census Data

Core Based Statistical Areas (CBSAs) consist of the county or counties or equivalent entities associated with at least one core (urbanized area or urban cluster) of at least 10,000 in population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties with the counties associated with the core. The general concept of a CBSA is that of a core area containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration with that core. The term "core based statistical area" became effective in 2003 and refers collectively to metropolitan statistical areas and micropolitan statistical areas. The U.S. Office of Management and Budget (OMB) defines CBSAs to provide a nationally consistent set of geographic entities for the United States and Puerto Rico for use in tabulating and presenting statistical data. Current CBSAs are based on application of the 2000 standards (published in the Federal Register of December 27, 2000) with Census 2000 data. The first set of areas defined based on the 2000 standards were announced on June 6, 2003; subsequent updates have been made to the universe of CBSAs and related statistical areas. No CBSAs are defined in the Island Areas. Statistical areas related to CBSAs include metropolitan divisions, combined statistical areas (CSAs), New England city and town areas (NECTAs), NECTA divisions, and combined NECTAs (https://www.census.gov/topics/housing/housing-patterns/about/core-based-statistical-areas.html).

Metropolitan Statistical Areas (MSA's) are CBSAs associated with at least one urbanized area that has a population of at least 50,000. The metropolitan statistical area comprises the central county or counties or equivalent entities containing the core, plus adjacent outlying counties having a high degree of social and economic integration with the central county or counties as measured through commuting (https://www.census.gov/programs-surveys/metro-micro/about.html).

Housing Unit is defined as a house, an apartment, a mobile home or trailer, a group of rooms, or a single room that is occupied, or, if vacant, is intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants live separately from any other persons in the building and which have direct access from the outside of the building or through a common hall (https://www.census.gov/housing/hvs/definitions.pdf).

Employment for this research is defined as number of firms or establishments or jobs located within a MSA's core business district.

Firm is defined as a business organization consisting of one or more domestic establishments in the same state and industry that were specified under common ownership or control. The firm and the establishment are the same for single-establishment firms. For each multi-establishment firm, establishments in the same industry within a state will be counted as one firm- the firm employment and annual payroll are summed from the associated establishments.

Establishment is defined as a single physical location where business is conducted or where services or industrial operations are performed. https://www.census.gov/ces/dataproducts/bds/definitions.html

Job is defined in On The Map, a job is counted if a worker is employed with positive earnings during the reference quarter as well as in the quarter prior to the reference quarter. This is called a "beginning of quarter" job because the assumption is that the worker was employed on the first day of the reference quarter. https://lehd.ces.census.gov/doc/help/onthemap/OnTheMapDataOverview.pdf

3.0. Methodology Approach and Rationale

3.1. General Methodology

Quantitative

The study proposes to analyze and compare U.S. Census housing and economic growth data for all 383 MSA's downtown census tracts with the U.S. Environmental Protection Agency (EPA)'s Smart Location database information on miles of pedestrian – oriented links per square mile, three-legged intersection density per square mile and four-legged intersection density per square mile.

3.2. Hypotheses

- An increase in the number of pedestrian-oriented street segments in a downtown positively affects the growth in housing units in that downtown.
- An increase in the number of pedestrian-oriented street segments in a downtown positively affects the growth in employment (number of firms and establishments) in that downtown.

Null Hypotheses

- An increase in the number of pedestrian-oriented street links in a downtown does not affect the growth in housing units in that downtown.
- An increase in the number of pedestrian-oriented street links in a downtown does not affect the growth in employment (number of firms and establishments) in that downtown.

3.3. Identify the Variables (Quantitative) or the Concepts (Qualitative)

The variables to be tested would include the following:

- Variable 1, dependent – economic growth as demonstrated by employment (number of firms and establishments or jobs) in downtown MSA census tracts.
- Variable 2, dependent – economic growth as demonstrated by number of housing units in downtown MSA census tracts.
- Variable 3, independent – smart location index score for urban design pedestrian-oriented street segments. Network density in terms of pedestrian-oriented links per square mile (D3apo).
- Variable 4, independent – smart location index score for urban design pedestrian-oriented street segments. Intersection density in terms of pedestrian-oriented intersections having three legs per square mile (D3bpo3).
- Variable 5, independent – smart location index score for urban design pedestrian-oriented street segments. Intersection density in terms of pedestrian-oriented intersections having four legs per square mile (D3bpo4).

3.4. Assumptions

- This research assumes that the data from the U.S. Census and the Environmental Protection Agency's Smart Location Index is accurate.
- Another assumption of this research is that the U.S. Census data for housing units and employment are good measures of economic growth and vitality.

3.5. Limitations

- A limitation to this research is the Smart Location index measure itself in accurately identifying the square miles of pedestrian-oriented street segments, three-legged intersections and four-legged intersections by individual Census tract.
- This research is limited in that it only focuses on the presence or absence of pedestrian-oriented street segments or three-legged and four-legged intersections in a downtown. The research does not attempt to measure the quality of pedestrian-oriented street segments or three-legged and four-legged intersections when identified in a downtown census tract.
- Consistency in the GEOID identifier in US Census data is a limitation in that extra digits may be at the beginning or ending of the numerical string or various data tables over different years. This makes it difficult to easily link large data tables and extract information without a lot of initial cleanup of the data table.

3.6. Measures/Instruments

ArcGIS was the instrument used to capture the geographic boundary data for each state and each state's MSA's; ArcGIS was also used to create the downtown geography for each MSA. Access and Excel were the instruments used for extracting, manipulating, and linking the downtown census tract data. SPSS was used as the instrument for analyzing the data.

3.7. Population and Sampling Plan

The population for this research study is represented by the 383 Metropolitan Statistical Areas (MSA's) in the United States. This sample will come from 2010 (housing and jobs) and 2014 (housing) and 2015 (jobs) U.S. Census data.

3.8. Sample Size

The size of the sample will be the downtown U.S. Census tracts for the identified 383 Metropolitan Statistical Areas (MSA's) in the United States.

3.9. Expected Site

Not applicable.

3.10. Site Permission

Not applicable.

3.11. Participant Contact and Ethical Considerations

Not applicable.

3.12. Data Collection/Project Design

Quantitative

The quantitative data has already been collected by the U.S. Census for years 2010, 2014, and 2015. The number of housing units and number of jobs are collected by the U.S. Census for all 383 MSA's. The identification of pedestrian-oriented street segments, three-legged intersections, and four-legged intersections has been collected by NAVSTREETS through the U.S. Environmental Protection Agency and is combined with 2010 U.S. Census data.

For the 383 MSA's, I used ArcGIS to select out all downtown census tracts from the larger data set. Access and Excel were used to join the different sets of data together and then query the data so that the downtown MSA census tracts.

3.13. Proposed Method for Data Analysis

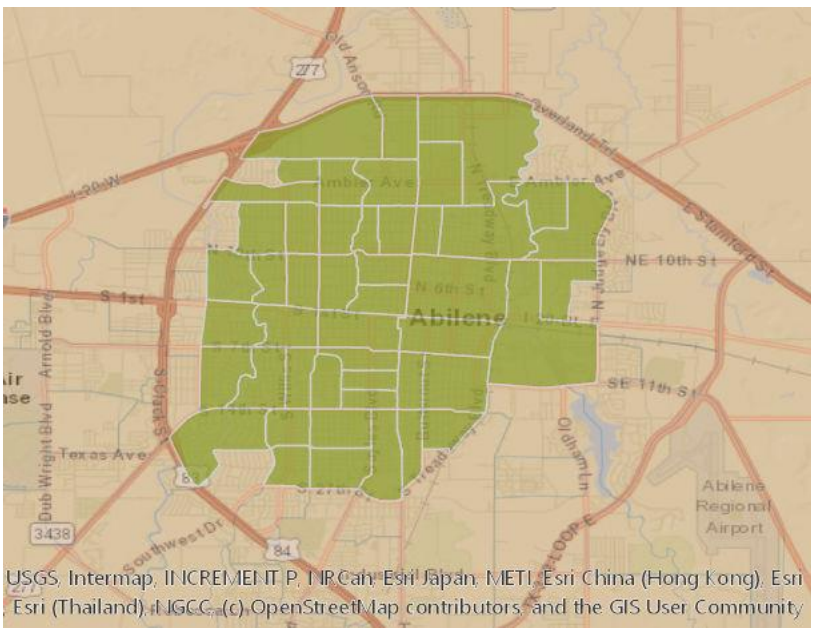
The method of data analysis for this research project will be quantitative and mathematical. First and foremost, I will use ArcGIS to select downtown census tracts for each MSA. Each MSA and its corresponding downtown census tracts will be listed in an Excel spreadsheet in alphabetical order along with U.S. Census data on housing units and employment for the years 2010, 2014, and 2015. Through the Smart Location Database, pedestrian-oriented street segment data for 2010 for each MSA will be joined to the table using Access. A correlation calculation will be completed for both housing units and employment against the pedestrian-oriented street segment data for each MSA's downtown census tracts to see if there is a positive or negative correlation and the degree to which it is strong or weak. If a subset of MSA's show a correlation, I would then investigate to see whether there are other common factors or features that the group shares in addition to pedestrian-oriented street segments that could result in significant correlation.

4.0. Research Findings

4.1. Preparing the Data

Preparing the data took immense time. The Smart Location Database includes pedestrian segment data for all census tracts for the entire United States but only includes 2010 census data. As a result, the Smart Location Database needed to be pared down to include only downtown census tracts for the 383 MSA’s. In order to isolate the geography for downtown census tracts for each MSA, each MSA’s downtown geography had to be manually selected and a downtown shapefile map create for each MSA. To get to this level of detail, census tract geography for each state had to be downloaded individually for each state at a CBSA level and then added to ArcGIS as one complete U.S. map of MSA’s. Each MSA’s downtown census tract geography was created individually by pulling it out of the larger MSA census tract map.

Figure 1. Abilene, Texas MSA with Downtown Census Tract Geography



Once the individual downtown MSA geography was created and identified by census tract, it was important to take the original Smart Location Database and refine it so that it only included MSA downtown census tracts. Exported downtown attribute tables by census tract by MSA by state from ArcGIS to D-base format to a DT Attributes folder and then I used file explorer to convert the D-base files to Excel. From there, each

MSA's downtown census tract file was imported into an Access database called SLD Downtowns Database.

The Smart Location Database was also imported into the SLD Downtowns Database. From there, each state's MSA downtown census tracts were queried against the Smart Location Database in order to get a complete set of downtown MSA census tracts that matched up with the pared down Smart Location Database tract data.

Housing

The SLD Downtowns database still needed to have 2014 housing tract data added to it. Downloaded 2014 census tract data for housing units and jobs and then matched those tracts to the refined downtown SLDB tracts. I used the 2016 planning database through the U.S. Census to download the data. The time period for the housing information from that database was 2014 data. From there, I was able to link the 2014 tract data spreadsheet to the SLD Downtowns access database in order to begin the process of paring down this data set. Differences in the number of digits for the identifying tract number between the SLD data and the 2014 housing data required a series of queries to get the tracts to match up correctly.

Jobs

A source for tract level data for employment was found under the On The Map application at onthemap.ces.census.gov using the LED extraction tool. All downtown shape files were exported by state to an external drive so that I could then import them into the On The Map application on the Census website to pull jobs data for those census tracts. After the On The Map analysis was completed, the jobs shape files representing that analysis were exported out after analysis. Even though the jobs data is based on individual census tract, the On The Map tool aggregates the jobs data is aggregated into one number instead of individually by tract. This required more data manipulation in order to get to the individual tract data behind the aggregate number. Using the map attribute files, the individual tract data was pulled out by MSA and then compiled into a 2010 jobs table and a 2015 jobs table. Those tables were then queried against the Smart Location database to create a data set that links the census tract identification number for 2010 jobs and 2015 jobs to the census tract specific pedestrian data.

Figure 2. Abilene, Texas MSA with Downtown Census Tract Geography Using On The Map Tool to Show Job Density

In some cases, there were issues with pulling out jobs data for the imported downtown census shape files into the On The Map tool. In all cases, this was due to too much data; all worked with smaller shapes but those MSA's with that issue are noted in Table 2 in the appendix. In Wyoming and Massachusetts, 2015 jobs data was not available, so they are not included in the jobs correlation analysis.

4.2. Analyzing the Data

Once the census tract data was compiled and matched to the pedestrian street segment data, the data was then imported into SPSS for analysis. Correlation analysis tested the change in housing units from 2010 to 2014 and the number of jobs in 2010 and 2015 against the three independent variables – pedestrian links per square mile, three-legged intersection density, and four-legged intersection density. For each results table, positive correlation is highlighted in green and negative correlation is noted in pink.

For the housing data, there was an adverse correlation in change in housing units for two of the three variables but a positive correlation for a third variable as shown in Table 1. Two variables – pedestrian links per square mile and four-legged intersection density – showed slightly negative correlation in the change in housing units over time. However, the variable of three-legged intersection density showed a positive correlation in the change in housing units over time.

Table 1 - Correlations – 2010 and 2014 Housing Units – All 383 MSA's

		Dependent Variable Y1 - 2010 Total Housing Units	Dependent Variable Y2 - 2014 Total Housing Units
Dependent Variable Y1 - 2010 Total Housing Units	Pearson Correlation	1	.994**
	Sig. (2-tailed)		.000
	N	16797	16797
Dependent Variable Y2 - 2014 Total Housing Units	Pearson Correlation	.994**	1
	Sig. (2-tailed)	.000	
	N	16797	16797
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.041**	-.047**
	Sig. (2-tailed)	.000	.000
	N	16797	16797
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.079**	.078**
	Sig. (2-tailed)	.000	.000
	N	16797	16797
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	-.064**	-.066**
	Sig. (2-tailed)	.000	.000
	N	16797	16797

MSA’s range in size from small cities like Manhattan, Kansas (70,000) to very large metropolitan areas like New York City (10,000,000). Furthermore, the size of a small MSA’s downtown area would be considerably smaller in that the downtown may only consist of a few census tracts; whereas, a large MSA’s downtown area could consist of hundreds of census tracts. Given this wide variation in scale, it was important to see if the larger MSA’s downtown census tracts were skewing the correlation results.

The same analysis was conducted without the ten largest MSA’s to see if eliminating them affected the correlation results. MSA’s eliminated from the data were: New York City, Los Angeles, Chicago, Houston, Phoenix, Philadelphia, San Antonio, San Diego, Dallas, and San Jose. Correlation results for this revised set of MSA’s against the three independent variables – pedestrian links per square mile, three-legged intersection density, and four-legged intersection density – were very similar to the results for the full 383 MSA data set. Table 2 shows that there was an adverse correlation in change in housing units for two of the variables – pedestrian links per square mile and four-legged intersection density but a positive correlation for the third variable – three-legged intersection density.

Table 2 - Correlations – 2010 and 2014 Housing Units Without 10 Largest MSA's

		Dependent Variable Y1 - 2010 Total Housing Units	Dependent Variable Y2 - 2014 Total Housing Units
Dependent Variable Y1 - 2010 Total Housing Units	Pearson Correlation	1	.994**
	Sig. (2-tailed)		.000
	N	14273	14273
Dependent Variable Y2 - 2014 Total Housing Units	Pearson Correlation	.994**	1
	Sig. (2-tailed)	.000	
	N	14273	14273
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.065**	-.069**
	Sig. (2-tailed)	.000	.000
	N	14273	14273
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.042**	.041**
	Sig. (2-tailed)	.000	.000
	N	14273	14273
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	-.092**	-.094**
	Sig. (2-tailed)	.000	.000
	N	14273	14273

Analysis was also conducted for the three independent variables against the individual sets of data – 2010 housing units as shown in Table 3 and 2014 housing units as shown in Table 4 - and the correlation results were very similar to the correlation results for the time series. The variables of pedestrian links per square mile and 4-legged intersection density showed slightly adverse correlation to the number of housing units while the variable of 3-legged intersection density showed a positive correlation to the number of housing units.

Table 3 - Correlations – 2010 Housing Units – All 383 MSA's

		Dependent Variable Y1 - 2010 Total Housing Units
Dependent Variable Y1 - 2010 Total Housing Units	Pearson Correlation	1
	Sig. (2-tailed)	
	N	16858
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.054**
	Sig. (2-tailed)	.000
	N	16858
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.065**
	Sig. (2-tailed)	.000
	N	16858
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	-.082**
	Sig. (2-tailed)	.000
	N	16858

Table 4 - Correlations – 2014 Housing Units – All 383 MSA's

		Dependent Variable Y2 – 2014 Total Housing Units
Dependent Variable Y2 – 2014 Total Housing Units	Pearson Correlation	1
	Sig. (2-tailed)	
	N	16649
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.048
	Sig. (2-tailed)	.000
	N	16649
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.078
	Sig. (2-tailed)	.000
	N	16649
Independent Variable – X3 4-Legged Intersection Density	Pearson Correlation	-.066
	Sig. (2-tailed)	.000
	N	16649

Unlike the housing data, the job data analysis showed slightly different correlation results, but this could be due to the inability to run a time-series correlation analysis. The job data was extracted from the On The Map census application at a block group level which made it difficult to cleanly link up to the tract data in the Smart Location Database. 2015 jobs data was not available through the On The Map census application for any MSA's in the states of Wyoming and Massachusetts so the total number of MSA's for jobs is 376 and not 383.

Furthermore, the number of data records for an MSA varied between the 2010 set of data to the 2015 data even though it was pulled out of the On The Map census application using the exact same geographic shape file, containing the same census tract and block groups. For example, the Portland, Oregon downtown MSA data for 2010 consisted of 925 records while the 2015 data consisted of only 832 records. Given the extremely large amounts of job tract data and the difficulty in joining 2010 and 2015 jobs data to the Smart Location Database in a manner that was accurate, correlation analysis was not conducted over the time series for 2010 and 2015 but was conducted individually by each year's data set.

For the 2010 jobs data across all 376 MSA's, analysis showed that all three independent variables resulted in a positive correlation to the number of jobs with the variables of 3-legged intersection density and 4-legged intersection density having the most statistical significance. The pedestrian links per square mile variable showed a very slight positive correlation as shown in Table 5. Analysis for the 2015 jobs data across all 376 MSA's resulted in positive correlation for two variables – intersection density 3-legged and intersection density 4-legged but an adverse correlation for the pedestrian links per square mile variable as shown in Table 6.

Table 5 - Correlations – 2010 Jobs – All 376 MSA's

		Dependent Variable Y1 – 2010 Jobs
Dependent Variable Y1 – 2010 Jobs	Pearson Correlation	1
	Sig. (2-tailed)	
	N	132191
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	.008**
	Sig. (2-tailed)	.003
	N	132191
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.069**
	Sig. (2-tailed)	.000
	N	132191
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	.052**
	Sig. (2-tailed)	.000
	N	132191

Table 6 - Correlations – 2015 Jobs – All 376 MSA's

		Dependent Variable Y2 – 2015 Jobs
Dependent Variable Y2 – 2015 Jobs	Pearson Correlation	1
	Sig. (2-tailed)	
	N	151173
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.004
	Sig. (2-tailed)	.086
	N	151173
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.085**
	Sig. (2-tailed)	.000
	N	151173
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	.055**
	Sig. (2-tailed)	.000
	N	151173

As with the housing data, analysis was conducted that eliminated the 10 largest MSA's from the jobs data set to see if the larger MSA's skewed the data. The results for the data set with the 10 largest MSA's removed were similar to the analysis for the full

376 MSA's with the 2010 jobs data resulting in positive correlations across all three variables as shown in Table 7 while the 2015 jobs data showed an adverse correlation for the pedestrian links per square mile variable but positive correlations for the 3-legged and 4-legged intersection density variables as shown in Table 8.

Table 7 - Correlations – 2010 Jobs Without 10 Largest MSA's

		Dependent Variable Y1 - 2010_Jobs
Dependent Variable Y1 – 2010 Jobs	Pearson Correlation	1
	Sig. (2-tailed)	
	N	120197
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	.005
	Sig. (2-tailed)	.093
	N	120197
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.060**
	Sig. (2-tailed)	.000
	N	120197
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	.046**
	Sig. (2-tailed)	.000
	N	120197

Table 8 - Correlations – 2015 Jobs Without 10 Largest MSA's

		Dependent Variable Y2 – 2015 Jobs
Dependent Variable Y2 – 2015 Jobs	Pearson Correlation	1
	Sig. (2-tailed)	
	N	137758
Independent Variable X1 – Pedestrian Links Per Square Mile	Pearson Correlation	-.008**
	Sig. (2-tailed)	.004
	N	137758
Independent Variable X2 - 3-Legged Intersection Density	Pearson Correlation	.082**
	Sig. (2-tailed)	.000
	N	137758
Independent Variable X3 - 4-Legged Intersection Density	Pearson Correlation	.050**
	Sig. (2-tailed)	.000
	N	137758

5.0. Conclusions

My hypotheses proposed that an increase in the number of pedestrian-oriented street segments in a downtown positively affects the growth in housing units and employment, characterized by number of jobs, in that downtown. In the last decade there has been a concerted effort by communities to invest in pedestrian infrastructure in order to make places more enjoyable and attractive for visitors, residents, and workers. The questions that I posed to answer with my analysis were:

Question 1: Is there a correlation between pedestrian-oriented urban design and an MSA's (Municipal Statistical Area) downtown economic growth in terms of employment?

Answer 1: For 2010 jobs data, there was a strong positive correlation for all three variables – number of pedestrian links per square mile, three-legged intersection density, and four-legged intersection density. For 2015 jobs data, there was a strong positive correlation for two of the variables – three-legged intersection density and four-legged intersection density but a slightly negative correlation for the variable of number of pedestrian links per square mile. Eliminating the 10 largest MSA's from the data set did not cause a noticeable effect in the results. Correlation results were like the full 376 MSA data set.

Question 2: Is there a correlation between pedestrian-oriented urban design and an MSA's (Municipal Statistical Area) downtown economic growth in terms of number housing units?

Answer 2: For housing units in 2010 and 2014, there was a strong positive correlation to the increase in the number of housing units for one of the three variables – three-legged intersection density. There was a negative correlation to the number of housing units for two of the variables – number of pedestrian links per square mile and four-legged intersection density. Eliminating the 10 largest MSA's from the data set did not cause a noticeable effect in the results. Correlation results were similar to the full 383 MSA data set.

The results of my analysis on the effect of pedestrian infrastructure on housing and job growth are mixed. The number of pedestrian-oriented street segments per square mile in a city's downtown area did not show direct positive correlation in the growth for downtown MSA's in terms of housing units but had a mildly positive correlation in terms of jobs. Also, the presence of four-legged intersections in a city's downtown area also did not prove to directly affect growth for housing but did have a positive correlation for jobs. The presence of three-legged intersections in a city's downtown area did correlate positively with growth in both housing and jobs.

The number of pedestrian-oriented street segments per mile may not directly affect growth in housing in a city's downtown area. This variable was based on the number of pedestrian-oriented street segments and did not include a qualitative component so that could be a factor in how it correlated to the housing and jobs data. Quantity does not always equal quality. The public realm has a lot of different components that are put together to make up the pedestrian environment. Previous case-study-based design measurement research proposes that there is not one specific element that makes for a great urban place but it is a collection of urban design components –

street trees, pedestrian-scale lighting, planted boulevard, on-street parking as a buffer between the street and the sidewalk – that make a comfortable, successful urban environment (Ewing, Clemente, pg. 46).

One explanation for why the three-legged intersection variable had a positive correlation while the other two variables did not could be that a three-legged intersection typically has less traffic traveling through it than a four-legged intersection. Less traffic at a three-legged intersection might make an area a more attractive location for residential development as opposed to a busy intersection (Hajrasouliha, Yin, pg. 2493). For the jobs data, while companies strive to be in high traffic areas, many also locate in areas that are attractive to employees. This could explain why there was a positive correlation between the number of jobs in an area for both the number of four-legged intersections and the number of three-legged intersections.

5.1. Future Research Considerations

This research analyzed large amounts of data over 383 MSA's in the U.S. Obtaining time series data on a census tract level by all 383 MSA's for housing and jobs for two separate years was very time-consuming. There was a relatively short span of time in between the housing (2010 and 2014) and jobs (2010 and 2015) data sets so more meaningful results could be gained with research that includes data over a longer span of time. Building on this research by including 2000 census data and upcoming 2020 data will improve and refine future research outcomes.

The Smart Location Database included pedestrian realm information by MSA by census tract for 2010 and was a snapshot of the environment at that given time. The original provider of the pedestrian realm data was NAVSTREETS, a company that has since been acquired by a different entity. Obtaining pedestrian realm data for 2015 was not available and was a limitation in this analysis. Future research efforts could include conducting this analysis again using both the 2010 Smart Location Database pedestrian-realm data as well as obtaining census tract-level pedestrian realm information for 2020 to see if the changes in that data set affect housing units and jobs over time.

Another consideration for future research efforts could focus on finding a way to add pedestrian-realm investment by census tract or MSA community on an annual basis over time to measure whether public realm investment directly reaps increases in housing or jobs. It would be helpful to localities who want to quantify that investment in infrastructure results in a return on investment at an acceptable level.

Another area for further research would be to add additional urban design variables at the census tract level and test for a combination of them across this large MSA dataset to find out whether different combinations result in growth in MSA downtowns. The number of pedestrian-oriented street segments as operationalized in the 2010 Smart Location Database did not prove to show a positive correlation to downtown MSA growth in housing units. However, operationalizing a variable of the quality of pedestrian-oriented street segments on a census tract level combined with other urban design variables such as lighting, buffers from traffic, landscaping, etc. could play a role in being able to predict future growth through infrastructure investment.

6.0. References and Appendix

6.1. References

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6.2. Appendix

Table 1. - Dissertation Data Collected and Analyzed by Year and Data Type

YEAR	**Census Tract Shapefile Data**	**Core-Based Statistical Area (CBSA) Shapefile Data**	**Combined Statistical Areas (CSA) Shapefile Data**	**MSA Housing Units – Census Data**	**CBSA Jobs via On The Map Online Census Application**	**Smart Location Database – Pedestrian-Oriented Street Segment Data matched with Census data**
2010	All 50 states individually downloaded and added to ArcGIS	United States – downloaded and added to ArcGIS	United States – downloaded and added to ArcGIS	Downloaded	Downloaded and imported into ArcGIS	Downloaded
2014				Downloaded		
2015		United States – downloaded and added to ArcGIS	United States – downloaded and added to ArcGIS		Downloaded and imported into ArcGIS	

Table 2. – Identified Issues with Downtown MSA Jobs Shapes in On The Map Jobs Application

Alabama	Arkansas	Connecticut	Florida – Problem with whole Punta Gorda shape; it worked when I selected fewer tracts	Idaho	Iowa
Alaska	California – Problems with Stockton shape; it worked when I selected fewer tracts	Delaware	Georgia	Illinois – problem with Chicago shapefile; it worked when I selected fewer tracts	Kansas
Arizona	Colorado	District of Columbia – Problem with	Hawaii	Indiana	Kentucky

		DOC shapefile; worked with a much smaller shape			
Louisiana	Maine	Maryland	Massachusetts - No MSA's for Massachusetts reported jobs data for 2015	Michigan – Trouble with Detroit; worked with a smaller shape	Minnesota
Mississippi	Missouri	Montana	Nebraska	Nevada	New Hampshire
New Jersey	New Mexico	New York – trouble with shape for Buffalo and New York; Buffalo worked with a smaller shape; New York worked with a smaller shape	North Carolina	North Dakota	Ohio
Oklahoma	Oregon	Pennsylvania – problem with Erie, Philly, and Reading; Philly, Erie and Reading shapes worked with smaller shapes.	Rhode Island	South Carolina	South Dakota
Tennessee – problem with Cleveland shapefile; worked with a smaller shape	Texas	Utah – problem with Salt Lake shape; worked with a smaller shape	Vermont	Virginia	Washington Problem with Seattle shape; worked with a smaller shape and it worked

West Virginia	Wisconsin	Wyoming – No MSA's in Wyoming reported jobs data for 2015			

Table 3. – Complete List of Metropolitan Statistical Areas Examined

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Abilene, TX Metro Area	Abilene	X and Access Linked	X	X	X	X
Akron, OH Metro Area	Akron	X and Access Linked	X	X	X	X
Albany, GA Metro Area	Albany, Georgia	X and Access Linked	X	X	X	X
Albany, OR Metro Area	Albany, Oregon	X and Access Linked	X	X	X	X
Albany-Schenectady-Troy, NY Metro Area	Albany, New York	X and Access Linked	X	X	X	X
Albuquerque, NM Metro Area	Albuquerque	X and Access Linked	X	X	X	X
Alexandria, LA Metro Area	Alexandria	X and Access Linked	X	X	X	X
Allentown-Bethlehem-Easton, PA-NJ Metro Area	Allentown	X and Access Linked	X	X	X	X
Altoona, PA Metro Area	Altoona	X and Access Linked	X	X	X	X
Amarillo, TX Metro Area	Amarillo	X and Access Linked	X	X	X	X
Ames, IA Metro Area	Ames	X and Access Linked	X	X	X	X
Anchorage, AK Metro Area	Anchorage	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Ann Arbor, MI Metro Area	Ann Arbor	X and Access Linked	X	X	X	X
Anniston-Oxford-Jacksonville, AL Metro Area	Anniston	X and Access Linked	X	X	X	X
Appleton, WI Metro Area	Appleton	X and Access Linked	X	X	X	X
Asheville, NC Metro Area	Asheville	X and Access Linked	X	X	X	X
Athens-Clarke County, GA Metro Area	Athens	X and Access Linked	X	X	X	X
Atlanta-Sandy Springs-Roswell, GA Metro Area	Atlanta	X and Access Linked	X	X	X	X
Atlantic City-Hammonton, NJ Metro Area	Atlantic City	X and Access Linked	X	X	X	X
Auburn-Opelika, AL Metro Area	Auburn	X and Access Linked	X	X	X	X
Augusta-Richmond County, GA-SC Metro Area	Augusta, Georgia	X and Access Linked	X	X	X	X
Austin-Round Rock, TX Metro Area	Austin	X and Access Linked	X	X	X	X
Bakersfield, CA Metro Area	Bakersfield	X and Access Linked	X	X	X	
Baltimore-Columbia-Towson, MD Metro Area	Baltimore	X and Access Linked	X	X	X	X
Bangor, ME Metro Area	Bangor	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Barnstable Town, MA Metro Area	Barnstable	X and Access Linked	X	X	X	Data Not Available for 2015 Jobs
Baton Rouge, LA Metro Area	Baton Rouge	X and Access Linked	X	X	X	X
Battle Creek, MI Metro Area	Battle Creek	X and Access Linked	X	X	X	X
Bay City, MI Metro Area	Bay City	X and Access Linked	X	X	X	X
Beaumont-Port Arthur, TX Metro Area	Beaumont, Port Arthur separately	X and Access Linked	X Beaumont, Port Arthur	X	X	X Beaumont and Port Arthur
Beckley, WV Metro Area	Beckley	X and Access Linked	X	X	X	X
Bellingham, WA Metro Area	Bellingham	X and Access Linked	X	X	X	X
Bend-Redmond, OR Metro Area	Bend	X and Access Linked	X	X	X	X
Billings, MT Metro Area	Billings	X and Access Linked	X	X	X	X
Binghamton, NY Metro Area	Binghamton	X and Access Linked	X	X	X	X
Birmingham-Hoover, AL Metro Area	Birmingham	X and Access Linked	X	X	X	X
Bismarck, ND Metro Area	Bismarck	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Blacksburg-Christiansburg-Radford, VA Metro Area	Blacksburg	X and Access Linked	X	X	X	X
Bloomington, IL Metro Area	Bloomington, Illinois	X and Access Linked	X	X	X	X
Bloomington, IN Metro Area	Bloomington, Indiana	X and Access Linked	X	X	X	X
Bloomsburg-Berwick, PA Metro Area	Bloomsburg	X and Access Linked	X	X	X	X
Boise City, ID Metro Area	Boise	X and Access Linked	X	X	X	X
Boston-Cambridge-Newton, MA-NH Metro Area	Boston	X and Access Linked	X	X	X	Data Not Available for 2015 Jobs
Boulder, CO Metro Area	Boulder	X and Access Linked	X	X	X	X
Bowling Green, KY Metro Area	Bowling Green	X and Access Linked	X	X	X	X
Bremerton-Silverdale, WA Metro Area	Bremerton	X and Access Linked	X	X	X	X
Bridgeport-Stamford-Norwalk, CT Metro Area	Bridgeport	X and Access Linked	X	X	X	X
Brownsville-Harlingen, TX Metro Area	Brownsville	X and Access Linked	X	X	X	X
Brunswick, GA Metro Area	Brunswick	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Buffalo-Cheektowaga-Niagara Falls, NY Metro Area	Buffalo	X and Access Linked	X	X	X	X
Burlington, NC Metro Area	Burlington, North Carolina	X and Access Linked	X	X	X	X
Burlington-South Burlington, VT Metro Area	Burlington	X and Access Linked	X	X	X	X
California-Lexington Park, MD Metro Area	Lexington Park	X and Access Linked	X	X	X	X
Canton-Massillon, OH Metro Area	Canton	X and Access Linked	X	X	X	X
Cape Coral-Fort Myers, FL Metro Area	Cape Coral and Fort Myers as one shape	X and Access Linked	X	X	X	X
Cape Girardeau, MO-IL Metro Area	Cape Girardeau	X and Access Linked	X	X	X	X
Carbondale-Marion, IL Metro Area	Carbondale	X and Access Linked	X	X	X	X
Carson City, NV Metro Area	Carson City	X and Access Linked	X	X	X	X
Casper, WY Metro Area	Casper	X and Access Linked	Problem with Casper jobs showing up as 0 for 2015			Data Not Available for 2015 Jobs

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Cedar Rapids, IA Metro Area	Cedar Rapids	X and Access Linked	X	X	X	X
Chambersburg-Waynesboro, PA Metro Area	Chambersburg	X and Access Linked	X	X	X	X
Champaign-Urbana, IL Metro Area	Champaign	X and Access Linked	X	X	X	X
Charleston, WV Metro Area	Charleston, West Virginia	X and Access Linked	X	X	X	X
Charleston-North Charleston, SC Metro Area	Charleston, South Carolina	X and Access Linked	X	X	X	X
Charlotte-Concord-Gastonia, NC-SC Metro Area	Charlotte	X and Access Linked	X	X	X	X
Charlottesville, VA Metro Area	Charlottesville	X and Access Linked	X	X	X	X
Chattanooga, TN-GA Metro Area	Chattanooga	X and Access Linked	X	X	X	X
Cheyenne, WY Metro Area	Cheyenne	X and Access Linked	Problem with 2015 jobs showing up as 0			Data Not Available for 2015 Jobs
Chicago-Naperville-Elgin, IL-IN-WI Metro Area	Chicago	X and Access Linked	X	X	X	X
Chico, CA Metro Area	Chico	X and Access Linked	X	X	X	X
Cincinnati, OH-KY-IN Metro Area	Cincinnati	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Clarksville, TN-KY Metro Area	Clarksville	X and Access Linked	X	X	X	X
Cleveland, TN Metro Area	Cleveland, Tennessee	X and Access Linked	X	X	X	X
Cleveland-Elyria, OH Metro Area	Cleveland	X and Access Linked	X	X	X	X
Coeur d'Alene, ID Metro Area	Coeur d'Alene	X and Access Linked	X	X	X	X
College Station-Bryan, TX Metro Area	College Station-Bryan	X and Access Linked	X	X	X	X
Colorado Springs, CO Metro Area	Colorado Springs	X and Access Linked	X	X	X	X
Columbia, MO Metro Area	Columbia, Missouri	X and Access Linked	X	X	X	X
Columbia, SC Metro Area	Columbia, South Carolina	X and Access Linked	X	X	X	X
Columbus, GA-AL Metro Area	Columbus, Georgia	X and Access Linked	X	X	X	X
Columbus, IN Metro Area	Columbus, Indiana	X and Access Linked	X	X	X	X
Columbus, OH Metro Area	Columbus, Ohio	X and Access Linked	X	X	X	X
Corpus Christi, TX Metro Area	Corpus Christi	X and Access Linked	X	X	X	X
Corvallis, OR Metro Area	Corvallis	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Crestview-Fort Walton Beach-Destin, FL Metro Area	Crestview	X and Access Linked	X	X	X	X
Cumberland, MD-WV Metro Area	Cumberland	X and Access Linked	X	X	X	X
Dallas-Fort Worth-Arlington, TX Metro Area	Dallas and Fort Worth separately	X and Access Linked	X Dallas, Fort Worth	X Dallas, Fort Worth	X Dallas, Fort Worth	X Dallas, Fort Worth
Dalton, GA Metro Area	Dalton	X and Access Linked	X	X	X	X
Danville, IL Metro Area	Danville	X and Access Linked	X	X	X	X
Daphne-Fairhope-Foley, AL Metro Area	Daphne	X and Access Linked	X	X	X	X
Davenport-Moline-Rock Island, IA-IL Metro Area	Davenport	X and Access Linked	X	X	X	X
Dayton, OH Metro Area	Dayton	X and Access Linked	X	X	X	X
Decatur, AL Metro Area	Decatur, Alabama	X and Access Linked	X	X	X	X
Decatur, IL Metro Area	Decatur, Illinois	X and Access Linked	X	X	X	X
Deltona-Daytona Beach-Ormond Beach, FL Metro Area	Daytona Beach	X and Access Linked	X	X	X	X
Denver-Aurora-Lakewood, CO Metro Area	Denver	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Des Moines-West Des Moines, IA Metro Area	Des Moines	X and Access Linked	X	X	X	X
Detroit-Warren-Dearborn, MI Metro Area	Detroit	X and Access Linked	X	X	X	X
Dothan, AL Metro Area	Dothan		X	X	X	X
Dover, DE Metro Area	Dover	X and Access Linked	X	X	X	X
Dubuque, IA Metro Area	Dubuque	X and Access Linked	X	X	X	X
Duluth, MN-WI Metro Area	Duluth and Superior as separate shapefiles	X and Access Linked	X Duluth and Superior	X Duluth and Superior	X Duluth and Superior	X Duluth and Superior
Durham-Chapel Hill, NC Metro Area	Durham	X and Access Linked	X	X	X	X
East Stroudsburg, PA Metro Area	East Stroudsburg and Stroudsburg together as one shape	X and Access Linked	X	X	X	X
Eau Claire, WI Metro Area	Eau Claire	X and Access Linked	X	X	X	X
El Centro, CA Metro Area	El Centro	X and Access Linked	X	X	X	X
Elizabethtown-Fort Knox, KY Metro Area	Elizabethtown	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Elkhart-Goshen, IN Metro Area	Elkhart	X and Access Linked	X	X	X	X
Elmira, NY Metro Area	Elmira	X and Access Linked	X	X	X	X
El Paso, TX Metro Area	El Paso	X and Access Linked	X	X	X	X
Erie, PA Metro Area	Erie	X and Access Linked	X	X	X	X
Eugene, OR Metro Area	Eugene	X and Access Linked	X	X	X	X
Evansville, IN-KY Metro Area	Evansville	X and Access Linked	X	X	X	X
Fairbanks, AK Metro Area	Fairbanks	X and Access Linked	X	X	X	X
Fargo, ND-MN Metro Area	Fargo, ND	X and Access Linked	X	X	X	X
Farmington, NM Metro Area	Farmington	X and Access Linked	X	X	X	X
Fayetteville, NC Metro Area	Fayetteville, North Carolina	X and Access Linked	X	X	X	X
Fayetteville-Springdale-Rogers, AR-MO Metro Area	Fayetteville, Arkansas	X and Access Linked	X	X	X	X
Flagstaff, AZ Metro Area	Flagstaff	X and Access Linked	X	X	X	X
Flint, MI Metro Area	Flint	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Florence, SC Metro Area	Florence, South Carolina	X and Access Linked	X	X	X	X
Florence-Muscle Shoals, AL Metro Area	Florence and Muscle Shoals as one shape	X and Access Linked	X	X	X	X
Fond du Lac, WI Metro Area	Fond du Lac	X and Access Linked	X	X	X	X
Fort Collins, CO Metro Area	Fort Collins	X and Access Linked	X	X	X	X
Fort Smith, AR-OK Metro Area	Fort Smith, Arkansas	X and Access Linked	X	X	X	X
Fort Wayne, IN Metro Area	Fort Wayne	X and Access Linked	X	X	X	X
Fresno, CA Metro Area	Fresno	X and Access Linked	X	X	X	X
Gadsden, AL Metro Area	Gadsden	X and Access Linked	X	X	X	X
Gainesville, FL Metro Area	Gainesville, Florida	X and Access Linked	X	X	X	X
Gainesville, GA Metro Area	Gainesville, Georgia	X and Access Linked	X	X	X	X
Gettysburg, PA Metro Area	Gettysburg	X and Access Linked	X	X	X	X
Glens Falls, NY Metro Area	Glens Falls	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Goldsboro, NC Metro Area	Goldsboro	X and Access Linked	X	X	X	X
Grand Forks, ND-MN Metro Area	Grand Forks, North Dakota	X and Access Linked	X	X	X	X
Grand Island, NE Metro Area	Grand Island	X and Access Linked	X	X	X	X
Grand Junction, CO Metro Area	Grand Junction	X and Access Linked	X	X	X	X
Grand Rapids-Wyoming, MI Metro Area	Grand Rapids	X and Access Linked	X	X	X	X
Grants Pass, OR Metro Area	Grants Pass	X and Access Linked	X	X	X	X
Great Falls, MT Metro Area	Great Falls	X and Access Linked	X	X	X	X
Greeley, CO Metro Area	Greeley	X and Access Linked	X	X	X	X
Green Bay, WI Metro Area	Green Bay	X and Access Linked	X	X	X	X
Greensboro-High Point, NC Metro Area	Greensboro	X and Access Linked	X	X	X	X
Greenville, NC Metro Area	Greenville, North Carolina	X and Access Linked	Trouble with shape			
Greenville-Anderson-Mauldin, SC Metro Area	Greenville, South Carolina	X and Access Linked	X	X	X	X
Gulfport-Biloxi-Pascagoula, MS Metro Area	Gulfport	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Hagerstown-Martinsburg, MD-WV Metro Area	Hagerstown	X and Access Linked	X	X	X	X
Hammond, LA Metro Area	Hammond	X and Access Linked	X	X	X	X
Hanford-Corcoran, CA Metro Area	Hanford	X and Access Linked	X	X	X	X
Harrisburg-Carlisle, PA Metro Area	Harrisburg	X and Access Linked	X	X	X	X
Harrisonburg, VA Metro Area	Harrisonburg	X and Access Linked	X	X	X	X
Hartford-West Hartford-East Hartford, CT Metro Area	Hartford	X and Access Linked	X	X	X	X
Hattiesburg, MS Metro Area	Hattiesburg	X and Access Linked	X	X	X	X
Hickory-Lenoir-Morganton, NC Metro Area	Hickory	X and Access Linked	X	X	X	X
Hilton Head Island-Bluffton-Beaufort, SC Metro Area	Hilton Head	X and Access Linked	X	X	X	X
Hinesville, GA Metro Area	Hinesville	X and Access Linked	X	X	X	X
Homosassa Springs, FL Metro Area	Homosassa Springs	X and Access Linked	X	X	X	X
Hot Springs, AR Metro Area	Hot Springs	X and Access Linked	X	X	X	X
Houma-Thibodaux, LA Metro Area	Houma	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Houston-The Woodlands-Sugar Land, TX Metro Area	Houston	X and Access Linked	X	X	X	X
Huntington-Ashland, WV-KY-OH Metro Area	Huntington	X and Access Linked	X	X	X	X
Huntsville, AL Metro Area	Huntsville	X and Access Linked	X	X	X	X
Idaho Falls, ID Metro Area	Idaho Falls	X and Access Linked	X	X	X	X
Indianapolis-Carmel-Anderson, IN Metro Area	Indianapolis	X and Access Linked	X	X	X	X
Iowa City, IA Metro Area	Iowa City	X and Access Linked	X	X	X	X
Ithaca, NY Metro Area	Ithaca	X and Access Linked	X	X	X	X
Jackson, MI Metro Area	Jackson, Michigan	X and Access Linked	X	X	X	X
Jackson, MS Metro Area	Jackson, Mississippi	X and Access Linked	X	X	X	X
Jackson, TN Metro Area	Jackson, Tennessee	X and Access Linked	X	X	X	X
Jacksonville, FL Metro Area	Jacksonville, Florida	X and Access Linked	X	X	X	X
Jacksonville, NC Metro Area	Jacksonville, North Carolina	X and Access Linked	X	X	X	X
Janesville-Beloit, WI Metro Area	Janesville	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Jefferson City, MO Metro Area	Jefferson City	X and Access Linked	X	X	X	X
Johnson City, TN Metro Area	Johnson City	X and Access Linked	X	X	X	X
Johnstown, PA Metro Area	Johnstown	X and Access Linked	X	X	X	X
Jonesboro, AR Metro Area	Jonesboro	X and Access Linked	X	X	X	X
Joplin, MO Metro Area	Joplin	X and Access Linked	X	X	X	X
Kahului-Wailuku-Lahaina, HI Metro Area	Kahului	X and Access Linked	X	X	X	X
Kalamazoo-Portage, MI Metro Area	Kalamazoo	X and Access Linked	X	X	X	X
Kankakee, IL Metro Area	Kankakee	X and Access Linked	X	X	X	X
Kansas City, MO-KS Metro Area	Kansas City, Kansas and Kansas City, Missouri as separate shapefiles	X and Access Linked	Kansas City, KS – X Kansas City, MO - X	Kansas City, KS – X Kansas City, MO - X	Kansas City, KS – X Kansas City, MO - X	Kansas City, KS Kansas City, MO
Kennewick-Richland, WA Metro Area	Kennewick	X and Access Linked	X	X	X	X
Killeen-Temple, TX Metro Area	Killeen	X and Access Linked	X	X	X	X
Kingsport-Bristol-Bristol, TN-VA Metro Area	Kingsport, Tennessee		X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Kingston, NY Metro Area	Kingston	X and Access Linked	X	X	X	X
Knoxville, TN Metro Area	Knoxville	X and Access Linked	X	X	X	X
Kokomo, IN Metro Area	Kokomo	X and Access Linked	X	X	X	X
La Crosse-Onalaska, WI-MN Metro Area	La Crosse	X and Access Linked	X	X	X	X
Lafayette, LA Metro Area	Lafayette	X and Access Linked	X	X	X	X
Lafayette-West Lafayette, IN Metro Area	Lafayette, Indiana	X and Access Linked	X	X	X	X
Lake Charles, LA Metro Area	Lake Charles	X and Access Linked	X	X	X	X
Lake Havasu City-Kingman, AZ Metro Area	Lake Havasu City	X and Access Linked	X	X	X	X
Lakeland-Winter Haven, FL Metro Area	Lakeland	X and Access Linked	X	X	X	X
Lancaster, PA Metro Area	Lancaster	X and Access Linked	X	X	X	X
Lansing-East Lansing, MI Metro Area	Lansing	X and Access Linked	X	X	X	X
Laredo, TX Metro Area	Laredo	X and Access Linked	X	X	X	X
Las Cruces, NM Metro Area	Las Cruces	X and Access Linked	X	X	X	X
Las Vegas-Henderson-Paradise, NV Metro Area	Las Vegas	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Lawrence, KS Metro Area	Lawrence	X and Access Linked	X	X	X	X
Lawton, OK Metro Area	Lawton	X and Access Linked	X			X
Lebanon, PA Metro Area	Lebanon	X and Access Linked	X	X	X	X
Lewiston, ID-WA Metro Area	Lewiston, Idaho	X and Access Linked	X	X	X	X
Lewiston-Auburn, ME Metro Area	Lewiston and Auburn as one shape	X and Access Linked	X	X	X	X
Lexington-Fayette, KY Metro Area	Lexington	X and Access Linked	X	X	X	X
Lima, OH Metro Area	Lima	X and Access Linked	X	X	X	X
Lincoln, NE Metro Area	Lincoln	X and Access Linked	X	X	X	X
Little Rock-North Little Rock-Conway, AR Metro Area	Little Rock	X and Access Linked	X	X	X	X
Logan, UT-ID Metro Area	Logan	X and Access Linked	X	X	X	X
Longview, TX Metro Area	Longview, TX	X and Access Linked	X	X	X	X
Longview, WA Metro Area	Longview, WA	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Los Angeles-Long Beach-Anaheim, CA Metro Area	Los Angeles	X and Access Linked	X	X	X	X
Louisville/Jefferson County, KY-IN Metro Area	Louisville	X and Access Linked	X	X	X	X
Lubbock, TX Metro Area	Lubbock	X and Access Linked	X	X	X	X
Lynchburg, VA Metro Area	Lynchburg	X and Access Linked	X	X	X	X
Macon, GA Metro Area	Macon	X and Access Linked	X	X	X	X
Madera, CA Metro Area	Madera	X and Access Linked	X	X	X	X
Madison, WI Metro Area	Madison	X and Access Linked	X	X	X	X
Manchester-Nashua, NH Metro Area	Nashua	X and Access Linked	X	X	X	X
Manhattan, KS Metro Area	Manhattan	X and Access Linked	X	X	X	X
Mankato-North Mankato, MN Metro Area	Mankato and North Mankato as one shape	X and Access Linked	X	X	X	X
Mansfield, OH Metro Area	Mansfield	X and Access Linked	X	X	X	X
McAllen-Edinburg-Mission, TX Metro Area	McAllen	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Medford, OR Metro Area	Medford	X and Access Linked	X	X	X	X
Memphis, TN-MS-AR Metro Area	Memphis	X and Access Linked	X	X	X	X
Merced, CA Metro Area	Merced	X and Access Linked	X	X	X	X
Miami-Fort Lauderdale-West Palm Beach, FL Metro Area	Miami	X and Access Linked	X	X	X	X
Michigan City-La Porte, IN Metro Area	Michigan City	X and Access Linked	X	X	X	X
Midland, MI Metro Area	Midland, Michigan	X and Access Linked	X	X	X	X
Midland, TX Metro Area	Midland, Texas	X and Access Linked	X	X	X	X
Milwaukee-Waukesha-West Allis, WI Metro Area	Milwaukee	X and Access Linked	X	X	X	X
Minneapolis-St. Paul-Bloomington, MN-WI Metro Area	Minneapolis and St Paul as two shapes within same shapefile	X and Access Linked	X	X	X	X
Missoula, MT Metro Area	Missoula	X and Access Linked	X	X	X	X
Mobile, AL Metro Area	Mobile	X and Access Linked	X	X	X	X
Modesto, CA Metro Area	Modesto	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Monroe, LA Metro Area	Monroe, Louisiana	X and Access Linked	X	X	X	X
Monroe, MI Metro Area	Monroe, Michigan	X and Access Linked	X	X	X	X
Montgomery, AL Metro Area	Montgomery	X and Access Linked	X	X	X	X
Morgantown, WV Metro Area	Morgantown	X and Access Linked	X	X	X	X
Morristown, TN Metro Area	Morristown	X and Access Linked	X	X	X	X
Mount Vernon-Anacortes, WA Metro Area	Mount Vernon	X and Access Linked	X	X	X	X
Muncie, IN Metro Area	Muncie	X and Access Linked	X	X	X	X
Muskegon, MI Metro Area	Muskegon	X and Access Linked	X	X	X	X
Myrtle Beach-Conway-North Myrtle Beach, SC-NC Metro Area	Myrtle Beach	X and Access Linked	X	X	X	X
Napa, CA Metro Area	Napa	X and Access Linked	X	X	X	X
Naples-Immokalee-Marco Island, FL Metro Area	Naples	X and Access Linked	X	X	X	X
Nashville-Davidson--Murfreesboro--Franklin, TN Metro Area	Nashville	X and Access Linked	X	X	X	X
New Bern, NC Metro Area	New Bern	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
New Haven-Milford, CT Metro Area	New Haven	X and Access Linked	X	X	X	X
New Orleans-Metairie, LA Metro Area	New Orleans	X and Access Linked	X	X	X	X
New York-Newark-Jersey City, NY-NJ-PA Metro Area	New York	X and Access Linked	X	X	X	X
Niles-Benton Harbor, MI Metro Area	Niles	X and Access Linked	X	X	X	X
North Port-Sarasota-Bradenton, FL Metro Area	North Port	X and Access Linked	X	X	X	X
Norwich-New London, CT Metro Area	Norwich	X and Access Linked	X	X	X	X
Ocala, FL Metro Area	Ocala	X and Access Linked	X	X	X	X
Ocean City, NJ Metro Area	Ocean City	X and Access Linked	X	X	X	X
Odessa, TX Metro Area	Odessa	X and Access Linked	X	X	X	X
Ogden-Clearfield, UT Metro Area	Ogden	X and Access Linked	X	X	X	X
Oklahoma City, OK Metro Area	Oklahoma City	X and Access Linked	X	X	X	X
Olympia-Tumwater, WA Metro Area	Olympia	X and Access Linked	X	X	X	X
Omaha-Council Bluffs, NE-IA Metro Area	Omaha	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Orlando-Kissimmee-Sanford, FL Metro Area	Orlando	X and Access Linked	X	X	X	X
Oshkosh-Neenah, WI Metro Area	Oshkosh	X and Access Linked	X	X	X	X
Owensboro, KY Metro Area	Owensboro	X and Access Linked	X	X	X	X
Oxnard-Thousand Oaks-Ventura, CA Metro Area	Oxnard	X and Access Linked	X	X	X	X
Palm Bay-Melbourne-Titusville, FL Metro Area	Palm Bay	X and Access Linked	X	X	X	X
Panama City, FL Metro Area	Panama City	X and Access Linked	X	X	X	X
Parkersburg-Vienna, WV Metro Area	Parkersburg	X and Access Linked	X	X	X	X
Pensacola-Ferry Pass-Brent, FL Metro Area	Pensacola	X and Access Linked	X	X	X	X
Peoria, IL Metro Area	Peoria	X and Access Linked	X	X	X	X
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metro Area	Philadelphia	X and Access Linked	X	X	X	X
Phoenix-Mesa-Scottsdale, AZ Metro Area	Phoenix	X and Access Linked	X	X	X	X
Pine Bluff, AR Metro Area	Pine Bluff	X and Access Linked	X	X	X	X
Pittsburgh, PA Metro Area	Pittsburgh	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Pittsfield, MA Metro Area	Pittsfield	X and Access Linked	X	X	X	Data Not Available for 2015 Jobs
Pocatello, ID Metro Area	Pocatello	X and Access Linked	X	X	X	X
Portland-South Portland, ME Metro Area	Portland, Maine	X and Access Linked	X	X	X	X
Portland-Vancouver-Hillsboro, OR-WA Metro Area	Portland, Oregon	X and Access Linked	X	X	X	X
Port St. Lucie, FL Metro Area	Port St. Lucie	X and Access Linked	X	X	X	X
Prescott, AZ Metro Area	Prescott	X and Access Linked	X	X	X	X
Providence-Warwick, RI-MA Metro Area	Providence	X and Access Linked	X	X	X	X
Provo-Orem, UT Metro Area	Provo	X and Access Linked	X	X	X	X
Pueblo, CO Metro Area	Pueblo	X and Access Linked	X	X	X	X
Punta Gorda, FL Metro Area	Punta Gorda	X and Access Linked	X	X	X	X
Racine, WI Metro Area	Racine	X and Access Linked	X	X	X	X
Raleigh, NC Metro Area	Raleigh	X and Access Linked	X	X	X	X
Rapid City, SD Metro Area	Rapid City	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Reading, PA Metro Area	Reading	X and Access Linked	X	X	X	X
Redding, CA Metro Area	Redding	X and Access Linked	X	X	X	X
Reno, NV Metro Area	Reno	X and Access Linked	X	X	X	X
Richmond, VA Metro Area	Richmond	X and Access Linked	X	X	X	X
Riverside-San Bernardino-Ontario, CA Metro Area	Riverside	X and Access Linked	X	X	X	X
Roanoke, VA Metro Area	Roanoke	X and Access Linked	X	X	X	X
Rochester, MN Metro Area	Rochester	X and Access Linked	X	X	X	X
Rochester, NY Metro Area	Rochester	X and Access Linked	X	X	X	X
Rockford, IL Metro Area	Rockford	X and Access Linked	X	X	X	X
Rocky Mount, NC Metro Area	Rocky Mount	X and Access Linked	X	X	X	X
Rome, GA Metro Area	Rome	X and Access Linked	X	X	X	X
Sacramento--Roseville--Arden-Arcade, CA Metro Area	Sacramento	X and Access Linked	X	X	X	X
Saginaw, MI Metro Area	Saginaw	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
St. Cloud, MN Metro Area	St. Cloud	X and Access Linked	X	X	X	X
St. George, UT Metro Area	St. George	X and Access Linked	X	X	X	X
St. Joseph, MO-KS Metro Area	St. Joseph	X and Access Linked	X	X	X	X
St. Louis, MO-IL Metro Area	St. Louis, Missouri	X and Access Linked	X	X	X	X
Salem, OR Metro Area	Salem	X and Access Linked	X	X	X	X
Salinas, CA Metro Area	Salinas	X and Access Linked	X	X	X	X
Salisbury, MD-DE Metro Area	Salisbury	X and Access Linked	X	X	X	X
Salt Lake City, UT Metro Area	Salt Lake City	X and Access Linked	X	X	X	X
San Angelo, TX Metro Area	San Angelo	X and Access Linked	X	X	X	X
San Antonio-New Braunfels, TX Metro Area	San Antonio	X and Access Linked	X	X	X	X
San Diego-Carlsbad, CA Metro Area	San Diego	X and Access Linked	X	X	X	X
San Francisco-Oakland-Hayward, CA Metro Area	San Francisco and Oakland as separate shapefiles	X and Access Linked	SF and Oakland X	SF and Oakland X	SF and Oakland X	SF and Oakland X
San Jose-Sunnyvale-Santa Clara, CA Metro Area	San Jose	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
San Luis Obispo-Paso Robles-Arroyo Grande, CA Metro Area	San Luis Obispo	X and Access Linked	X	X	X	X
Santa Cruz-Watsonville, CA Metro Area	Santa Cruz	X and Access Linked	X	X	X	X
Santa Fe, NM Metro Area	Santa Fe	X and Access Linked	X	X	X	X
Santa Maria-Santa Barbara, CA Metro Area	Santa Maria	X and Access Linked	X	X	X	X
Santa Rosa, CA Metro Area	Santa Rosa	X and Access Linked	X	X	X	X
Savannah, GA Metro Area	Savannah	X and Access Linked	X	X	X	X
Scranton--Wilkes-Barre--Hazleton, PA Metro Area	Scranton	X and Access Linked	X	X	X	X
Seattle-Tacoma-Bellevue, WA Metro Area	Seattle and Tacoma separately	X and Access Linked	Problem with Seattle shape X Tacoma ok	X Tacoma	X Tacoma	X
Sebastian-Vero Beach, FL Metro Area	Sebastian	X and Access Linked	X	X	X	X
Sebring, FL Metro Area	Sebring	X and Access Linked	X	X	X	X
Sheboygan, WI Metro Area	Sheboygan	X and Access Linked	X	X	X	X
Sherman-Denison, TX Metro Area	Sherman and Denison together	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	Downtown Shape File and Attribute File Used	Export the Attribute File into Excel	Imported Shape Files to On The Map	Exported Downtown Jobs Data from On The Map to Excel	Exported Downtown Jobs Shapefile from On The Map	Jobs Census Tracts
Shreveport-Bossier City, LA Metro Area	Shreveport	X and Access Linked	X	X	X	X
Sierra Vista-Douglas, AZ Metro Area	Sierra Vista	X and Access Linked	X	X	X	X
Sioux City, IA-NE-SD Metro Area	Sioux City, IA	X and Access Linked	X	X	X	X
Sioux Falls, SD Metro Area	Sioux Falls	X and Access Linked	X	X	X	X
South Bend-Mishawaka, IN-MI Metro Area	South Bend	X and Access Linked	X	X	X	X
Spartanburg, SC Metro Area	Spartanburg	X and Access Linked	X	X	X	X
Spokane-Spokane Valley, WA Metro Area	Spokane	X and Access Linked	X	X	X	X
Springfield, IL Metro Area	Springfield, Illinois	X and Access Linked	X	X	X	X
Springfield, MA Metro Area	Springfield, Massachusetts	X and Access Linked	X	X	X	Data Not Available for 2015 Jobs
Springfield, MO Metro Area	Springfield, Missouri	X and Access Linked	X	X	X	X
Springfield, OH Metro Area	Springfield, Ohio	X and Access Linked	X	X	X	X
State College, PA Metro Area	State College	X and Access Linked	X	X	X	X
Staunton-Waynesboro, VA Metro Area	Staunton	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Stockton-Lodi, CA Metro Area	Stockton	X and Access Linked	X	X	X	X
Sumter, SC Metro Area	Sumter	X and Access Linked	X	X	X	X
Syracuse, NY Metro Area	Syracuse	X and Access Linked	X	X	X	X
Tallahassee, FL Metro Area	Tallahassee	X and Access Linked	X	X	X	X
Tampa-St. Petersburg-Clearwater, FL Metro Area	Tampa	X and Access Linked	X	X	X	X
Terre Haute, IN Metro Area	Terre Haute	X and Access Linked	X	X	X	X
Texarkana, TX-AR Metro Area	Texarkana	X and Access Linked	X	X	X	X
The Villages, FL Metro Area	The Villages	X and Access Linked	X	X	X	X
Toledo, OH Metro Area	Toledo	X and Access Linked	X	X	X	X
Topeka, KS Metro Area	Topeka	X and Access Linked	X	X	X	X
Trenton, NJ Metro Area	Trenton	X and Access Linked	X	X	X	X
Tucson, AZ Metro Area	Tucson	X and Access Linked	X	X	X	X
Tulsa, OK Metro Area	Tulsa	X and Access Linked	X	X	X	X
Tuscaloosa, AL Metro Area	Tuscaloosa	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Tyler, TX Metro Area	Tyler	X and Access Linked	X	X	X	X
Urban Honolulu, HI Metro Area	Honolulu-Waikiki	X and Access Linked	X	X	X	X
Utica-Rome, NY Metro Area	Utica	X and Access Linked	X	X	X	X
Valdosta, GA Metro Area	Valdosta	X and Access Linked	X	X	X	X
Vallejo-Fairfield, CA Metro Area	Vallejo	X and Access Linked	X	X	X	X
Victoria, TX Metro Area	Victoria	X and Access Linked	X	X	X	X
Vineland-Bridgeton, NJ Metro Area	Vineland	X and Access Linked	X	X	X	X
Virginia Beach-Norfolk-Newport News, VA-NC Metro Area	Virginia Beach and Norfolk as one shape	X and Access Linked	X	X	X	X
Visalia-Porterville, CA Metro Area	Visalia	X and Access Linked	X	X	X	X
Waco, TX Metro Area	Waco	X and Access Linked	X	X	X	X
Walla Walla, WA Metro Area	Walla Walla	X and Access Linked	X	X	X	X
Warner Robins, GA Metro Area	Warner Robins	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area	Washington, D.C.	X and Access Linked	X	X	X	X
Waterloo-Cedar Falls, IA Metro Area	Waterloo and Cedar Falls as one shape	X and Access Linked	X	X	X	X
Watertown-Fort Drum, NY Metro Area	Watertown	X and Access Linked	X	X	X	X
Wausau, WI Metro Area	Wausau	X and Access Linked	X	X	X	X
Weirton-Steubenville, WV-OH Metro Area	Weirton	X and Access Linked	X	X	X	X
Wenatchee, WA Metro Area	Wenatchee	X and Access Linked	X	X	X	X
Wheeling, WV-OH Metro Area	Wheeling	X and Access Linked	X	X	X	X
Wichita, KS Metro Area	Wichita	X and Access Linked	X	X	X	X
Wichita Falls, TX Metro Area	Wichita Falls	X and Access Linked	X	X	X	X
Williamsport, PA Metro Area	Williamsport	X and Access Linked	X	X	X	X
Wilmington, NC Metro Area	Wilmington	X and Access Linked	X	X	X	X
Winchester, VA-WV Metro Area	Winchester	X and Access Linked	X	X	X	X

Metropolitan Statistical Areas – 2010 Census	**Downtown Shape File and Attribute File Used**	**Export the Attribute File into Excel**	**Imported Shape Files to On The Map**	**Exported Downtown Jobs Data from On The Map to Excel**	**Exported Downtown Jobs Shapefile from On The Map**	**Jobs Census Tracts**
Winston-Salem, NC Metro Area	Winston-Salem	X and Access Linked	X	X	X	X
Worcester, MA-CT Metro Area	Worcester	X and Access Linked	X	X	X	Data Not Available for 2015 Jobs
Yakima, WA Metro Area	Yakima	X and Access Linked	X	X	X	X
York-Hanover, PA Metro Area	York	X and Access Linked	X	X	X	X
Youngstown-Warren-Boardman, OH-PA Metro Area	Youngstown, Ohio	X	X	X	X	X
Yuba City, CA Metro Area	Yuba City	X	X	X	X	X
Yuma, AZ Metro Area	Yuma	X and Access Linked	X	X	X	X

Table 4. Ten Largest Metropolitan Statistical Areas in United States as of July 1, 2017

Rank	Area Name	State	2017 total population
1	New York city	New York	8,622,698
2	Los Angeles city	California	3,999,759
3	Chicago city	Illinois	2,716,450
4	Houston city	Texas	2,312,717
5	Phoenix city	Arizona	1,626,078
6	Philadelphia city	Pennsylvania	1,580,863
7	San Antonio city	Texas	1,511,946
8	San Diego city	California	1,419,516
9	Dallas city	Texas	1,341,075
10	San Jose city	California	1,035,317

Source: https://www.census.gov/newsroom/press-releases/2018/estimates-cities.html