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16. Abstract

Transit-Oriented Development (TOD) refers to dense, pedestrian-friendly, livable communities that have good transit as a nucleus. While transit facilities are missing in most suburban towns and the residents are heavily dependent on their vehicles, it is wondered whether residents would take advantage if public facilities were available. This paper presents information about some vital aspects of TOD when viewed in suburban communities. The residents in three Houston area suburban communities were studied as to whether they use public transit for work trips via: (1) light rail (2) commuter bus and (3) express bus. The comparisons of the three work trip modes and the use of personal automobiles indicate that were transit facilities more available in their community, transit systems would be an effective approach to absorb some growth in trips. One goal of TOD encourages people to work near home as a way to reduce sprawl and decrease congestion. A job to housing balance is also assessed. Creation of better jobs to housing balance would further improve the number of internal trips reducing the use of single-occupancy vehicles. Enhancements to the convenience of transit, bicycling and walking encourage livable communities by providing safe, convenient and engaging experiences for pedestrians.

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AN EVALUATION OF THE EFFECTS OF TRANSIT ORIENTED DEVELOPMENT IN A SUBURBAN ENVIRONMENT

Krystal Michelle Lastrape, M.S.

Carol Abel Lewis, Ph.D.

Research Report SWUTC/10/476660-00048-1

Southwest Region University Transportation Center
Center for Transportation Training and Research
Texas Southern University
Houston, Texas 77004

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EXECUTIVE SUMMARY

Transit-Oriented Development (TOD) refers to dense, pedestrian-friendly, livable communities that have good transit as a nucleus. While transit facilities are missing in most suburban towns and the residents are heavily dependent on their vehicles, it is wondered whether residents would take advantage if public facilities were available. This paper presents information about some vital aspects of TOD when viewed in suburban communities. The residents in three Houston area suburban communities were studied as to whether they use public transit for work trips via: (1) light rail (2) commuter bus and (3) express bus. The comparisons of the three work trip modes and the use of personal automobiles indicate that were transit facilities more available in their community, transit systems would be an effective approach to absorb some growth in trips. One goal of TOD encourages people to work near home as a way to reduce sprawl and decrease congestion. A job to housing balance is also assessed. Creation of better jobs to housing balance would further improve the number of internal trips reducing the use of single-occupancy vehicles. Enhancements to increase the convenience of transit, bicycling and walking encourage livable communities by providing safe, convenient and engaging experiences for pedestrians.

Livable communities are the new and modern way of life for high density balance that is within walking distance of goods, services and that are surrounded by transit facilities. The fact is that this mixture is popular in the urban communities, in comparison, suburban areas lack sufficient transit facilities. Research was done on the case study areas, The Woodlands Town Center, a TOD with transit and was compared to Pearland Town Center and Sugar Land Town Square, suburban communities that depend on the automobile. Residents of these areas used public transportation, even when they had to drive to obtain access. Full attainment of TOD goals realized for these developments may take decades. Observations show the transit linkages to the remainder of the region are weak. However, there is a template in place of more compact, mixed-use development that will allow incorporation of transit at a later date.

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CHAPTER 1

INTRODUCTION

The basis of beneficial transportation planning consists of developing a program that the public likes and one that makes their lives easier, such as Smart Growth, Livable Centers, Transit Village, Mixed-Use Developments, TOD, and Urban Village. Transit-Oriented Development is a planning tool designed to create more livable, pedestrian-friendly communities largely through the following methods:

- Increase the convenience of transit, bicycling and walking,
- Increase internal trip making,
    - reduce use of single-occupancy vehicles

Most existing suburban environments are mixed use, but transit is not readily available for the community. Parking layouts are different in suburban environments than those in urban environments because transportation is largely automobile-dominated. "Most development is still happening in the suburbs. But, there are reasons to believe the balance could shift and that we will need to redevelop our urban and suburban centers to accommodate more growth, because without transit, neighborhoods will be overrun with traffic" (Reconnecting America, p. 12).

It is understood that most suburban communities are okay with the fact that there are not sufficient transit facilities available; however, some residents of the suburban communities do not understand the benefits of a TOD. Also, many communities that used to be suburban find themselves more a part of urban environments as growth continues beyond the "used to be" suburbs. TODs are very effective approaches to contemporary living and a positive way to help the environment. Suburban areas have the usual shopping centers, accessible businesses, and learning institutes located in the vicinity of residents; however, no public transit is available for the community. Spatial arrangements, which include parking layouts, are different and there are more parking lots available for the community because transportation is solely for private vehicle usage. Yet, a decision to modify a suburban neighborhood to accommodate TOD may become a challenge because the population is not as large as in urban communities. Nonetheless, a suburban community that is well developed will consist of most of transit within at least a five minute walk that serves at a fast, frequent, reliable, and comfortable rate, and is traffic-calming to each resident.

The focus of TOD is to reduce sprawl in and around cities which is a contributor to air pollution, social alienation, and long commutes. However, sprawl may be the answer people are looking for when it comes to affordable real estate on the outskirts of the city (Crane and Chatman, 2003). TOD has been the target for promoting smart growth in the United States, with transportation being the basis of smart growth; it is where the issues of sprawling and smart growth merge. "Suburban sprawl is the spreading out of a city and its suburbs over rural land at the fringe of an urban area. An urban area is an area with an increased density of human-created structures in comparison to the areas surrounding it. Which is the better decision one may wonder? The fact is neither one is better than the other. They both are very different and have many good and bad things to offer" (Rivera, 2008, p. 1). However, to fully understand transit-oriented design is to understand sprawl.

Sprawling Development

Smart Growth of America is an organization consisting of national, state and local members committed towards enhancing different plans for building towns, cities and metro areas we call home. "The almost single-minded focus on highway development from the 1950s through the 1980s encouraged spread-out housing, and made it easy for businesses to locate in remote office parks, far from traditional walkable downtowns. As a result, the automobile became almost the only way to travel, and traffic increased exponentially, bringing with it congestion and frustration. Sixty-nine percent of the increase in traffic can be attributed to factors associated with sprawl" (2010, p. 1). This is a major issue for large cities like Houston, TX, where everything is so widespread and the solution is to build away from the center of the city. Population growth is another major contributor that can cause sprawl, due to the fact so many people need to move in and around the city. One logical option is to spread out and commute to find better jobs and/or housing. Still a number of scholars argue against sparse development patterns. "Urban Sprawl negatively affects the community with the continued outward expansion of an urban area (politicians who believe in expansion do not call it sprawl), and Smart Growth promotes development within an existing area" (Serrano, 2008, p. 1).

Smart Growth

Smart Growth, ideally aimed to achieve various valuable land use objectives, is structured for neighborhoods and livable communities to have easy and accessible land use patterns that reduce the amount of mobility required to reach goods and services. Investing time,

cost, attention and the necessary resources to revitalize older suburban communities and towns, would be some of the basic steps needed. This alternative to sprawl not only accommodates the void of transit and pedestrian orientation in the community; it is also designed in a way that will accommodate that particular town. According to Smart Growth America, "Smart Growth transportation provides choice and convenience, and is coordinated with the way the community is growing. The movement is already catching on in many places. Communities such as Dallas, Denver and Salt Lake City have built new transit systems and have seen ridership exceed projections. Other communities have put some highways on a *road diet*, taking unneeded lane space for amenities such as sidewalks, plantings, express buses or bicycles." Smart Growth is a fundamental concept of TOD, using available land use to design livable communities where public transit can be utilized. Clearly, the basis for urban sprawl opposes smart growth. Table 1 gives a comparison between urban sprawl and smart growth. This evaluation clearly defines smart growth as the better option as far as transportation planning. For instance, smart growth defines transportation as having more transit options and better usage of land patterns. Whereas, urban sprawl is geared towards personal vehicles and a variety of residential designs that have less public facilities such as markets, cleaners, shopping centers, and local businesses. As stated previously, smart growth is similar to TOD and public transit is a major concept of TOD. Most communities must have population growth to obtain funding for transportation facilities. The larger the population in the community, the easier it is to have mass transportation facilities. The City of Houston's Transit Corridor program is designed to do exactly that along the Houston rail corridors. "TOD puts bus and train stops at the center of communities so that housing, offices, and shops are all within walking distance. People have more opportunities to live or work near a bus or train and to run errands on foot on their way to or from the bus and train" (Smart Growth America). If people are located in the vicinity of transit and mixed use developments, then it becomes less of a problem to do daily commutes. We choose to use our privately owned vehicles to drop off kids at school, to shop, and to go for a doctor's appointment; some trips may be best made in a personal vehicle. Therefore, trying to eliminate sprawl will be difficult. However, residing in a TOD environment does reduce driving and increases the use of transit.

Table 1. Comparing Sprawl and Smart Growth

Attributes	Smart Growth	Urban Sprawl
Density	Higher-density	Lower-density
Scale	Smaller buildings, blocks and roads. Careful detail, since pedestrians experience the landscape up close.	Larger buildings, blocks, wide roads. Less detail, since people experience the landscape at a distance, as motorists.
Transportation	Multi-modal transportation and land use patterns that support walking, cycling and public transit.	Automobile-oriented transportation and land use patterns; poorly suited for walking, cycling and transit.
Street design	Designed to accommodate a variety of activities. Traffic calming.	Designed to maximize motor vehicle traffic volume and speed.
Planning process	Planned and coordinated between jurisdictions and stakeholders.	Unplanned, with little coordination between jurisdictions and stakeholders.
Public space	Emphasis on the public realm (streetscapes, pedestrian environment, public parks, public facilities).	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs).

Source: (Evaluating Transportation Land Use Impacts, 2006.)

Public Transportation for the Suburbs

An obvious shortcoming in most suburbs is the level of public transportation available, which leads to the question of whether the suburbs will get public transportation facilities to accommodate the residents in their communities.

It is important to understand the difference between urban areas and non-urban areas. Non-urban areas, unlike urban communities, do not support public transportation well. Most suburban areas lack the public transit needed to commute their residents from work, school, or other everyday activities. These residents must mainly rely on their personal vehicles to transport them to and from their destinations. However, because transit facilities are missing in most suburban communities, and because residents are so heavily dependent on their vehicles, it is challenged if the residents would take advantage and utilize the offered public facilities. "The goals of the non-urbanized formula program are: 1) to enhance access of people in non-urbanized areas to health care, shopping, education, employment, public services, and recreation; 2) to assist in the maintenance, development, improvement, and use of public transportation systems

in rural and small urban areas; 3) to encourage and facilitate the most efficient use of all Federal funds used to provide passenger transportation in non-urbanized areas through the coordination of programs and services; 4) to assist in the development and support of intercity bus transportation; and 5) to provide for the participation of private transportation providers in non-urbanized transportation areas to the maximum extent feasible", according to the FHWA (2009). Public transit is the key to having a successful TOD, because not only is the mixed-use development practical, there must be transit available, which brings me to my research focus - Are suburban communities likely to survive with transit facilities, like major urban areas?

Research Focus

This study will ultimately determine if it will be beneficial or advantageous to have transit facilities in suburban developments. Since mixed-use suburban environments often do not support transit properly, and the urban environments tend to better support transit, the target is to effectively construct a suburban environment in which transit facilities are available and utilized. Can TOD replicate some urban features in a suburban environment and be effective? Through this study, we seek an understanding of the rationale of TOD and its meaning to the community. This research will determine the impact transit has on mixed-use developments and attempt to explore such questions as:

- What is the magnitude of ridership in the Woodlands compared to Pearland and Sugar Land?
- What effect does public transit have on each of the three communities?
- What is the potential perspective of Pearland and Sugar Land residents if they had more public transportation?

The following chapters of this study will attempt to explore a comparison of two fairly new suburban transit deficient communities with a long established suburban community that has elements promoting use of transit modes other than the single person automobile.

- *Town Square in Sugar Land, TX*
- *Town Center in Pearland, TX* against a TOD;
- *The Woodlands Town Center in The Woodlands, TX*

CHAPTER 2

LITERATURE REVIEW

Suburban public transportation is lacking a sufficient system. A public transportation system needs to be created for all suburban areas so they can benefit from it as others do (Mefford, p.1). To effectively transform a mixed-use community into an urban environment that accommodates transit facilities, we must first understand the definition of TOD and its purpose. One focus of TOD is eliminating sprawl in and around cities. Sprawl contributes to air pollution, social alienation, and long commutes; although, sprawl may be the answer people are looking for when it comes to affordable real estate on the outskirts of the city (Crane and Chatman, 2003). Having real estate located in a sprawling environment is a disadvantage because of the time and effort spent in having to travel to an area for shopping, business usage, and other purposes. Further, sprawl arguably increases public costs for all residents. "In sprawling cities, the available infrastructure resources are drained to finance for the construction of new roads, schools and sewage systems. This undermines the effective maintenance of existing infrastructure. In addition, exurban development increases the societal cost for transportation. This is because, in general, sprawling areas try to accommodate the growing traffic by expensive retrofits of roads and highways" (McElfish, 2007).

Purpose of Transit-Oriented Development

TOD is a beneficial approach to modern day living and a great way to help the environment. Unfortunately, the suburban environment is only a mixed use development without the transit facilities. "What's the difference between a true transit-oriented development, which will deliver promised social and economic benefits, and a transit-adjacent development? A true TOD will include most of the following: transit that lies within a five minute walk, transit services that are fast, frequent, reliable, comfortable, and traffic calming" (Siegman (2003, p. 17). It is correct to infer that a livable and successful TOD community must accommodate transit, but a TOD without the transit puts a different spin on the development. "To be most effective, TOD should have similar attributes to its urban counterpart even in a suburban setting. Pedestrian scale design draws people to return again and again. Urban development supports

transit; suburban development generally does not. This is a powerful idea once established. The concept includes mixed use, higher density, buildings at the sidewalk, less private and more public open space, smaller blocks, narrow streets with wider sidewalks, street trees and lights, lower parking ratios, shared parking, parking behind buildings, and on-street parallel parking" (Markus, 2000, p. 1).

Typical suburban developments are not equipped with transit facilities such as circular buses, light rail, commuter buses, or developed feasible sidewalks for walking and biking because most people are heavily dependent on their own transportation. People who live near transit stops have a much higher rate of transit usage than the typical resident who has to drive to a park and ride location. "Studies have established statistical correlation between built environment and travel behavior: residents of traditional neighborhoods do drive less and walk more than residents of suburban neighborhoods" (Handy, Mokhtarian, 2005).

Suburban residents lack the livable communities needed to comfortably feel the necessity to walk; with sidewalks only in some areas and not all, residents are forced to walk on the street. "Creating sustainable transport systems that meet people's needs equitably and foster a healthy environment requires putting the automobile back into its useful place as a servant. With a shift in priorities, cars can be part of a broad, balanced system in which public transport, cycling, and walking are all viable options" (Lowe, 1990). The habit of depending on private transportation is a handicap. There must be a suitable way to reduce the use of single occupancy vehicles and have it as an option rather than the only means of transit. In order to effectively sustain a healthy environment, public transportation, cycling, and walking is vital.

Planning for Transit-Oriented Development

Determining the effect of TOD in a suburban environment when compared to an urban environment has to do with the purpose of TOD. It's understood that TOD is designed to bring communities together by having residents centered in a place where they can work, shop, gather, and take care business. A planner could question whether a suburban area is too small for at least one mode of public transportation. However, large suburban areas like Pearland and Sugar Land may be able to support transit because most suburbanites ride public transportation to work. In some cities, due to increased rider demand, transit lines are being extended to outlying suburban

communities and bus shuttles carry workers from rail lines to employer destinations. For service and entry-level employees with limited mobility options, transit is a key link to suburban-based jobs (The National Business Coalition for Rapid Transit, 2003). When a suburban resident ventures to an urban area, for whatever reason, one option would be to ride transit to get back into town. This may reduce some congestion; unfortunately, most suburban trips are auto-dominated and thus become the problem of traffic management in the suburban areas.

The overwhelming majority of suburban areas in the United States are oriented only to automobile travel. Most suburbs do not accommodate bicyclists and pedestrians, and they rarely provide good access to transit (with a few exceptions). With all this in mind, it is necessary to expand walking and bicycling travel opportunities in the suburbs without eliminating the car. Suburbs were organized around automobile travel and, in many instances, won't function well without it (Federal Highway Administration, 2007). According to the FHWA, suburbs are much smaller than urban communities and mainly rely on their own automobiles versus public transit unless transit is offered directly to their destination (e.g. Park and Ride). However, reducing the automobile travel and implementing a pedestrian friendly community is the key to changing traditional norms. It cannot be argued that the suburbs are automobile dependent, however, it is never too late to start in a suburban community adapting to include public transit.

This TOD design section identifies the suburban and urban communities considered in evaluation.

Table 2. Largest U.S. Urbanized Areas Ranked by Square Miles of Sprawl

Urbanized Area (ranked by sprawl)	Square Miles of Sprawl (growth in land area)
Houston, TX	638.7

Source: (Sprawl City, 2008)

"Clearly, the amount of rural land lost to sprawl is the key issue from an environmentalist and agricultural perspective. The amount of rural land lost and urban expansion is also significant to the quality of life for urban dwellers. The larger an urban area, the more difficult it will be for the average resident to reach the open spaces beyond the urban perimeter; the increase in urban distances can also affect commuting time, mobility and a resident's feeling of being "trapped" (Sprawl City, 2008, p. 2). Research in Portland, OR, has shown that the residents of

neighborhoods with adequate transit access and mixed-use development use their cars less than residents of suburban neighborhoods: only 58 percent of trips are by auto in mixed-use neighborhoods with adequate transit access compared to 87 percent in suburban neighborhoods. Research in California showed that people who live in TODs are five times as likely to use transit as residents of the region at large, and people who work in TOD are three and a half times as likely to use transit (Reconnecting America, p. 13). The creation of a neighborhood or district with housing, shopping and job opportunities placed in an environment that promotes walking and transportation choices is a TOD. These transit-oriented districts can be around heavy rail, light rail, streetcars or even bus, and they can be in both urban and suburban locations. The goal is to make it possible for residents to live convenient, affordable, active lives by providing multiple housing and transportation choices including access to regional transit (Poticha, 2007, p. 3). Transit, surrounding housing, is a major factor for TOD communities because the families that surround the TOD designs make up the population that will utilize various transportation modes and drive to area businesses. It is more likely that if the community is conveniently located within reasonable miles from public transportation, then the residents of the community will maximize their use of transit facilities.

Most TOD entails the maximum densities that are high enough to allow transit. With high gas prices prompting a surge in transit ridership to 52-year-highs, there are calls to dramatically increase investment in public transit. The danger, however, is that transit advocates might take their argument about the successes of transit too far. Indeed, this may well be the case with the so-called claims about "transit-oriented development," or TOD, where transit advocates often suggest that transit is a driver of economic development (Staley, 2008, p.1). As a consequence of auto-oriented planning, many station areas lack the infrastructure necessary to make people feel comfortable walking or biking to the transit stop. Large, dark parking lots separate pedestrians from station entrances, not to mention the major arterials and freeway overpasses that surround them. For the many benefits attributed to TOD to work, it has to be integrated into the landscape with easy accessibility to transit, including well-lit streets, comfortable sidewalks and street side amenities. Sprawl — uncontrolled, poorly planned, low density, and single-use community growth — depends on individual motor vehicles to flourish. As people move farther and farther from cities, they inevitably will travel longer distances to work, shop, and play. From 1960 through 1990, the percentage of workers with jobs outside their

counties of residence increased by 200 percent, while the proportion of workers commuting within their counties of residence declined. This trend contributed to an increase in the number of vehicle miles traveled in passenger cars — an increase of more than 250 percent (915 billion miles) from 1960 through 1997 (Jackson & Kochtitzky p. 5). TOD has increased transit ridership, on the other hand, because not all TOD residents take transit and as an alternative drive, dense developments will congest the nearby road and intersections during peak periods, which brings me to my next point.

Automobile Impact on the Environment

As a resolution to the high number of vehicles that travel daily and contribute to the poor air quality, more public transit options is a huge necessity. Cutting down the number of personal vehicles traveling during peak hours, which are mostly work trips, and having the citizens commute via light rail, bicycle, walking, or carpool can help the environment. Transportation problems in urban areas are intrinsically linked to air quality and energy consideration. Increasing demand for transportation has become the largest contributor to poor air quality in many U.S. cities. Even Houston, where point source emissions from manufacturing facilities continue to pose a challenge, mobile sources will become increasingly important in emission discussions as point source emissions are reduced substantially over the next few years (Hitchcock, p.1). The choice to drive cars long distances to work was common among people in North America and Europe in the past 60 years. The development of suburbs often placed homes far from work places which led to massive road construction from extravagant car use. Commuting had health and economic consequences for them personally and for every other inhabitant of planet earth.

The Environmental Protection Agency (2010) notes, “Emissions from an individual car or truck are generally low, but add up the emissions from millions of vehicles in use every day and you have serious air pollution. Driving your car probably causes more pollution than anything else you do today - and you have the power to fix that! ” Figure 1 is an image of the percentage of emission that is produced by different vehicle types.

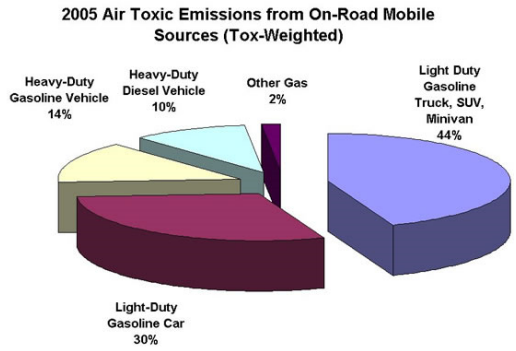

Figure 1. Air Toxic Emission from On-Road Vehicles

Source: (Department of Environmental Protection, 2010.)

Pedestrian Transportation

Pedestrian transportation is the key to improving mobility, particularly in striving towards a successful TOD community. Bicycle and pedestrian modes of travel are recognized nation-wide as cost-efficient ways to address mobility and air quality concerns while improving physical health and quality of life (North Central Texas Council of Governments). However, it is also argued pedestrian transportation is not safely available or designed in a way to transition the citizens who choose to walk or bike. In the last 15 years, more than 76,000 Americans have been killed while crossing or walking along a street in their community. More than 43,000 Americans – including 3,906 children under 16 – have been killed this decade alone. This is the equivalent of a jumbo jet going down roughly every month, yet it receives nothing like the kind of attention that would surely follow such a disaster (Transportation for America, 2010). As referenced in Figures 2 and 3, the most dangerous metropolitan areas in the U.S. for walking in 2007-2008 were:

Rank	Metropolitan Area 2007-08
1	Orlando-Kissimmee, FL
2	Tampa-St. Petersburg-Clearwater, FL
3	Miami-Fort Lauderdale-Pompano Beach, FL
4	Jacksonville, FL
5	Memphis, TN-MS-AR
6	Raleigh-Cary, NC
7	Louisville/Jefferson County, KY-IN
8	Houston-Sugar Land-Baytown, TX
9	Birmingham-Hoover, AL
10	Atlanta-Sandy Springs-Marietta, GA

Figure 2. Images of Dangerous Walking Areas

Source: (Transportation for America, 2010)

Walking is great for your health and helps the environment. It can also be extremely hazardous in the Houston region, where car-oriented development and wide, busy commercial strips create a hostile environment for foot traffic (Feibel, 2009). Pedestrian safety improvements depend on an integrated approach that involves the 4E's: Engineering, Enforcement, Education, and Emergency Services (FHWA, 2009). Houston, along with other cities, has adopted various tools to reduce accidents from happening by pedestrian mobility.

- Traffic calming and street design which includes a host of engineering techniques used to physically alter road design for the purpose of slowing traffic and improving safety for bicyclists and pedestrians.
- Complete Streets policies ensure that future road projects consistently take into account the needs of all users, ages and abilities, particularly pedestrians and bicyclists and they also reduce speeding.
- Safe Routes to School programs take a comprehensive approach to improving safety around schools for children walking and bicycling with engineering upgrades and improvements.

- Walkable neighborhoods are safe and inviting for walking and bicycling - such as lighted communities at night, sidewalks in open areas, and correct signs and signals for walking and biking. The characteristics described above are very important in understanding the concept of TOD and its effect on suburban and urban communities. The TOD design is intended to focus suburban residents and urban communities to maximize access by transit and non-motorized transportation. These characteristics serve as the very substance upon which the concepts of livable communities are based - walkable neighborhoods, improved safety near schools, and traffic-calming.

CHAPTER 3

DESIGN OF STUDY

The data will be used to assess characteristics of two mixed-used developments, Pearland Town Center and Sugar Land Town Square against a well developed Transit-Oriented Design, Woodlands Town Center. The descriptions of the subjects and the recurrent updating of information regarding TOD will come from internet sources. Other data will be solicited from the Metropolitan Planning Organization (MPO), Houston-Galveston Area Council (H-GAC), which is the regional organization through which local governments consider issues and cooperate in solving area wide problems.

H-GACs' data service department provided supplemental information on the areas to be analyzed. This was conducted to establish the parameters of the study and to determine data sources.

The interview supplemented the literature review process which was a difficult aspect of this thesis because of the limited quantity of information available, specifically regarding the TOD in the suburban environment. Consequently, the literature reasonable for this TOD evaluation was researched and selected from a variety of TOD websites and has been studied, evaluated and applied. Gaining an understanding of sprawling environments, its disadvantages to the community and commuters, and how suburban environments can be considered mixed-use despite a lack of public transportation, proved valuable. Important is the understanding that TOD is designed to bring communities together by having residents centered on a place to work, shop, gather, and take care business.

Three communities were originally considered for evaluation. Out of the communities, two suburban mixed-use communities were evaluated against one urbanized transit-oriented developed area project to determine if they exhibit the key traits that would allow them to transition to transit oriented developed environments.

The case studies listed for evaluation are:

- Sugar Land, Texas (Town Square)
- Pearland, Texas (Town Center)
- The Woodlands, Texas (Town Center)

The selection of these areas is an outgrowth of a Transportation Research Board (TRB) presentation on this topic. TRB committee members expressed an interest in the suburban communities.

Concluding this thesis, the comparison will be clearly defined and will allow the reader the opportunity to consider both sides of the issue and establish whether or not future communities should be designed with TOD in mind. Specific tasks are as follows:

- Task 1: Conduct a literature review of findings targeting suburban communities with and without transit.
- Task 2: Collect data and evaluate characteristics of the three case study communities.
- Task 3: Evaluate criteria characteristics.
- Task 4: Interview professional planners to gather supplemental data.
- Task 5: Gather statistics on travel time to and from communities.
- Task 6: Synthesize findings from Tasks 1 through 5 and prepare the final report.
- Task 7: Develop Summary Conclusions and Recommendations.

Subsequently, discussing relevant information on TOD and how it is associated with sprawl, the environment, and most significantly transit, the evaluation and results should paint a clearer picture. Now that the leading information has been given, the evaluations of data and results can be presented.

CHAPTER 4

RESULTS AND DISCUSSION

Determining Variables for the Evaluation

It was a challenge selecting from the many communities that currently utilize or are in the process of moving towards the concept of TOD. As stated previously, the selection of these areas is an outgrowth of a TRB presentation on this topic. Committee members from TRB expressed an interest to the suburban communities. Nevertheless, after much consideration and research of the individual communities, for the intent of this analysis, three communities were chosen that would be best for this study. The determining variables used for this evaluation are listed below:

- Population
- Number of housing units with respect to TOD
- Transit impact on urban & suburban environment

Population was important to consider in suburban areas as well as urban areas, for the purposes of this research, in order to show that TOD can be implemented despite the size of a community. The second consideration was the number of housing units in the TOD area. The population in the TOD area varies depending upon the number of available residential spaces. More housing in the area could possibly make a successful TOD; after all, the residents are the group that will support the area businesses. The third consideration involved the impact of transit in the suburban communities. Do these suburban communities have transit and what impact would it have on them? This issue was key in determining the variable factors considered in order for a TOD to have transit facilities.

Design of Elements of Transit-Oriented Development

Transportation engineers and planners have been working to develop a resolution to traffic congestion; consequently, TOD is one of the alternatives. As stated earlier, a TOD should be built as part of a mixed-use development area with public transit surrounding it. Design

elements of a TOD are as listed:

- Efficiently uses public and private resources
- Positively address side-effects of growth
- Efficiently uses L=land
- Enhances mobility conveniently
- Presents a sense of public safety
- Is pedestrian friendly
- Has bus or other public transit mode
- Creates a sense of place and identity
- Provides alternative to suburban living
- Is consistent with air quality goals

"Transit-Oriented Development can help a municipality achieve multiple sustainable development principles. First and foremost, TOD promotes transportation choices, reducing auto usage. TOD also results in efficient use of existing land, infrastructure, and services, and supports the revitalization of community centers and neighborhoods by encouraging reuse and infill" (Smart Growth/Energy Toolkit, p.1). Affordable housing frequently is a major place in TOD. Households with low or moderate incomes are attracted to transit access and are likely to own fewer cars and occupy more space efficient dwellings, meaning that they can take full advantage of the transit facilities. While transit is essential to TODs, access for pedestrians, bicyclists and automobiles is also important.

Should Our Communities be built with Transit Options in Mind?

This research analyzed The Woodlands, TX, as a suburban community which supports TOD very well. Per the design elements listed above, they establish 10 out of the 10, including the pedestrian and bicycle paths, water ferries and circulator bus service. In comparison Pearland, Texas and Sugar Land, Texas do not support transit facilities well, but do show 6 design elements out of the 10 design elements including: positively addressing side-effects of growth, efficient use of land, presents a sense of public safety, is pedestrian friendly, provides an alternative to suburban living, and creates a sense of place and identity. Subsequently, in choosing these communities, the fact that they had already begun to incorporate more pedestrian-oriented transportation improvements as a part of everyday life shows that it can be achieved. Figure 3 lists the various communities that were considered for this study.

FINDINGS	SUBURBAN AREAS: LOW TRANSIT		SUBURBAN TOD AREAS
Study Areas	Pearland, TX (Town Center)	Sugar Land, TX (Town Square)	The Woodlands, TX (The Woodlands Town Center)
Established Date	2008	1996	1994
Destination from Downtown	20.3 miles	22.9 miles	29.4 miles

Figure 3. Description of Case Studies

Below is a map of the case studied areas with Houston, Texas as the center.

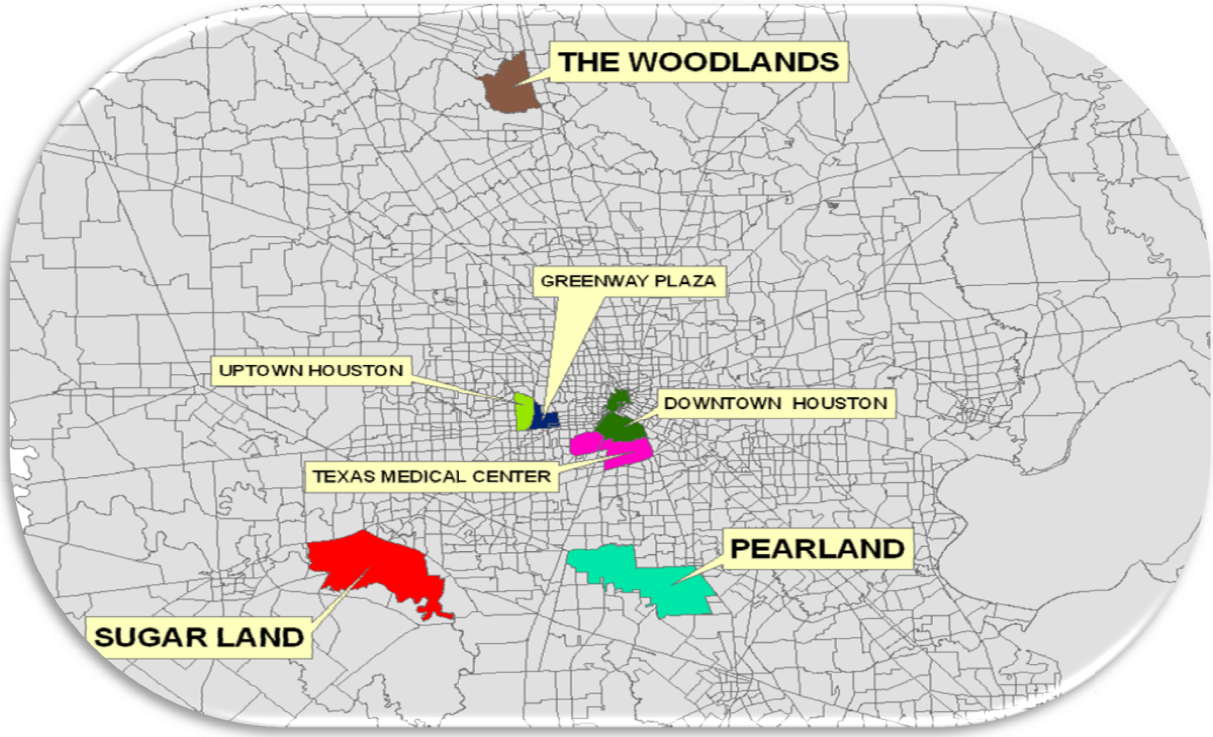

Figure 4. Map of Case Studies

The Woodlands Town Center

The Woodlands, TX, was originally founded in 1974 and is located 30 miles north of Houston, TX. It is known as the best-selling master-planned community in Texas since 1990. The Woodlands carefully integrates a range of recreational amenities, residential neighborhoods (see Figure 5), commercial office spaces, retail shops, entertainment venues and more in a naturally beautiful setting. In fact, 28 percent of The Woodlands is dedicated to green space – including parks, pathways, open spaces, golf courses and forest preserves. It's the perfect blend of nature with today's modern conveniences – for everyone (The Woodlands Development Company, p. 1). As of January 1, 2009, the growing population stood at 89,397 median household income was $115,481 along with over 44,200 employees, and over 37,000 households. When it comes to a business environment for corporate and recreational, The Woodlands Town Center is 1,000-acres of regional focal point for business, shopping, dining, entertainment and cultural events. The Woodlands Town Center has become a model of new urbanism; a pedestrian-friendly enterprise center full with business and everyday activity and events.

Center to the Town Center is The Woodlands Waterway, a 1.4-mile linear park that invites visitors or residents to cruise in a water taxi and travel to offices, restaurants, urban residences, shopping centers, hotels, parks and landmarks along the way. Currently under construction is the extension to the west that will link Town Center's 18 million square feet of commercial, residential and office spaces to 200-acre Lake Woodlands. More transportation options include a landscaped network of paths for pedestrian travel and the new trolley system. Also, the Town Center consists of The Woodlands Mall, a 1.3 million square-foot shopping center, which boasts a 150,000 square-foot retail and restaurant courtyard near The Waterway. Market Street, a 34-acre "Main Street", features a continually growing collection of upscale shops and restaurants clustered around a central park (The Woodlands Development Company, p. 2). Transportation is never an issue as water taxis, trolleys (see Figure 6), and park and ride, circular bus, and walking paths create a pedestrian-friendly urban center. The Town Center would be considered a livable community, not only because of the TOD usage, but of the green space that makes the town environmentally safe.

Figure 5. The Woodlands Town Center

(Source: The Woodlands Convention & Visitors Bureau, 2010).

Figure 6. The Woodlands Waterway Trolley

(Source: The Woodlands Convention & Visitors Bureau, 2010).

Figure 7. Water Taxi

(Source: The District, 2010).

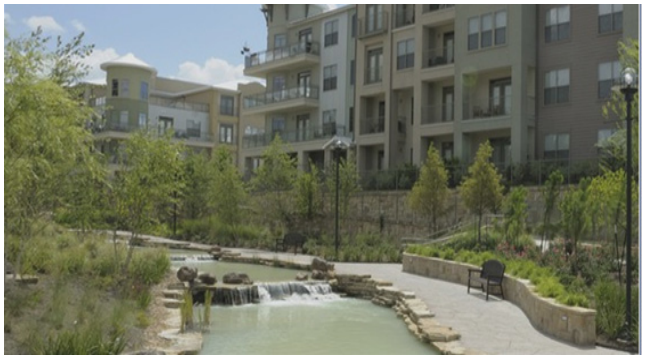

Figure 8. Apartment Living

(Source: The Woodlands, 2010).

As seen in Figure 9, these retail shop are desgined for pedestrian venture, and there are no parking spots available for vehicles in front of the shops.

Figure 9. The Woodlands Mall

(Source: The Woodlands, 2010)

Figure 10 shows the population increase in the Town Center area; seemingly, the population increased its greatest amount between 2009 with 35,206 people to 36,561 people in 2010. It is predicted the population will continue to grow in the Town Center area.

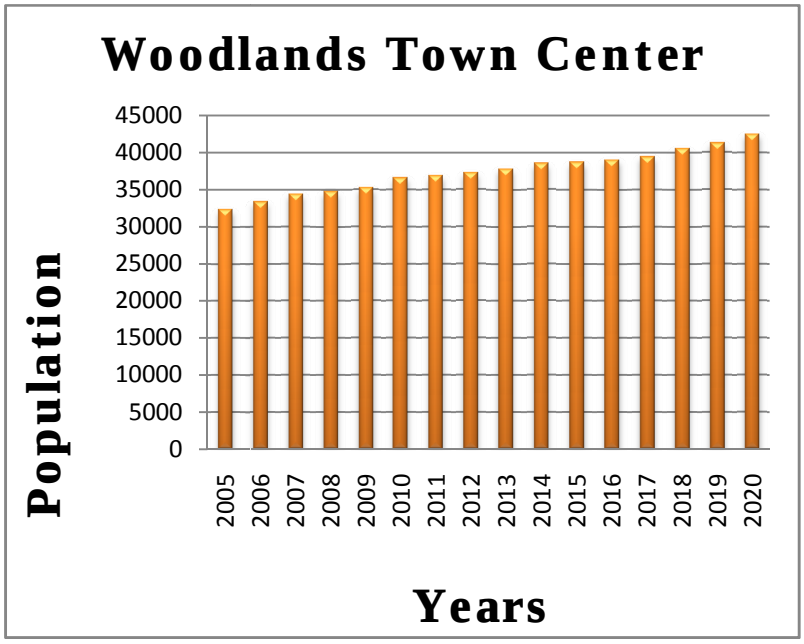

Figure 10. The Woodlands Town Center Population

Figure 11 shows the housing increase in the Town Center area; from 2010 to 2020 it is projected by H-GAC that the number of housing will continuously increase in this area.

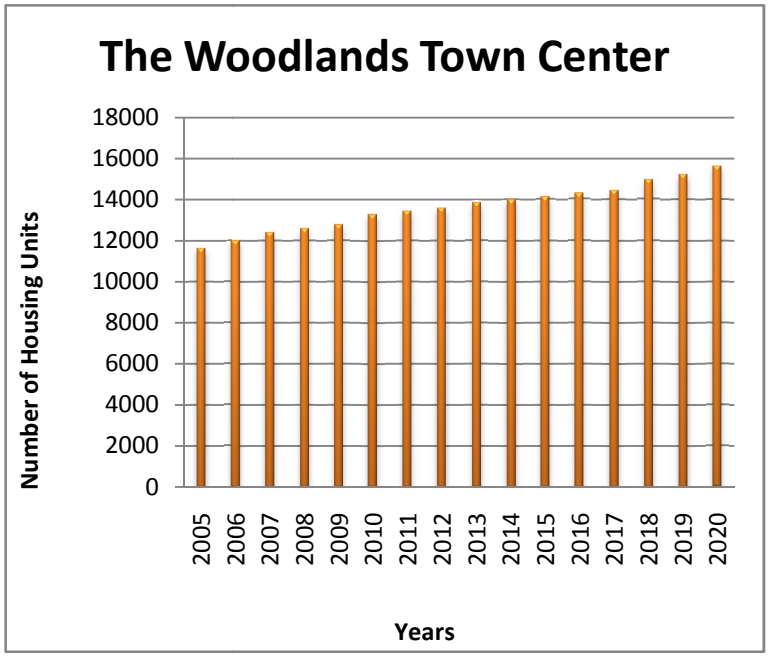

Figure 11. The Woodlands Town Center # of Housing

Figure 12 shows the jobs increase in the Town Center area, according to H-GAC data, 2010 is the highest increase in jobs since 2005. Between 2010 (# of jobs = 24603) and 2011 (# of jobs = 24724), there will not be much of an increase.

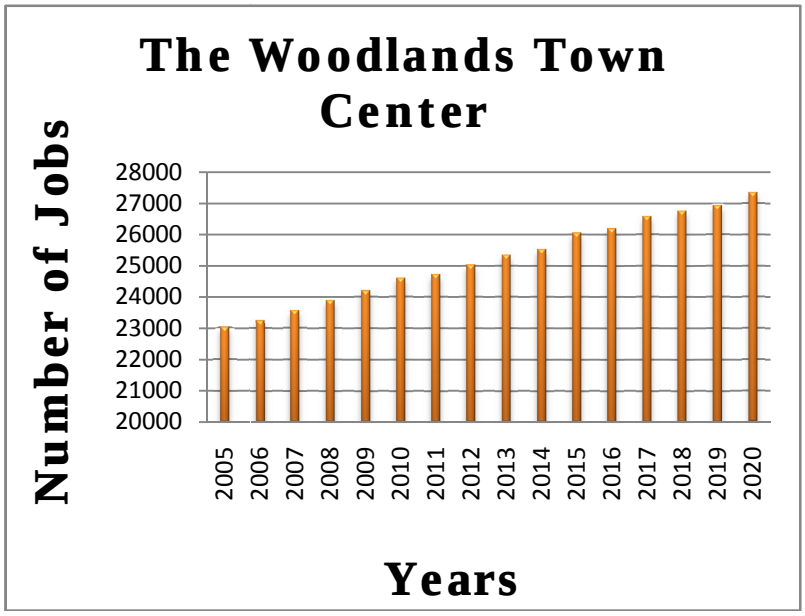

Figure 12. The Woodlands Town Center # of Jobs

The Woodlands has been successful in maintaining its TOD planning and design, with a growing community, growing job market and housing. In addition, transportation facilities are available for residents. The Woodlands Town Center, a suburban area, can and does serve as a urban environment now it will be compared to suburban areas with mixed-use designs with no transit options.

Sugar Land Town Square

The city of Sugar Land, Texas, was incorporated in 1959 from a sugar plantation in the mid 1800s and is located approximately 20 miles from downtown Houston. Sugar Land was presumed to be one of the fastest growing cities in Texas, and the community offers outstanding schools, libraries, civic organizations and other resources that make Sugar Land a great place to work, live and raise a family. In 2009, Sugar Land was named the eleventh safest city in America, a distinction based on an analysis of FBI crime statistics, just one of their outstanding

awards. This city residential real estate market is growing to meet demands of the developing population. The city boasts numerous, exceptional master-planned communities, with new developments in the works (Sugar Land, 2010). Town Square is a 1.4 acre pedestrian-oriented, main-street city center and central business district that is within walking distance of stores, services, restaurants, sidewalk cafes, entertainment and a hotel and conference center. This plaza was developed in 1996 when the economy was strong and the businesses were flourishing. The town offers a unique blend of designer stores, gourmet restaurants, trendy cafes and community events, with one, two and three-bedroom condominiums available, ranging between 838 to 1,526 square feet for residents who love the city's style. Figure 13 shows the shopping area at Town Square. This community is set up for TOD mixed-use and is designed for pedestrian gathering and walking, not for vehicles to pull up and park in front.

Figure 13. Sugar Land Town Square I

(Source: Sugar Land 2010)

Figure 14 is an image of Sugar Land Town Square. To the right, in the image, are condominiums and below the condos are boutiques. The center of the image shows the Sugar Land City Hall building. Directly across from the condos is a steak restaurant which is convenient for the residents. The image to the right is a better shot of the condos.

Figure 14. Sugar Land Town Square II

As shown in Figure 15 the Town Square population soared between 2005 and 2006 and it is foreseen to stay almost steady until 2010, where the population increases very little.

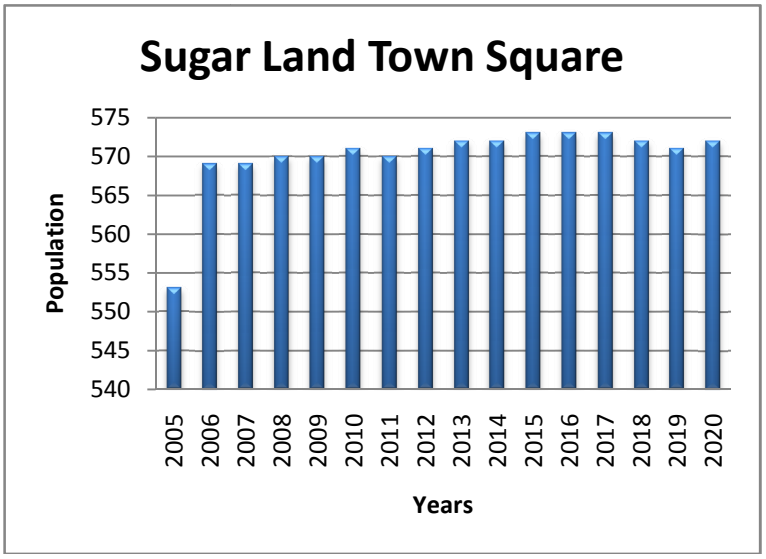

Figure 15. Sugar Land Town Square Population

Figure 16 is a graph of the housing increase in the Town Square area; it is evident that Sugar Land Town Square area, unlike The Woodlands Town Center, is unstable from year to year. Year 2010 to 2020 is projected by H-GAC that the number of housing will continuously jump around. However, 2012 is supposedly going to be the least number of housing.

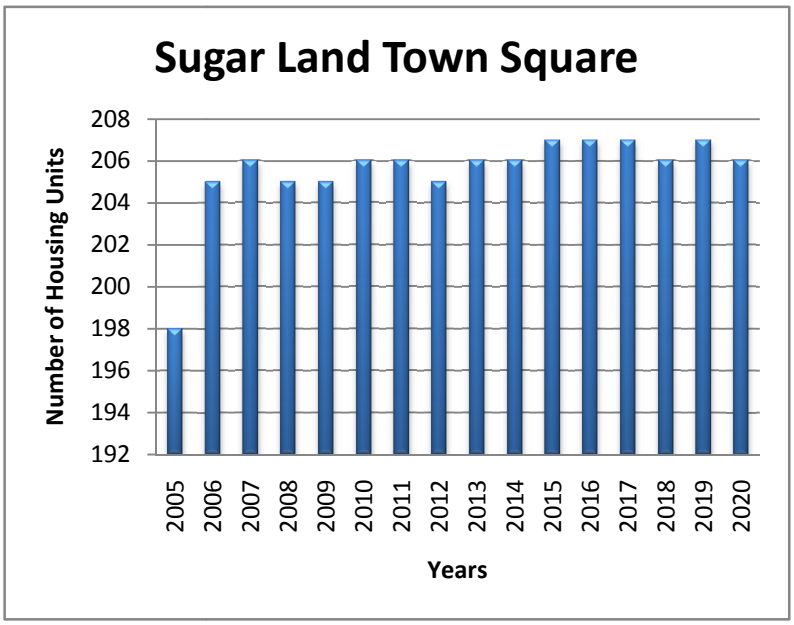

Figure 16. Sugar Land Town Square Housing

Below is the chart of Sugar Land Town Square jobs from years 2005 to 2020. The numbers of jobs are much greater than the housing; it does not illustrate an even ratio.

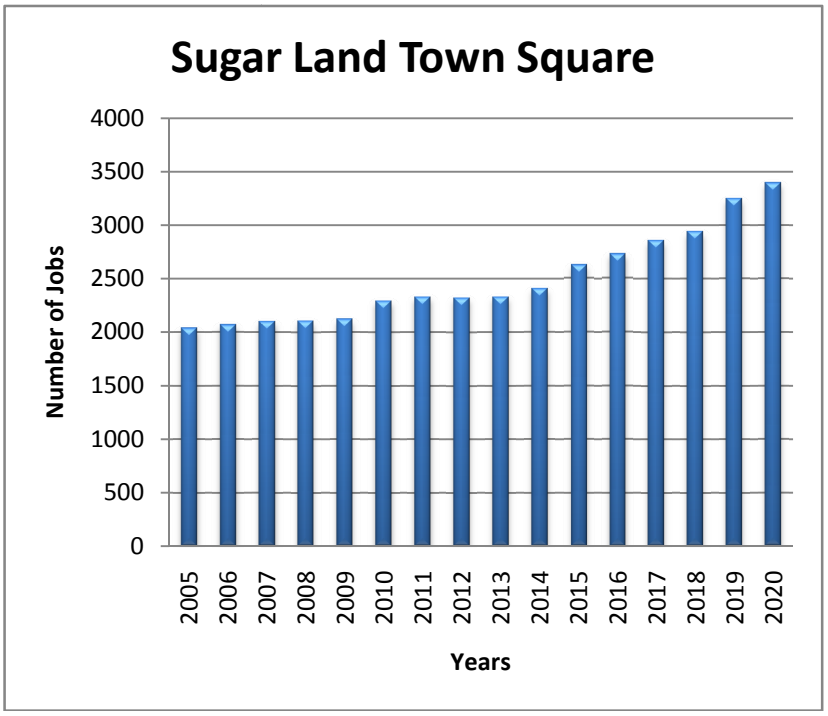

Figure 17. Sugar Land Town Square Jobs

Pearland Town Center

Pearland, Texas, was established in 1894, located 14.1 miles from downtown Houston. Pearland Town Center is a newly developed area opened July 2008 and stretches 1.2 million-square-feet. The Town Center includes retail, residential and office space, hotel developments, as well as a 25-acre lake, walking paths and parks. Figure 18 is an image of the Pearland Town Center design; to the left are residential apartments and in walking distance directly ahead are the shopping centers.

Figure 18. Pearland Town Center

Below are graphs of the population, number of housing units and number of jobs in the Town Center from 2005 to 2020.

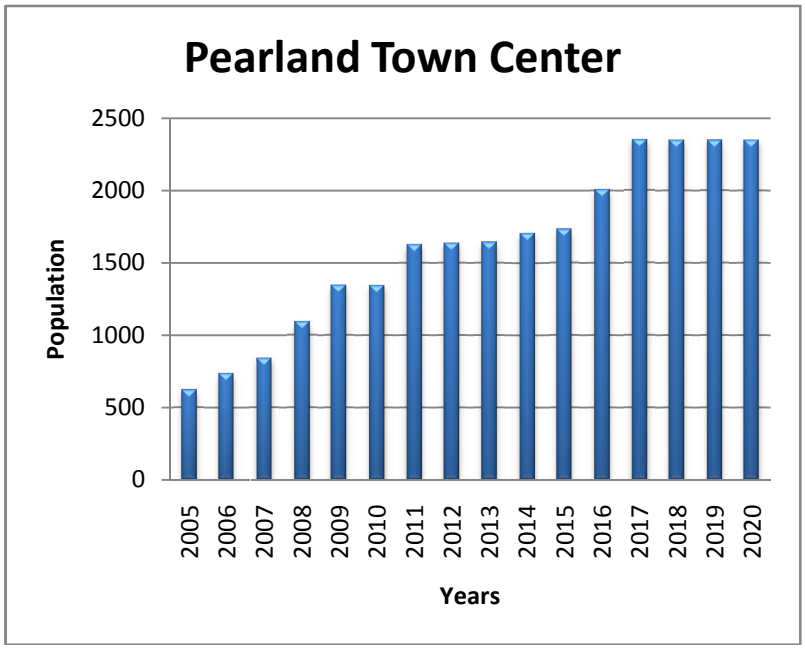

Figure 19. Pearland Town Center Population

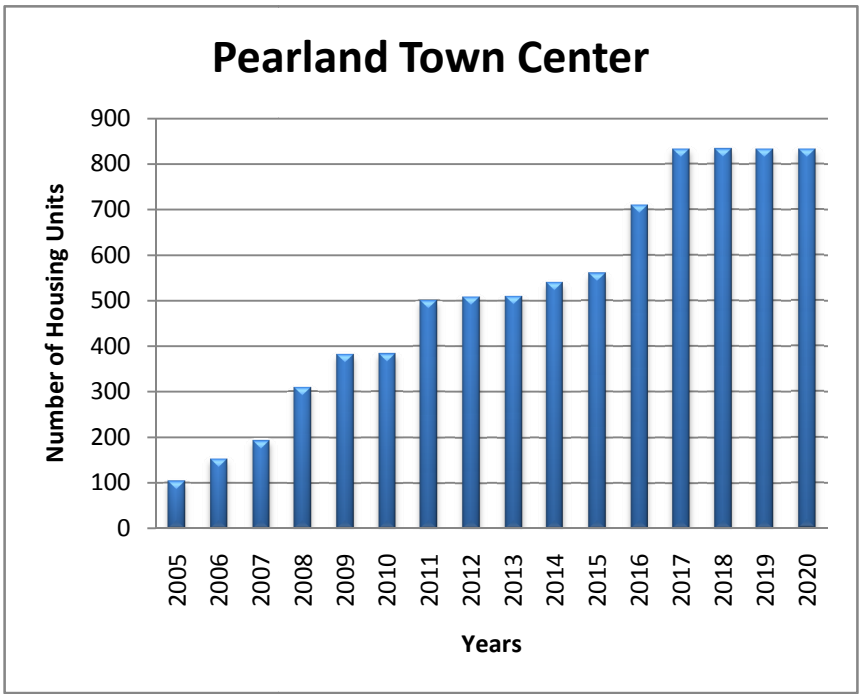

Figure 20. Pearland Town Center Number of Housing Units

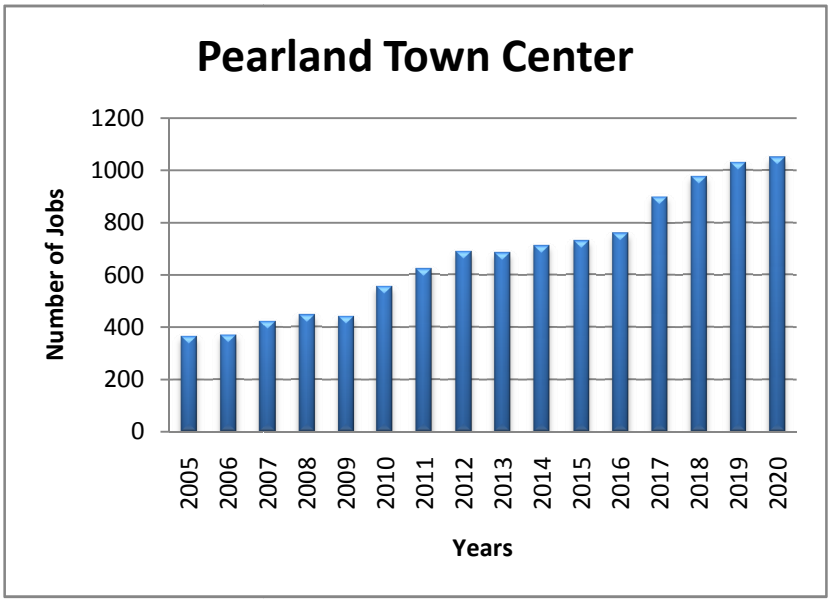

Figure 21. Pearland Town Center Number of Jobs

The graphs display the activity before and after the Town Center development as well as future predictions. After close obversation, it is apparent that population in this instance is growing far more rapidly than housing or jobs. Each of the studied areas will be closely compared to understand how population, number of jobs, and number of housing units impact the suburban communities.

Case Study Comparison

The final observation was graphing and analyzing the past five years to see the trend in housing, population, and jobs in the selected TOD areas.

Figure 22 displays Pearland Town Center's population, number of housing, and number of jobs from 2005 to 2009. To reiterate the point made earlier, this Town Center was opened in 2008 and, according to the data given, population has soared, and the jobs to housing balance evenly grew and almost became equal.

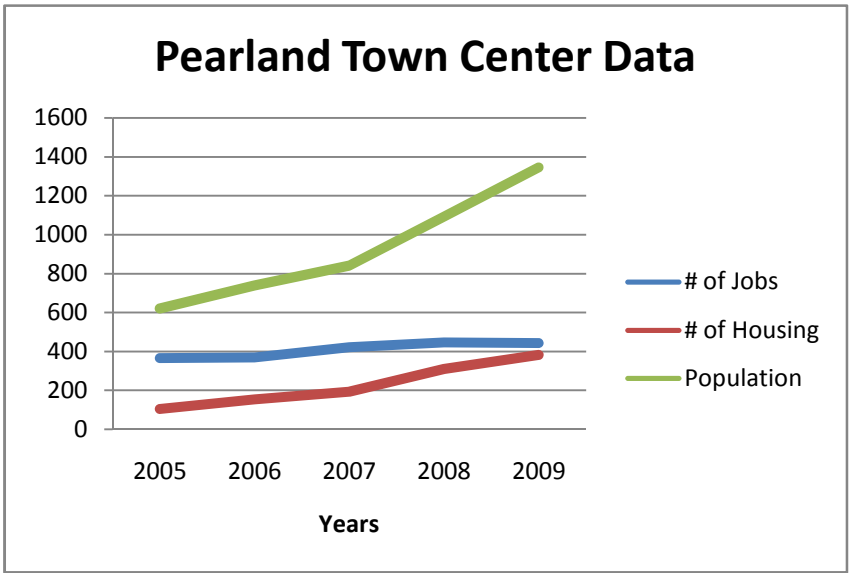

Figure 22. Pearland Town Center Data

After evaluation, it is evident the development of the Town Center in Pearland created a growth in population, jobs, and housing. Yet, the jobs and housing balance still does not support the increasing growth in population.

Figure 23 presents Sugar Land Town Square's population, number of housing, and number of jobs from 2005 to 2009. The Town Square was developed in 1996. According to H-GAC data, population, number of jobs, and number of housing units shows little to no increase from 2005 to 2009. Seemingly, the jobs to housing balance are not equal, with 205 housing units available and 2,121 jobs in 2009.

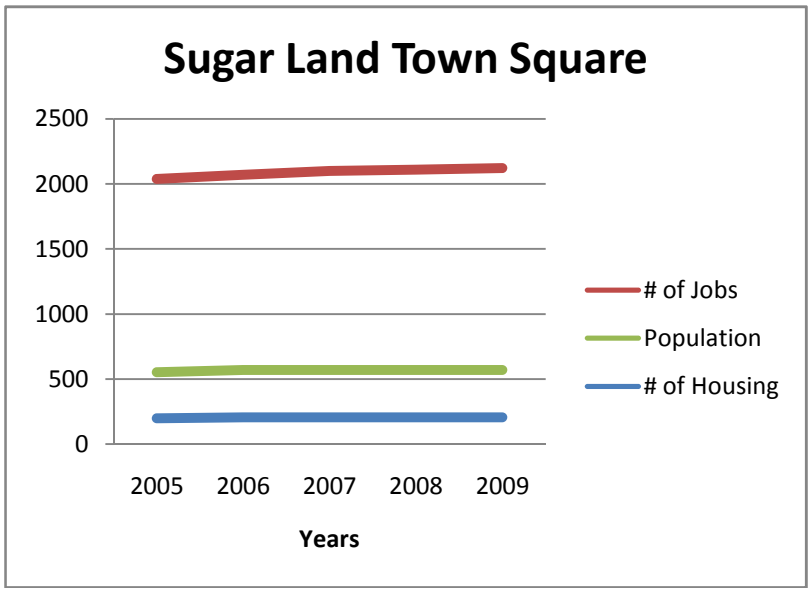

Figure 23. Sugar Land Town Square Data

While the Town Square has been in Sugar Land for quite some time, the number of housing units and population are very small compared to the number of jobs available during the time period given.

The last suburban area descibed in this reaseach is The Woodlands Town Center. This center was incorporated in 1994, a few years before Sugar Land Town Square. The figure below represents the Town Center's population, number of housing, and number of jobs from 2005 to 2009. Number of jobs, housing units, and population did not result in much of an increase in this time period; conversely, there are significantly more jobs than housing units available in the Town Center.

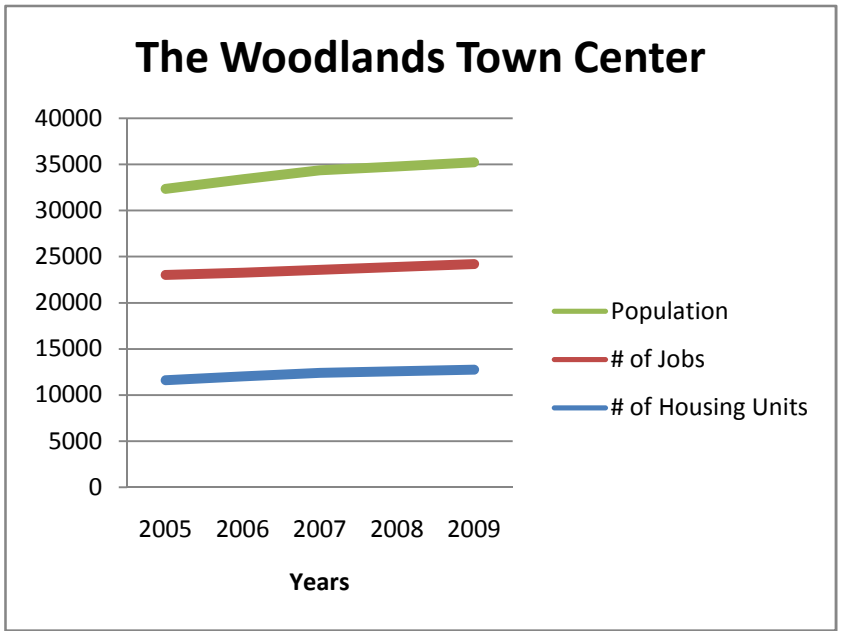

Figure 24. The Woodlands Town Center Data

Previous figures were relevant assessments to the thesis in order to understand the impact transit has on the jobs to housing balance**. "**Jobs-housing balance is a planning tool that local governments can use to achieve a roughly equal number of jobs and housing units (or households) in a jurisdiction. The notion of balancing jobs and housing goes well beyond trying to attain numerical equality. Ideally, the jobs available in a community should match the labor force skills and housing should be available at prices, sizes, and locations suited to workers who wish to live in the area" (Weitz, 2003). If there are enough jobs to support the number of housing units, then residents would not have to commute outside of their community for employment. This would decrease peak hour congestion in sprawling areas.

Work Trips to Major Activity Centers

The work trips assessment focuses on internal trips, along with those trips made to Houston's four largest activity centers: Texas Medical Center (TMC), Downtown Houston, Greenway Plaza, and Uptown Houston (Galleria Mall Area). These trips are easiest to capture on public transit.

Table 3 shows the work trips made by transit from its origin to destination. The origns on this table are the suburban areas chosen for this case study - Pearland Town Center, Sugar Land Town Square, and The Woodlands Town Center. Its destinations are Houston's four largest activity centers as listed above. Each activity center shows the type of transit used from its destination. For example, the destination to the Texas Medical Center is nine miles from Pearland Town Center; also according to Houston Galveston Area Council (H-GAC), light rail transit, commuter bus, and express bus had almost no ridership. In addition, Sugar Land Town Square is located about 22 miles from the Texas Medical Center with its highest number of transit at 0.45 for commuter bus and express bus 0.23; there was no ridership on light rail. The Woodlands Town Center, located 34.5 miles from the Texas Medical Center, had 22.43 people ride the commuter bus to work and no ridership on the light rail or express bus.

From the data collected, Pearland Town Center had 2.2 people ride the light rail who work in downtown Houston; the largest number of people to take light rail to work with a 14.6 mile ride. Whereas, The Woodlands Town center had their largest ridership 219.05, by way of commuter bus to work downtown with a 28.5 mile distance. On the other hand, the express bus had very little ridership with its highest amount being 0.23 from Sugar Land Town Square to the Texas Medical Center at a destination of 22 miles.

Table 3. Major Activity Centers

TEXAS MEDICAL CENTER				
SUBURBAN AREA	DESTINATION IN MILES	LIGHT RAIL	COMMUTER BUS	EXPRESS BUS
PEARLAND TOWN CENTER	9	0.915	0	0
SUGAR LAND TOWN SQUARE	22	0	0.45	0.23
WOODLANDS TOWN CENTER	34.5	0	22.43	0

DOWNTOWN HOUSTON				
SUBURBAN AREA	DESTINATION IN MILES	LIGHT RAIL	COMMUTER BUS	EXPRESS BUS
PEARLAND TOWN CENTER	14.6	2.2	0.005	0
SUGAR LAND TOWN SQUARE	22.4	0	2.235	0
WOODLANDS TOWN CENTER	28.5	0	219.05	0

GREENWAY PLAZA				
SUBURBAN AREA	DESTINATION IN MILES	LIGHT RAIL	COMMUTER BUS	EXPRESS BUS
PEARLAND TOWN CENTER	15.5	0	0.005	0
SUGAR LAND TOWN SQUARE	15.4	0	0.08	0
WOODLANDS TOWN CENTER	36.1	0	4.08	0

UPTOWN HOUSTON				
SUBURBAN AREA	DESTINATION IN MILES	LIGHT RAIL	COMMUTER BUS	EXPRESS BUS
PEARLAND TOWN CENTER	17.3	0	0	0
SUGAR LAND TOWN SQUARE	16	0	0.07	0
WOODLANDS TOWN CENTER	34.1	0	4.31	0

Subsequent to identifing the major activity centers, transit types and usage from the suburban areas, it was vital to examine the percenatge of work trips transit to each selected community.

All Work Trips

Table 4 below is a percentage of transit for all the work trips and single occupancy vehicle trips made to the activity centers from the suburban areas. According to H-GAC, Pearland Town Center, a fairly new mixed-use development with very little housing units and job opportunity as stated previously, had a total of 3.12 people who used some form of transit, either the express bus, commuter bus, or light rail. Whereas, 20.32 people drove to work in their personal automobiles, and it was concluded 13 percent of the residents used some form of transit to travel to work at the major activity centers from Pearland Town Center. Sugar Land Town Square, another area which is still fairly new and upcoming, had low transit ridership with an overall percentage of 10. However, The Woodlands Town Center which supports transit facilities in the community has an overall 21 percentage of transit ridership for those who work in the major activity centers.

Table 4. All Major Activity Centers Work Trips

SUBURBAN AREA	All Transit Trips	Single Occupancy Vehicle Trips	Total	Percent of Transit
PEARLAND TOWN CENTER	3.12	20.32	23.44	**13%**
SUGAR LAND TOWN SQUARE	3.065	27.77	30.835	**10%**
WOODLANDS TOWN CENTER	249.87	937.62	1187.49	**21%**

Table 4 above is relevant because it represents the impact transit has on each community. According to the results of this evaluation, transit can be successfully utilized by residents if it were available. An assessment on the impacts of public transit is required for this thesis, in order to determine whether or not transit is a viable asset to the selected communities.

Another measurement of transit activity in each of the selected communities was the amount of internal transit trips to work by means of single occupancy vehicles. Below is a table used to display internal work trips and work trips made to the major activity centers using personal vehicles.

Table 5. Internal Work Trips

SUBURBAN AREA	Internal Trips	Single Occupancy Vehicle Trips	Total	Percent of Transit
PEARLAND TOWN CENTER	2.35	20.32	22.67	**10%**
SUGAR LAND TOWN SQUARE	4.7	27.77	32.47	**14%**
WOODLANDS TOWN CENTER	6,725.61	937.62	7,662.62	**88%**

Table 5 is important because this research includes consideration of the jobs to housing balance. One goal of TOD is to encourage people to work near home as a way to reduce sprawl and decrease congestion. Sugar Land Town Square and The Woodlands Town Center illustrate more internal work trips than Pearland Town Center. Proven in the Case Study Comparison section of this research, Sugar Land and The Woodlands both demonstrate a higher number of jobs available for their residents than do Pearland.

Once the data were collected, a per capita analysis was done for transit. This table is an analysis of the population in 2007 divided by the transit to get the per capita and shows the data more normalized. For example, Pearland Town Center had a population of 841 people in 2007 and 3.12 took some form of transit, (light rail, express bus, or commuter bus) and out of the 3.12, 0.0037 persons took transit. Per capita gives a more realistic analysis by showing the closeness of the numbers.

Table 6. Per Capita Analysis: Transit

SUBURBAN AREA	POPULATION 2007	ALL TRANSIT	PER CAPITA (ROUNDED)
PEARLAND TOWN CENTER	841	3.12	0.0037
SUGAR LAND TOWN SQUARE	569	0.83	0.0014
WOODLANDS TOWN CENTER	34,353	249.87	0.0073

The data provided in the table prove that even though Pearland and Sugar Land Town Centers do not have public transportation, the residents still found a way to ride public transportation to work. In addition, the per capita results show how close the numbers are to Woodlands Town Center, a community with public transit.

Also, Table 7 is an analysis of per capita for internal trips in the case studied areas. As shown in Table 6, the table below examines the work trips within the suburban areas by use of single occupancy vehicles.

Table 7. Per Capita Analysis: Internal Trips

SUBURBAN AREA	POPULATION 2007	INTERNAL TRIPS	PER CAPITA (ROUNDED)
PEARLAND TOWN CENTER	841	2.35	0.0028
SUGAR LAND TOWN SQUARE	569	4.07	0.0074
WOODLANDS TOWN CENTER	34,353	6725.61	0.1978

It is no surprise that The Woodlands Town Center surpassed Pearland and Sugar Land numerically. However, it is illustrated that Pearland Town Center, along with Sugar Land Town Square, shows a close number of persons who work and drive to work in the cased studied areas.

Woodlands Town Center and Sugar Land Town Square Comparison based on Survey Responses

As noted, characteristics of Transit Oriented Development include: mixed use, attractive, convenient, safe and healthy, encourages social, civic, and physical activity, protects the environment, stimulates economic growth, and creates more choices across all age groups as far as livability and getting around. Transportation availability, trip reduction, people gathering space, having a unique identity, and green space preservation are other major characteristics. Transit professionals, who served on the metropolitan planning organization "Livable Communities Taskforce", were asked to consider typical TOD traits as they apply to Sugar Land Town Square and the Woodlands Town Center. Assessment of the two Houston suburban centers based on the criteria of core elements and how transportation fits into suburban mixed use developments found the following survey responses:

Table 8. Survey Responses: Woodlands Town Center and Sugar Land Town Square

Woodlands Town Center	Sugar Land Town Square
Multimodal Transportation	Pedestrian, limited bicycle
Encourages walking, biking, reduces internal trips	Not enough critical mass for trip reduction
Great gathering spots	Formal gathering place
Identity -- Wooded, master planned 25% green space	Identified as high Quality of Life
Key uses within a ¼ mile walk of center	Spurred nearby similar development
Met all elements, unanimity between respondents	Many uses
	Creates focal starting point

Survey respondents noted that the greatest portion of residential space is not within walking distance for either center. Residents in the Woodlands may bicycle, but residents in Sugar Land must drive to the mixed use development. Residents also tend to use the developments more intensively in the evenings and on the weekends. Full attainment of the TOD goals for these developments may take decades. Other observations and insights show the transit linkages to the remainder of the region are weak. However, there is a development template in place that shows a more compact mixed-use development and an incorporation of transit that can be pursued when transit oriented development serves as a foundational pattern.

Synthesis of Findings

Livable communities are the new and modern way of life for high density balance that is within walking distance of goods, services that are surrounded by transit faclilites. The fact is that this mixture is popular within the urban communities, whereas suburban areas lack sufficient transit faclilites. There are notable benefits to a TOD community as the residents need for an automobile can potentially diminish as public transit becomes an option. This is due to the walkable communities with easily accessible transit modes. For example, a resident can leave home for work, walk to the rail station and, if necessary, switch from rail to bus, all within a walkable one mile radius. TOD also provides for the increase of jobs with easier access to and from work. A transit oriented community must have a mode of transportation that is convenient as well as easily accessible for the entire community. Research was done on the case studied areas, The Woodlands Town Center, a TOD with sufficient transit, and was compared to Pearland Town Center and Sugar Land Town Square, suburan communities that depend on automobile.

CHAPTER 5

RESEARCH CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Several Houston area suburban communities embraced the option to plan for the future by designing transit-oriented developed areas. Most urban environments properly support public transportation. What happens when suburban towns are forced to find employment in the nearest urban town located 15 or more miles away? Clearly, sprawling areas would develop if many suburban area residents decided to work 15 or more miles in town especially during peak hour congestion.

Therefore, how would TODs and public transit impact a suburban environment? Moving people and goods on rail, bus, and/or by walking and biking, in and around, high dense, pedestrian-friendly, livable communities is a characteristic of TOD. Moreover, a TOD should allow for more than just a mixed development of residents, shopping centers, restaurants, and local businesses. Transit facilities are a must to properly create an excellent TOD. Traditionally, suburban communities are developed with auto focus, and of late, there has been a question of whether suburban communities benefit from public transit. For example, Pearland Town Center and Sugar Land Town Square accommodate biking, walking, and a high density blend of goods and services, but do not accommodate rail or bus, whereas, The Woodlands Town Center provides bus service, waterway transportation, safe biking, and walking.

Does public transit make a difference in these areas that are without it or is it just a waste of money? As previously confirmed, Sugar Land Town Square (SLTS) and Pearland Town Center (PTC) are fairly new. However, early representations of several TOD concepts are promising. Once more housing units are added to the center and the development continues, population will continue to grow and more jobs will be created. PTC jobs to housing balance are adequate for an upcoming community with population on a continuous rise. SLTS and PTC demonstrate residents will use transit if it were available. Although not a large amount, according to Table 6, the per capita analysis showed a great number of residents found a way to take advantage of public transit. It comes as no surprise that internal work trips to The Woodlands

displayed a great number of travelers who did indeed work within their community.

These observations are a plus when deciding to increase transit and the ability to walk in the selected communities. Mobility in TOD areas is vital and beneficial for walking, bicycling, and transit. Commercial and retail centers have been surrounded by a sea of parking spaces. Access for pedestrians and transit vehicles, in many cases, is virtually impossible. (Why Build Near Transit, 2009) These suburbs are auto-dominated, and are primarily structured that way, therefore when pedestrians do not feel a since of "trust" in an area to walk or bike, then they choose to not do so. If a sidewalk is too close to the street and the flow of cars are heavy, then this does not promote a pedestrian friendly community.

Therefore, public transit does impact a suburban community positively. The three case studied areas prove that when transit facilities are available they will be utilized, even if the community does not fully accommodate public transit.

Implications for future research consist of:

- Continue to monitor for movement within this direction Obtain Vehicle Miles Traveled for suburban centers.
- Determine employment, income, and age for selected suburban areas to establish if that is a factor in the transit outcome.
- Compare findings with regional transit totals.
- Evaluate the economic impact of a TOD in these suburban areas.

Recommendations

On the basis of this study, the following recommendations are suggested: Primarily to reduce the use of single-occupancy vehicles and to increase the convenience of transit, bicycling and walking in livable communities that provide safe, convenient, and engaging experiences for pedestrians. Although modern pedestrian designs have oriented and scale buildings, good separation of persons on foot from public transit and parking, a suburban community that is well developed will consist of most these accommodations with transit within at least a five minute walk. Transit services are fast, frequent, reliable, comfortable, and traffic calming.

When we think of transit and commuting, for this particular research, sprawling is a factor. This is a major issue for large cities like Houston, TX, where everything is so widespread and the solution is to build away from the center. Population growth is another major contributor

that can cause sprawl because so many people need to move in and around the city. One logical option is to spread out and commute to find better jobs or housing.

Subsequently jobs, housing, and population have driven commuters out of their suburban towns to the city, as shown in earlier data, to find work outside the TOD area. If job availability is low, then transit has to be re-routed to the city, as is in the situation of this study. So, after evaluating the effect of TOD in a suburban environment as compared to an urban environment, PTC and STS should consider an equal ratio of jobs and population as did TWTC in order to possibly have a successful livable community.

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