# The Fruits of Growth Management in the Sunshine State:
# An Examination of Urban Form in Orange County, Florida

**Gerrit-Jan Knaap**
**Professor and Director**
**1112 Preinkert Hall**
**National Center for Smart Growth Research and Education**
**University of Maryland**
**College Park, MD 20742**

**Yan Song**
**Assistant Professor**
**Department of City and Regional Planning**
**University of North Carolina**
**Chapel Hill, NC 27599**

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## 1.0. Growth Management in Florida

The state of Florida is nationally recognized as a leader in urban growth management. In 1972, Florida's legislature passed a host of statutes aimed at addressing the increasingly apparent strains on the natural environment caused by then uncontrolled development. The Florida Environmental Land and Water Management Act of 1972 was based on the American Law Institute Model Land Development Code, and created a new regulatory process for "developments of regional impact" (DRIs) in those jurisdictions with local land use controls (FLA. STAT. §§ 380.06, 380.012 *et seq.*). It also provided for designation of environmentally sensitive "areas of critical state concern," which entailed stringent state oversight of development (FLA. STAT. § 380.05). Other legislation passed that year include the Florida Water Resources Act of 1972, which created regional water management districts, and the Land Conservation Act of 1972, which authorized the Governor and Cabinet to buy environmentally endangered lands and land for outdoor recreational use (FLA. STAT. §§ 373.013 *et seq.*, 259.01 *et seq.*).

Specifically related to land use planning, the Florida State Comprehensive Planning Act of 1972 required the Governor to prepare a State Comprehensive Plan, which would articulate goals and policies to guide Florida's future growth following enactment by the legislature (FLA. STAT. § 186.001 *et seq.*) Three years later, the Local Government Comprehensive Planning Act of 1975 required that: 1.) all local governments adopt a comprehensive plan; 2.) plans identify future land uses and adopt capital improvement programs to serve identified future development; 3.) all local governments implement their plans with land development regulations such as subdivision and zoning; and 4.) all development within a given jurisdiction be consistent with its adopted plan (FLA. STAT. § 163, pt. II). Although the state could review and comment on local plans, its comments remained advisory (non-binding).

In the State and Regional Planning Act of 1984, the legislature authorized a new effort to draft a State Comprehensive Plan, which plan was enacted in 1985 (FLA. STAT. § 186.007). That same legislature also amended the Local Government Comprehensive Planning Act to require state review and approval of local plans, based on state minimum criteria (FLA. STAT. § 163.3177). The 1985 amendments are collectively known as Florida's "Growth Management Act" (Nicholas and Steiner 2000, 645). In 1986, the legislature inserted Florida's "concurrency" requirement, occasionally referred to as the "teeth" of Florida's growth management framework. Concurrency mandates that development be approved only if adequate public facilities are available concurrent with the impacts of the development (FLA. STAT. § 163.3177(10)(h)).

The Growth Management Act's concurrency requirement shifted the planning focus away from the impacts of large developments in favor of an examination of the cumulative impacts of all development. Thus, the DRI process became less important, and even, some argued, superfluous. In 1991, then Governor Lawton Chiles convened the third Environmental Land Management Study committee (ELMS III), charged with providing recommendations on the role of the DRI process and various other issues surrounding implementation of the Growth Management Act of 1985 (Van Rooy 2003, 229).

Among the comprehensive changes included in the resulting legislation (known as the Growth Management Act of 1993), was a temporary termination of the DRI program. Local implementation, however, created uncertainty to the point where development interests (generally opposed to the cumbersome and sometimes duplicative requirements of the DRI process) opined that the existing system wasn't so bad after all (Pattison 2001). Ultimately, the termination provision was removed from the legislation.

The Growth Management Act of 1993 also reduced the authority of Florida's eleven regional planning councils (RPCs), including the Orlando area's RPC, the East Central Florida Regional Planning Council. Formerly able to appeal local government decisions, the RPCs are now empowered only to act in an advisory capacity, and to provide technical assistance, to local governments on planning and growth management matters (FLA. STAT. §§ 186.505(10), (20)).

Florida is still considering the specifics of a workable regional planning framework. Governor Bush's Growth Management Study Commission filed its final report, *A Livable Florida for Today and Tomorrow*, in February 2001 (Van Rooy 2003, 290). The report recommended that local governments and RPCs enter into regional cooperation agreements in order to address developments with extra-jurisdictional impacts, and that the DRI process be eliminated by January 1, 2003 (*Ibid*.). Instead, the legislature passed measures during the 2002 session that increased the threshold required for automatic DRI review (thereby decreasing the number of developments subject to review) and exempted certain marinas, petroleum storage facilities and airports already subject to extensive permitting requirements from the DRI process altogether (*Ibid*., FLA. STAT. § 380.06(24)).

## 2.0. *Urban Growth and Growth Management in Orange County*

Orange County is the most populous county in central Florida with nearly a million people covering more than a thousand square miles (Board of County Commissioners, Orange County, Florida 2004). Without including the visitors who can inflate Orange County's population by 120,000 or more per day, the County has more residents than Alaska, Delaware, Montana, North and South Dakota, Vermont and Wyoming (*Ibid*.). The County is one of the fastest growing in the state, adding about 30,000 new residents per year (*Ibid*.).

The Orlando/Orange County Convention & Visitors Bureau reports 95 theme parks and attractions in the area, but the three most widely known theme parks in the area are Walt Disney World, Sea World and Universal Studios, each of which draws both national and international visitors. The economic impact of Walt Disney World alone is immense: it attracts more than forty million visitors per year, pays hundreds of millions of dollars in taxes, and is one of the state's largest employers (Wetherell 2002, 2).

Disney has also played an important part in the growth of the Orlando region, eventually converting the formerly small city into a huge metropolis, with one of the busiest airports in the country (*Ibid*.). In 1967, the Florida Legislature passed special act, chapter 67-764 of the Laws of Florida ("chapter 67-764"), which created the Reedy Creek Improvement District (the "District" or "RCID") (*Ibid*., 3). The District includes approximately 25,000 acres (thirty-nine square miles) of land, almost all of which is owned by Disney (*Ibid*.). The RCID is granted nearly a full array of governmental powers by chapter 67-764, including the power to construct, operate, and maintain public utilities, to issue bonds, and perhaps most importantly, the District and all development within it is specifically exempt from the zoning and other regulations of Orange and Osceola Counties, in which it is located (*Ibid*., 4). Moreover, development within the RCID has been exempt from the DRI process (*Ibid*., 8).

Development outside the RCID but within unincorporated Orange County is subject to County zoning and subdivision regulations and concurrency requirements. Development within the numerous incorporated cities contained in Orange County (including such cities as Orlando, Apopka, Ocoee, and Winter Garden) is subject to local (city) land development regulations. Unincorporated Orange County imposes minimum lot area requirements, as well as minimum setbacks and maximum building height requirements for development in each of its agricultural, residential and commercial zones (Orange County Zoning Ordinances, § 38-1501 *et seq*.). Density bonuses are offered to developers within specified zoning districts in exchange for dedication of land for certain public purposes or contribution to the Orange County Parks and Recreation Department parks fund (*Ibid*., §§ 38.558, 38-607).

In 1991, the City of Orlando enacted a broader-reaching attempt to discourage sprawl and promote a compact urban form, by including in its zoning code minimum floor area ratio (FAR) and density requirements for development on vacant land (Orlando Illustrated Land Development Code, §§ 58.205-206). Orlando has also established a comprehensive system of density (intensity) bonuses, the stated purpose of which is to (*Ibid*., § 58.1001):
:

> discourage the proliferation of urban sprawl, encourage a compact urban form, encourage the redevelopment and renewal of blighted areas, and provide incentives for infill development.

Despite the extensive growth management framework put in place in Florida, Orange County and its numerous incorporated localities since 1972, the extent to which development patterns in the Orlando metropolitan area have changed remains in dispute. In this paper, we evaluate development patterns and trends in the Orlando metropolitan area by computing several measures of urban form and examining how they change over time. Our intent is not to isolate and analyze the effects of particular regulations or plans, which are too numerous, mutually interactive and difficult to date-stamp. Instead we use Orange County as a case study site to compare patterns of urban development in Florida to those in other states and to analyze trends in development patterns over time. We also do not claim that the trends in Orange County are representative of those in other Florida metropolitan areas. But because Orange County is a rapidly growing area in the central part of the state, we feel our analysis provides some insights into larger Florida development trends.

## 3.0. Quantitative Analysis of Urban Form

In this paper we analyze the pattern of urban development in Orange County in three ways. In our first approach we compute measures of urban form for five metropolitan areas across the United States: Orange County, Florida; Maricopa County, Arizona; Montgomery County, Maryland; Minneapolis-St. Paul, Minnesota; and Portland, Oregon. We then divide each of the metropolitan areas into neighborhoods (defined by transportation analysis zones, TAZs), and compute several measures of urban form for each neighborhood. This allows us to compare recently developed neighborhoods in Orange County to recently developed neighborhoods in other parts of the country. In our second approach, we identify all the single family homes constructed in Orange County in 2000 and compute our measures of urban form for the neighborhood (in this case, defined as a half-mile buffer around the building site), in which the new home was located. Then, using cluster analysis, we identify specific neighborhood types and enumerate how many single family homes were built in each type of neighborhood. This allows us to examine the kinds of neighborhoods in Orange County in which single family homes are currently being built. Finally, we estimate the dates at which each neighborhood in Orange County was built, and examine trends in urban development patterns over time. This allows us to examine whether development trends in Orange County are becoming more or less consistent with the principles of smart growth.

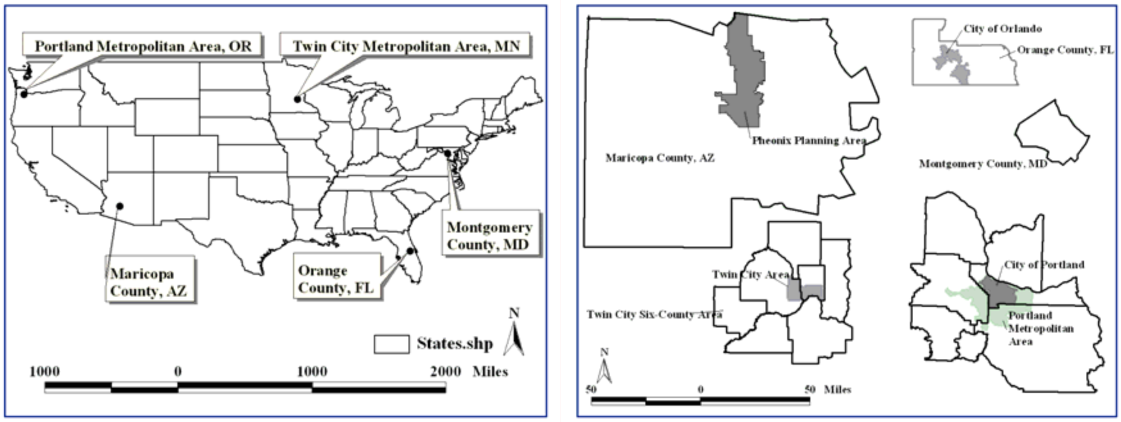
### 3.1 Measures of Urban Form

To begin our analysis, we obtained GIS data from each site (Site locations are illustrated in Figure 1). These data include: (1) attributes of parcels such as year built of the structure, land use type, lot size, and floor space; (2) street network centerlines; (3) bus routes; (4) political and planning boundaries, such as county and city boundaries and urban growth boundaries; (4) open space, and (6) aerial photographs. We then use these data to compute measures of urban form. Our measures fall into three categories: Street Network Design; Land Use Intensity; and Land Use Pattern. A definition of each measure and how they were computed is provided below.[1] Figure 2, which contains illustrations of typical[2] TAZs recently developed in each study area help illustrate what these measures are intended to capture.

[1] All the calculations were computed using ArcInfo and/or ArcView.

[2] We define "typical" here as the TAZ that comes closest to the median value in all the measures of urban form.

**Figure 1: Location and Size of Five Study Areas**




Street Network Design. We compute two measures of street network design: internal and external connectivity. Internal connectivity involves the number of nodes and intersections within the neighborhood; external connectivity measures distance between points of access into and out of the neighborhood. Internal connectivity measures transportation route options within a neighborhood; external connectivity measures route options between neighborhoods.[3]

- *Int_Connectivity* – number of intersections divided by the sum of cul-de-sacs (or dead ends) and intersections; the higher the ratio, the greater the internal connectivity. In Figure 2, internal connectivity is illustrated by the ratio of red dots (intersections) to the sum of red dots plus blue dots (intersections plus cul-de-sacs).

- *Ext_Connectivity* – median distance between Ingress/Egress (access) points in feet; the greater the distance, the poorer the external connectivity. In Figure 2, external connectivity is illustrated by the length of the red line segment around the perimeter of the neighborhood; this line represents the median length of the distance between points of access into or out of the neighborhood.

Land Use Intensity. We offer two measures of development intensity: single family lot size and single family floor space.

- *Lot_Size* – median lot size of single-family dwelling units in the neighborhood; the smaller the lot size, the higher the intensity. In Figure 2, lot size is illustrated by the size of the parcel polygons.

- *Floor space* – median floor space of single-family dwelling units in the neighborhood; the larger the floor space, the higher the intensity. Median floor space is not illustrated in Figure 2.

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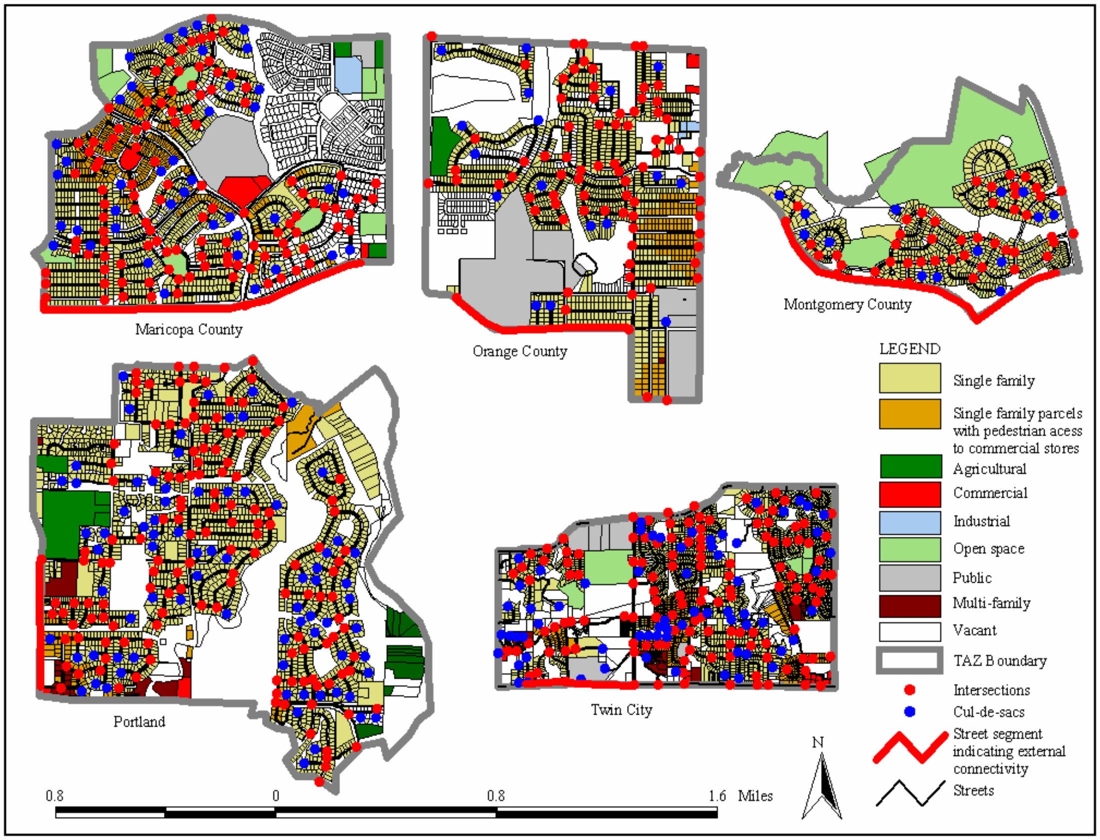
[3] For more on connectivity, see Allen (2001) and Southworth (1997).

**Figure 2. A "typical" Neighborhood built after 1995 in each study area**




Land Use Pattern. We offer one measure of land use mix and two measures of accessibility. Our measure of land use mix is based on the concept of entropy – a measure of variation, dispersion or diversity (Turner et al. 2001). Our measures of accessibility capture the distance of single-family homes from commercial uses and the percent of single-family homes that are within walking distance of a commercial use.

- *LU_Mix* – A diversity index $H_1 = \frac{-\sum_{i=1}^{s}(p_i)\ln(p_i)}{\ln(s)}$ where $H_1$ = diversity, $p_i$ = proportions of each of the five land use types such as SFR, MFR, Industrial, Public and Commercial uses, and s = the number of land uses, in this case s equals to five. The higher the value, the more evenly distribution of land uses. In Figure 2, the mix of land uses is illustrated by the variety in the color of the parcels.

- *Comdis* – median distance to the nearest commercial use; the greater the distance, the lower the accessibility. This measure is not illustrated in Figure 2.

- *Ped_Com* – percentage of SFR units within one quarter mile of commercial uses; the greater the percentage, the greater the pedestrian accessibility. In Figure 2, single family parcels within one quarter mile of a commercial use are colored orange.

## 3.2. Characteristics of Recently Developed Neighborhoods in Five Study Areas

To analyze patterns of recent developments in each study area, we compute the median value and the coefficient of variation of each measure for all neighborhoods developed after 1995, where neighborhood is defined by Traffic Analysis Zones (TAZs).[4] The results are presented in Table 1.[5]

As shown, some aspects of development patterns vary within and across study areas while others do not. As shown by the coefficients of variation, land use mix, and pedestrian accessibility vary most within metropolitan areas.[6] The variation in these values is particularly high in Montgomery and Orange Counties. This implies that metropolitan areas have some areas that are characterized by a mixture of uses and commercial areas that are accessible by foot and some areas that are not—and that the intrametropolitan differences are statistically significant. In addition, internal and external connectivity, land use mix, distance to nearest commercial use, and pedestrian accessibility to commercial uses all vary significantly between study areas.[7] Lot size and single-family floor space do not differ significantly across study areas.

Orange County ranks somewhere in the middle of most of these measures of urban form. In internal connectivity (proportion of non cul-de-sacs) it ranks second best, though the variation between metropolitan areas is not large. In external connectivity (median distance between access points into the neighborhood) ranks about 250 feet better than Montgomery County and about 250 worse than Portland. Lot sizes in Orange County are also in the middle of a fairly narrow range, whereas in floor space it ranks in the middle of a larger range. A relatively large proportion of single family homes (28 percent) are within one-quarter mile of a commercial use, yet the median distance to commercial uses from single family residences is the greatest of the five study areas. These results can be interpreted in at least two ways. On one hand, growth management efforts have not produced results that distinguish Orange County from the other areas in this study. On the other hand, the other study areas are among the most actively involved in growth management. Thus, while development trends in Orange County do not stand out from the set of study areas, the set of study areas is a good group from which not to stand out.

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[4] TAZs are geographic units designed for use in transportation planning and are roughly coincident with census block groups. In previous work we explored alternative definitions of neighborhood. Our analysis showed not that TAZs are necessarily the best geographic unit but that they were useful for demonstrating differences in development patterns that were not inconsistent with alternative geographic units.

[5] The last column of Table 1 also presents the results of F tests which are used to test the equality of means across study areas. In other words, the results of F tests indicate whether the measures of urban form vary significantly across study areas.

[6] For these variables in most of the study areas, the standard deviation is greater than the mean value.

[7] These differences were statistically confirmed using F tests.

**Table 1. Urban Form median values and Coefficients of Variation for neighbourhoods built after 1995**

| | Montgomery County | Orange County | Maricopa County | Portland | Twin City | F-test |
|---|---|---|---|---|---|---|
| Int_Connectivity | 0.76<br>(0.16) | 0.78<br>(0.11) | 0.79<br>(0.18) | 0.65<br>(0.22) | 0.77<br>(0.13) | 18.3* |
| Ext_Connectivity | 989<br>(0.36) | 631<br>(0.43) | 937<br>(0.42) | 392<br>(0.46) | 389<br>(0.43) | 21.9* |
| Lot Size | 8035<br>(0.32) | 7695<br>(0.45) | 8165<br>(0.45) | 6838<br>(0.36) | missing data | not sig |
| Floor Space | 2900<br>(0.26) | 2107<br>(0.29) | 2047<br>(0.33) | 1883<br>(0.26) | missing data | not sig |
| Land use Mix | 0.36<br>(1.81) | 0.39<br>(1.46) | 0.45<br>(1.13) | 0.48<br>(0.98) | 0.42<br>(1.45) | 13.8* |
| Distance to Commercial | 2545<br>(0.68) | 3653<br>(0.31) | 1676<br>(0.67) | 1851<br>(0.46) | 965<br>(0.72) | 11.9* |
| Pedestrian Accessibility | 0.11<br>(1.80) | 0.28<br>(2.13) | 0.19<br>(1.47) | 0.30<br>(0.66) | 0.22<br>(1.00) | 13.3* |

* stands for significance at 95% Confidence Interval; Coefficients of Variation are provided in parenthesis.

| | |
|---|---|
| Internal Connectivity = | Percent of nodes that are not cul-de-sacs or dead ends. |
| External Connectivity = | Distance between access points to the neighborhood; |
| Lot Size = | Single family lot size in square feet; |
| Floor Space = | Square feet of floor space in single family houses; |
| Land Use Mix = | Entropy measure: 0 = single use; 1 = highly mixed use; |
| Distance to Commercial = | Median straight-line distance from single family homes in the neighborhood to nearest commercial use; |
| Pedestrian Accessibility = | Percent of homes in neighborhood within ¼ mile of commercial use along road network. |

## 4.0. Quantitative Analysis of Orange County Neighborhoods

Measuring the development characteristics of recently build neighborhoods, of course provides an incomplete picture. If a number of homes are being built in older, existing neighborhoods then measures of new neighborhoods fail to capture these trends. In Portland, Oregon, for example, a very large number of homes are being built in inner city neighborhoods with traditional characteristics of urban form. To explore this possibility we next identify the Orange County neighborhoods where single family homes were recently built. Based on our measures of urban form, we then classify these neighborhoods into specific types and enumerate the number of homes built in each neighborhood type.

To begin, we first identify the 5,810 new or redeveloped single-family homes that are built in Orange County in the year 2000. We then compute a set of urban form measures for the neighborhoods around these new homes. Specifically, we compute the following measures of urban form for the ¼-mile buffer for each of the 5,810 single-family homes.

*Street Design Measures* include:

- #Intersection – number of intersections in the buffer area of the parcel;
- #Cul-de-sac – number of cul-de-sacs in the buffer area;
- StreetLength – length of street miles in the buffer area;
- BlockSize – perimeter of the block where the parcel is located in;
- Nbr_BlockSize – median perimeter of the blocks in the buffer area;
- BlockArea – area of the block where the parcel is located in;
- Nbr_BlockArea – median area of the blocks in the buffer area;

*Density Measures* include:

- LotSize – lot size of the parcel;
- Nbr_LotSize – median lot size of single-family parcels in the buffer area;
- #Lots – number of single-family lots in the buffer area;
- FloorSpace – floor space of the single-family house on the lot;
- Nbr_FloorSpace – median floor space of all single-family houses in the buffer area;

*Mixed land uses Measures* include:

- Commercial – acres of commercial land use in the buffer area;
- Com_Dist – distance from the lot to the nearest commercial land;

*Natural Environment Measures* include:

- OpenArea – acres of open space per buffer;

*Alternative Transportation Modes* include:

- Bus_Dist – distance from the lot to the nearest bus route;

Summary statistics for all these measures are provided in Table 2.

## - Table 2. Summary Statistics for All Variables

| Variable | Unit of Measure | Mean | StDev | Minimum | Maximum |
|---|---|---|---|---|---|
| BlockArea | Acre | 449 | 979 | 0 | 18077 |
| Nbr_BlockSize | Feet | 17557 | 19758 | 1256 | 253429 |
| BlockSize | Feet | 41961 | 58998 | 292 | 320719 |
| Nbr_BlockArea | Acre | 205 | 504 | 2 | 14211 |
| StreetLength | Feet | 876 | 888 | 299 | 30297 |
| #Cul-de-sac | # of counts | 4 | 3 | 0 | 24 |
| #Intersection | # of counts | 14 | 8 | 0 | 69 |
| Nbr_FloorSpace | Square Feet | 2043 | 590 | 948 | 9444 |
| FloorSpace | Square Feet | 2197 | 800 | 998 | 12959 |
| #Lots | # of counts | 189 | 86 | 1 | 554 |
| Nbr_LotSize | Square Feet | 10012 | 22123 | 3899 | 1341171 |
| LotSize | Square Feet | 10879 | 24861 | 1160 | 1341171 |
| Commercial | Acre | 2 | 7 | 0 | 110 |
| Com_Dist | Feet | 2145 | 1756 | 37 | 19564 |
| Bus_Dist | Feet | 1434 | 5174 | 29 | 63557 |
| OpenArea | Acre | 3 | 3 | 0 | 10 |

### 4.1. Critical Dimensions of Neighborhood Form

Some of the above measures of physical neighborhood form are highly correlated. The distribution of cul-de-sacs, for example, is highly correlated with the distribution of large blocks. Therefore it is useful to condense these variables into a smaller set of variables that removes the correlation in the data. For this purpose we use factor analysis, a technique for data reduction, to help us understand the dimensional structure of our group of variables.

From the above defined sixteen correlated variables measuring various aspects of physical neighborhood form, we use factor analysis to extract six dimensions (factors). The results are presented in Table 3. The variables are listed in the order of the size of their factor loadings sequentially for each factor. The extracted factors reproduce about 71.1% of the total variation among the cases. Principal component analysis for extraction and Varimax with Kaiser Normalization as rotation method[8] in the factor analysis are used since this combination explained the most variation in the data.

[8] Varimax is used to maximize the variance of the squared loadings. Varimax is an orthogonal rotation method which simply rotates the axes of the first factor to a variable or group of variables and then rotates the subsequent factors to be at right angles (uncorrelated) with the first. By this way it removes the effects of variables which could be highly loaded on the first factor. Compared to unrotated factor solution, an orthogonal rotation minimizes the number of samples needed to account for the variation of distinct groups of variables.

**Table 3. Factor Analysis of Each Physical Neighbourhood Form Dimension**

| Variable | Factor1 Street block Design | Factor2 Density | Factor3 House Size | Factor4 Connectivity | Factor5 Commercial Use | Factor6 Nature Environment |
|---|---|---|---|---|---|---|
| BlockArea | **0.88** | 0.06 | 0.17 | 0.09 | 0.02 | -0.06 |
| Nbr_BlockSize | **0.87** | 0.08 | 0.06 | 0.20 | 0.16 | -0.17 |
| BlockSize | **0.81** | -0.05 | 0.01 | 0.02 | -0.11 | -0.17 |
| Nbr_BlockArea | **0.80** | 0.08 | 0.21 | -0.11 | 0.20 | -0.01 |
| Nbr_LotSize | 0.04 | **0.87** | 0.11 | 0.16 | -0.27 | -0.21 |
| LotSize | 0.06 | **0.77** | 0.01 | 0.20 | 0.09 | -0.21 |
| #Lots | -0.06 | **-0.55** | 0.06 | 0.16 | 0.06 | -0.06 |
| Nbr_FloorSpace | 0.13 | 0.24 | **0.88** | -0.05 | -0.01 | 0.18 |
| FloorSpace | -0.03 | 0.03 | **0.86** | -0.27 | 0.20 | -0.01 |
| #Cul-de-sac | 0.06 | 0.18 | -0.05 | **0.73** | -0.13 | 0.17 |
| #Intersection | 0.02 | -0.15 | 0.18 | **-0.61** | -0.11 | -0.03 |
| StreetLength | 0.04 | 0.06 | -0.07 | **-0.50** | -0.05 | 0.26 |
| Bus_Dist | 0.07 | 0.20 | -0.06 | **0.44** | -0.15 | -0.14 |
| Commercial | -0.01 | -0.10 | -0.04 | -0.10 | **-0.66** | 0.06 |
| Com_Dist | 0.03 | 0.26 | 0.06 | 0.01 | **0.65** | 0.15 |
| OpenArea | 0.15 | -0.02 | -0.11 | 0.02 | -0.21 | **-0.57** |
| | | | | | | |
| % Var | 0.20 | 0.11 | 0.15 | 0.09 | 0.09 | 0.06 |

Inspection of Table 3 reveals six dimensions (factors) of physical neighborhood form that emerge from the analysis. The last row of Table 3 presents the percent of the total variation accounted for by each factor. The first factor reflects the dimension *Street Block Design*. Factor loadings indicate that smaller street blocks, both the block where the home locates and other blocks in the buffer area, contribute to a smaller value of factor 1. The second factor includes *Density* variables: smaller lots (both the lot itself and other lots in the immediate buffer area) and more lots in the buffer area contribute to a smaller value of factor 2. The third factor relates to *House Size* and shows that larger houses (both the structure itself and other houses in the buffer area) contribute to a larger value of factor 3. The fourth factor reflects *Connectivity*: less cul-de-sacs, more intersections, more street miles, and shorter distance to the nearest bus stop contribute to a smaller value of factor 4. The fifth factor reflects the level of *Commercial Uses*: more commercial land uses and shorter distance to commercial units contribute to a smaller value of factor 5. Finally, the sixth factor relates to *Natural Environment* and indicates that more open space contributes to a smaller value of factor 6.

### 4.2. Classifying Neighborhood Types

We then carry out a cluster analysis to classify the 5,810 homes into groups based on their similarity within the set of the factors mentioned above. This process can identify characteristics of homes that share similar neighborhood characteristics in the value of the above factors no matter where they are located spatially. Specifically, a K-means cluster analysis[9] is used to classify all 5,810 homes into different neighborhood types on the basis of similarities and dissimilarities in the values of the six factors derived from previous step[10] in such a way that each neighborhood type is internally as similar as possible but externally dissimilar to other neighborhood types.

The best clustering solution, based on the interpretability of the results and associated cluster statistics, is found to be a five-cluster solution. The values of the cluster centroids for each of the five neighborhood types are presented in Table 4. The centroids values of the individual clusters uncover the characteristics of the each neighborhood type. Performance of each neighborhood type on each of the six dimensions of physical neighborhood form can be derived from the centroids values, which we discuss in the following section. The last two rows of Table 4 reveal the distribution of homes by each cluster. For each neighborhood type, Table 5 provides additional information on the distribution of homes by age of their immediate neighborhoods – determined by the median "year built" attribute of all single-family units contained in the ¼-mile buffer areas.

**Table 4. Cluster Centroid Values for Each of the Neighborhood Type**

| Physical Design Dimensions | Cluster1 Urban Core | Cluster2 Inner Ring | Cluster3 Outer Ring | Cluster4 Greenfields | Cluster5 Rural Developments |
|---|---|---|---|---|---|
| Streetblock Design | -0.5923 | -0.2590 | -0.5162 | 1.9308 | 7.2959 |
| Density | -0.0941 | 0.3253 | 0.5298 | -0.1429 | 20.9385 |
| House Size | 1.0988 | 0.2695 | 2.0988 | -0.3622 | 3.4448 |
| Connectivity | -0.5605 | 0.5898 | 0.6940 | -0.1037 | 1.1857 |
| Commercial Use | -2.4736 | 0.3757 | 0.5384 | 0.2342 | 0.6438 |
| Natural Environment | 3.4455 | 4.6753 | 0.2625 | 0.5856 | -0.3899 |
| | | | | | |
| Counts | 368 | 1532 | 3095 | 803 | 12 |
| Percentage of All | 6.33 | 26.37 | 53.27 | 13.82 | 0.21 |

[9] K-means clustering begins with a grouping of observations into a predefined number of clusters. It evaluates each observation and moves it into its nearest cluster. The nearest cluster is the one which has smallest Euclidean distance between the observation and the centroid of the cluster. When a cluster changes by losing or gaining an observation, the cluster centroid is recalculates. At the end, all observations are in their nearest cluster.

[10] Cluster analysis procedures are affected by the magnitude of the variables included, that is to say, variables with large numbers have a greater impact on the outcome of the analysis than variables with small magnitudes. To control for this imbalance, scaling is necessary to convert the original variable values to standard scores. Since the six factor scores derived from the factor analysis are used here in the cluster analysis, the magnitude of the variables is not a concern here.

**Table 5. Cross-Tabulation of Neighbourhood Types Versus Age of Buffer**

| Counts in Each Neighborhood Type | 1950s and before | 1960s | 1970s | 1980s | 1990s | 2000 and after | All |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Urban Core | 84 | 119 | 36 | 63 | 54 | 12 | 368 |
| Inner ring | 8 | 12 | 9 | 39 | 109 | 1351 | 1532 |
| Outer ring | 0 | 15 | 24 | 120 | 426 | 2510 | 3095 |
| Greenfields | 0 | 0 | 0 | 0 | 5 | 798 | 803 |
| Rural Developments | 0 | 0 | 1 | 0 | 3 | 8 | 12 |
| All | 92 | 146 | 70 | 222 | 597 | 4679 | 5810 |

### 4.3. Characterization of Neighborhood Types

Based on the information provided in the tables listed the above, this Section provides a discussion of neighborhood types. Figure 3 illustrates locations of new homes by neighborhood type. Figure 4 illustrates the prototypical site design of each neighborhood type.

**Figure 3: Distribution of Neighborhood Types in Orange County, Florida**

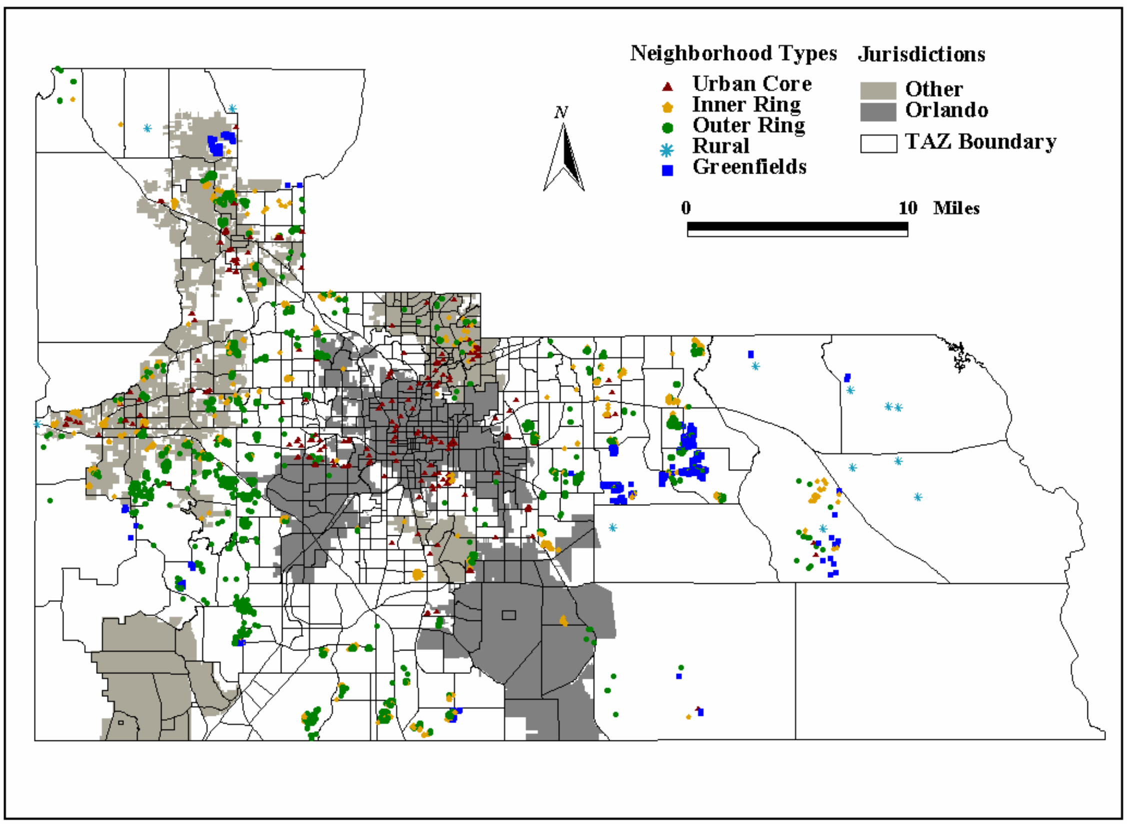
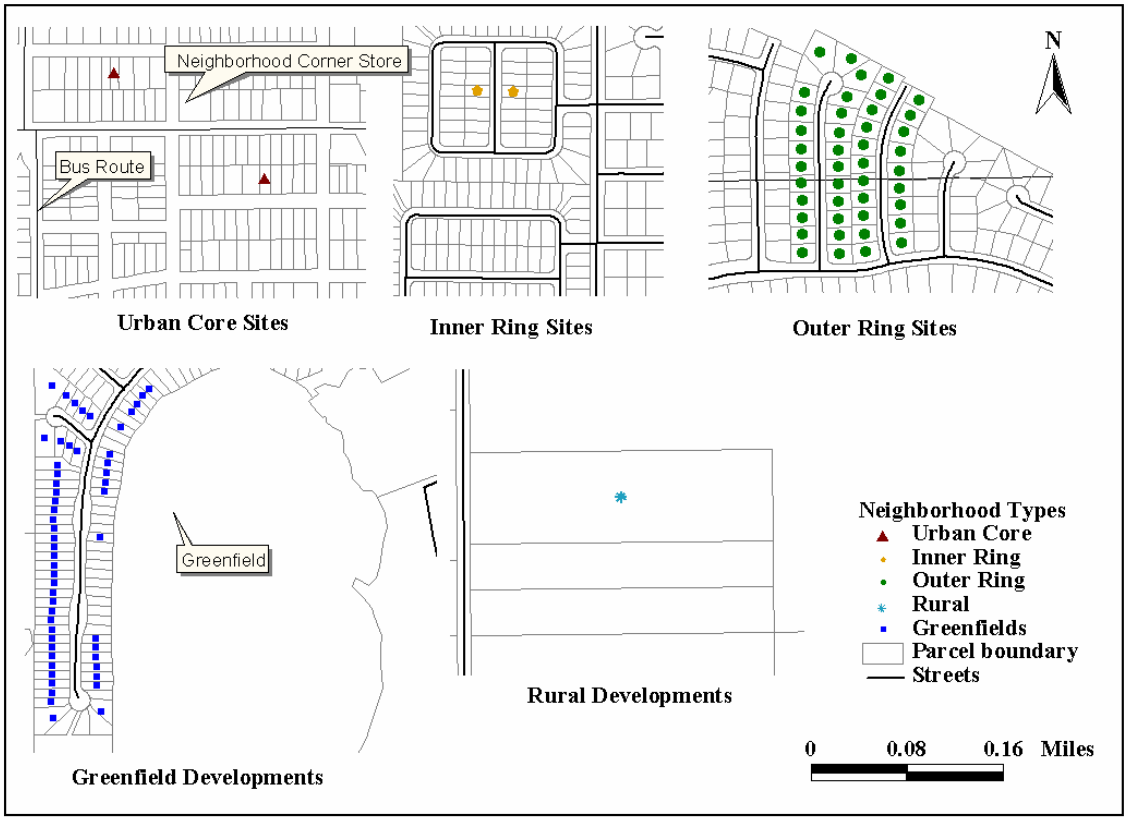


**Figure 4. Site Design of Each Neighborhood Type**




- Neighborhood Type 1 – Urban Core.

Neighborhood type 1 structures are located in central city areas or at the immediate inner ring suburbs. There are 368 homes in this neighborhood type, which make up to 6% of our sample. Most of Type 1 homes are on neighborhoods with following characteristics such as: grid street networks, small lots and houses, high density, abundant commercial stores, and accessible bus services. However, there is no open space nearby (Figure 4). It is noteworthy to see that there are many of these structures are built into older neighborhoods: many (65%) of these structures of are built in areas developed before the 1980s (Table 5).

- Neighborhood Type 2 – Inner Ring Suburbs.

Neighborhood type 2 can be classified as the inner ring suburban infill developments. Type 2 has 1,532 structures which make up to 26% of our total observations. Neighborhoods hosting Type 2 structures have smaller houses, more transit access, and less open space nearby (Table 4). Some (5%) of Type 2 neighborhoods are built before 1990s (Table 5).

- Neighborhood Type 3 – Outer Ring Suburbs.

Neighborhood type 3 can be classified as the outer ring suburban developments. Type 3, the largest neighborhood type, has 3,095 structures which make up to 53% of our total observations. Type 3 structures are characterized by curvilinear street arrangements, some cul-de-sacs, wide streets, relatively large and clustered lots in uniform size and shape, predominant detached single-family homes close to suburban malls, and some open space nearby (Figure 4).

- Neighborhood Type 4 – Greenfield developments.

Neighborhood type 4 structures can be classified as greenfield developments. This type has 803 structures. Type 3 homes generally are located at greenfields and have following neighborhood characteristics: some cul-de-sacs, curvilinear streets, large houses and lots, moderate to high density, and scarce mixed land uses and transit services. Type 4 neighborhoods are also distinct in their inviting open spaces nearby (Figure 4). Table 5 reveals some additional interesting information on the age of the neighborhoods around the structures. Greenfield neighborhoods are very new: almost all Type 4 neighborhoods are built after 2000.

- Neighborhood Type 5 –Rural developments.

Neighborhood type 5 structures, dispersed across the rural landscape at the periphery area (Figure 3), can be characterized as rural developments. Only 12 structures belong to neighborhood type 5. Type 5 neighborhoods have a set of typical rural development features (Figure 4): large blocks, extremely low density, extremely large lots and houses, no access to transit or mixed land uses, and dominant rural land uses with abundant open spaces.

In sum, our analysis suggests of single family homes in Orange County suggests that they have been built in five distinct neighborhoods that range in character from Urban Core to Rural Development. The majority of homes built in 2000 were built in Outer Ring Suburbs. Very few were built in the Urban Core.

## 5.0. Changes in Orange County Neighborhoods over Time

Finally, to get a sense of how development patterns in Orange County have changed over time we conducted a time series analysis. We began by date stamping neighborhoods based in the median "year built" attribute of every single-family house. We then computed the median value of each urban form measure for every neighborhood built in each decade since 1940. The results are presented in Table 6 below.

**Table 6. Median Values of Urban Form Measures by Decade**

| | 40s | 50s | 60s | 70s | 80s | 90s | 00s |
|---|---|---|---|---|---|---|---|
| Internal Connectivity | 0.94 | 0.91 | 0.87 | 0.82 | 0.78 | 0.79 | 0.83 |
| External Connectivity | 321.34 | 350.80 | 387.26 | 553.60 | 642.50 | 693.55 | 776.99 |
| Length of Cul-De-Sac | 339.98 | 334.06 | 416.49 | 463.25 | 438.91 | 375.61 | 682.42 |
| Block Size | 1774.50 | 1843.33 | 2246.18 | 2231.96 | 2365.71 | 2090.32 | 2487.77 |
| Number of Blocks | 0.66 | 0.46 | 0.48 | 0.97 | 0.42 | 0.28 | 0.45 |
| Lot Size | 16847.84 | 10000.28 | 17547.14 | 20169.25 | 19108.71 | 10753.73 | 8389.16 |
| Floor Space | 1284.81 | 1317.96 | 1519.53 | 1513.02 | 1666.95 | 1936.91 | 2057.80 |
| SFR Dwelling Unit Density | 4.87 | 4.30 | 3.81 | 3.46 | 3.42 | 3.06 | 4.15 |
| Land use Mix | 0.39 | 0.40 | 0.37 | 0.41 | 0.46 | 0.42 | 0.33 |
| Distance to Commercial Unit | 1578.66 | 1612.20 | 1866.76 | 2372.42 | 3401.19 | 3973.70 | 5945.11 |
| Pedestrian Access to Commercial | 0.82 | 0.59 | 0.32 | 0.19 | 0.15 | 0.08 | 0.10 |

As shown, in Table 6, the proportion of cul-de-sacs in Orange County fell from the 1940s to the 1970s and began rising in about 1980, though the changes over time are relatively small. The distance between access points into neighborhoods, however, rose throughout most of the post-war period. Like internal connectivity, single-family lot sizes rose sporadically through the early post-war period but began falling in about 1970. Single-family house sizes, measured by square feet of living space, have risen throughout the post-war period. Land use mix in single family neighborhoods has fallen recently but displays not clear temporal trend. The median distance to a commercial use has risen since 1940 and most dramatically since 1990. Finally, the percent of homes within ¼ mile of a commercial use has fallen steadily since 1940 with a slight up tick in 2000.

These trends paint a relatively clear picture of development trends in Orange County. Though lot sizes are falling, house sizes are rising. Neighborhoods are becoming slightly more internally connected but more regionally isolated. What's more neighborhoods are becoming more homogeneous, and fewer homes are within walking distance of commercial uses. With the exception of falling lot size and slightly greater internal connectivity, the trends are clearly not in the direction of smarter growth.

## 5.0. Caveats and Limitations

Before we draw implications from this study, it is necessary to note several significant limitations of our approach. First, our approach of classifying neighborhood types only focuses on physical neighborhood form. We do not consider any social or economic characteristics. Second, we only examine the development patterns for single-family homes. Due to data limitations, we are not able to examine trends in multifamily development. Finally, though our results provide some interesting information about development trends in Orange Count, it is impossible to generalize these results to all of Florida or even Central Florida.

## 6.0. Conclusions

Although the state of Florida is recognized as a national leader in growth management, Florida's growth management program has evolved in fits and starts and, with the exception of concurrency, lacks a consistent theme or framework for effectively managing urban growth. This lack of coherence and consistency is evident in Orange County, where intergovernmental complexity mixes with large-scale private developments and continuous rapid growth. Although every jurisdiction in the County has a plan, it is hard to characterize overall growth in the County as well planned.

To provide some assessment of growth management in Orange County, we examined patterns of urban form in three ways. First, we compute measures of urban form for five study areas across the United States and computed several measures of urban form for each neighborhood in each study area. Second, we identified all the single family homes constructed in Orange County in 2000 and computed our measures of urban form for the neighborhood in which the new home was located. Then, using cluster analysis, we identified specific neighborhood types and enumerate how many single family homes were built in each type of neighborhood. Finally, we estimated the dates at which each neighborhood in Orange County was built, and examine trends in urban development patterns over time.

The results are mixed at best. In most measures of urban form, Orange County falls near the middle of the five study areas. That is, among the five study areas, Orange County doesn't have a street network, house sizes or densities, or land use patterns that stand out, though the median distance from single family homes to commercial uses is the highest of the five study areas. Perhaps given Orange County's rapid rate of growth and the national reputations of the comparison groups, these results are commendable.

Our analysis of the types of neighborhoods in which new houses are being built also present a mixed picture. Over half of all new developments in Orange County is taking place in Outer Ring neighborhoods—neighborhoods characterized by curvilinear streets, cul-de-sacs, wide streets, uniformly large lots, and predominantly single family homes—i.e., typical suburban sprawl. Yet the second most common type of neighborhood in which new houses are being built is Inner Ring neighborhoods—neighborhoods characterized by suburban infill and better transit access. Rural and Greenfield neighborhoods are the next most common and Urban Core neighborhoods are the least common. Without comparison to other study areas, it is difficult to judge these results; but it is also difficult to argue that the proportions in Orange County are ideal.

Our analysis of trends over time are perhaps least ambiguous. Over the post-war period in Orange County, lot sizes have fallen and house sizes have risen. In recent periods, neighborhoods have become slightly more internally connected but less regionally connected. Further, neighborhoods have become more homogeneous with fewer homes within walking distance of commercial uses. With the exception of falling lot size and slightly greater internal connectivity, these trends are not encouraging.

Though the results are not encouraging, they are perhaps not the best test of growth management success in Florida. Besides the difficulty of generalizing from Orange County to the rest of the state, it is not clear that measures of urban form are the best measures of growth management success—especially in Florida. The focus of growth management in Florida has long been concurrency; that is, the timely provision of public services as new development occurs. Clearly our measures of urban form provide no insights into the success of that effort. Neither do our measures offer any insights into the degree that Florida has been successful in protecting its unique natural environment. In fact, most of our measures reflect more on the influence of local subdivision ordinances than perhaps any other element of state or local comprehensive planning. To date, the state has not weighed in on these elements. That said, we believe that our measures of urban form do provide insights into the kinds of urban environments recently and currently under construction in the state of Florida. And to the extent that Orange County is exemplary, there remains considerable room for improvement.

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