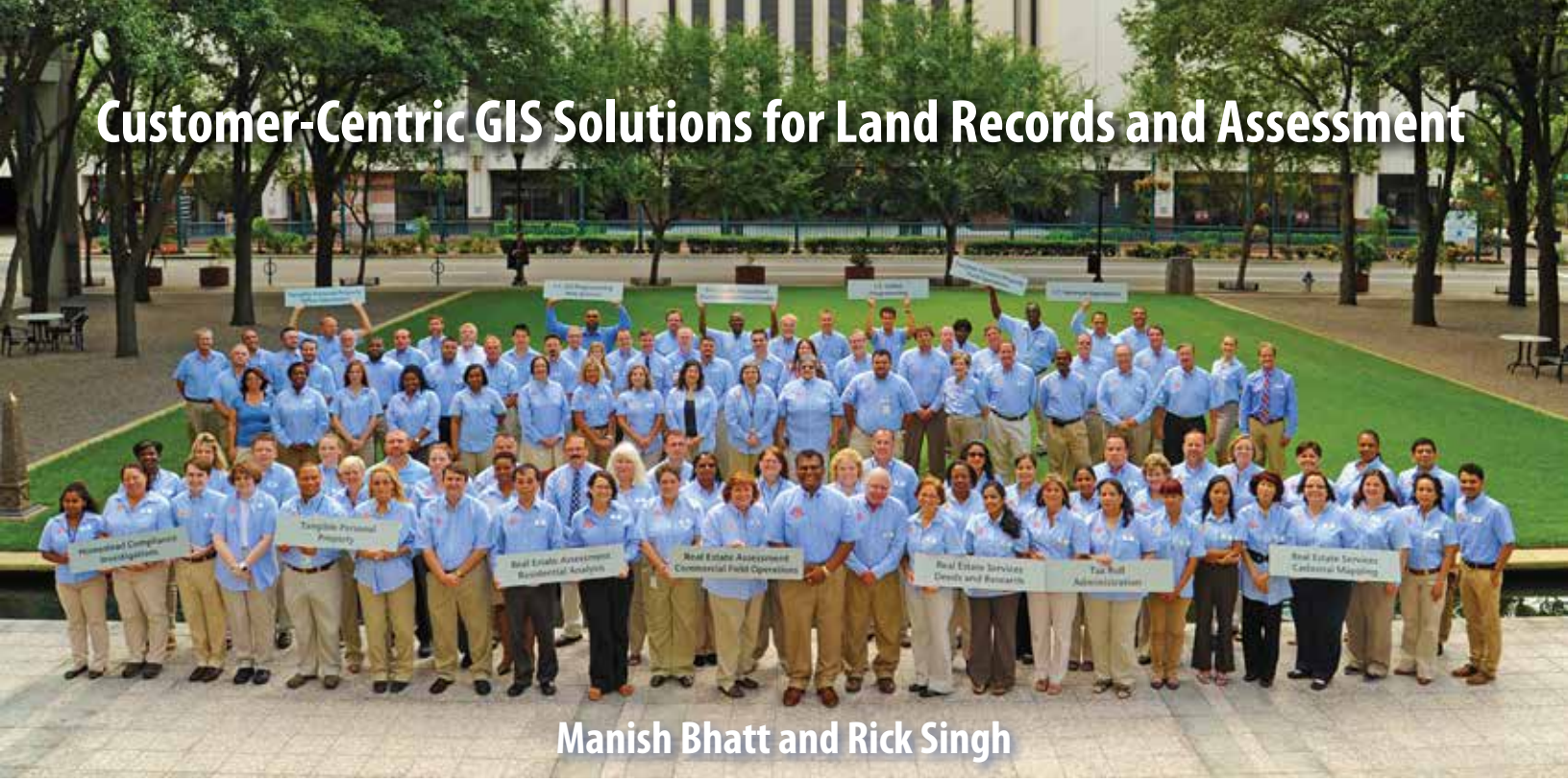
Customer-Centric GIS Solutions for Land Records and Assessment



Manish Bhatt and Rick Singh

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> *A customer is the most important visitor on our premises. He is not dependent on us. We are dependent on him. He is not an interruption in our work. He is the purpose of it. He is not an outsider in our business. He is part of it. We are not doing him a favor by serving him. He is doing us a favor by giving us an opportunity to do so.*
>
> —Mahatma Gandhi

In July 2013 the market valuation in Orange County, Florida, reached $115 billion and the taxable valuation $89 billion, from 430,000 parcels and 62,000 personal property accounts. The newly elected Property Appraiser, Rick Singh, has accelerated technology adoption in the office and implemented technology at every customer touch-point. This article highlights the 15 customer needs that the office has identified and the corresponding geographic information system (GIS) solutions to them.

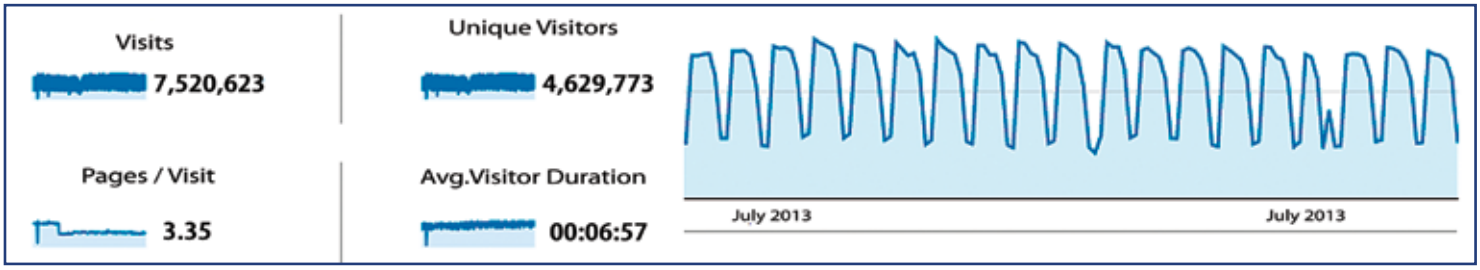
Who Are the Customers?

As a public service agency, the Orange County Property Appraiser's office has customer service as its primary mission. This mission is achieved through five primary services:

1. Inventory of all real and tangible assets, to ensure full representation on the tax roll and the cadastral map
2. Fair and equitable valuation of assets for ad valorem tax purposes, as approved by the state governing body
3. Yearly notification of assessment and tax rates to property holders, typically followed by valuation defense
4. Administration of property-related exemptions
5. Transparency in governance and 24/7 access to public information.

The office's customers are segmented into three broad categories: internal staff, intragovernmental users, and public users, each with its own needs for the data and their applications. The office currently provides data, tools, and support to this amazingly diverse customer base of approximately 4.6 million unique customers each year, which translates to approximately 2–3 searches per second during peak usage times (8 a.m. to 5 p.m.). Figure 1 presents numbers recorded in Google Analytics from July 2012 to July 2013. The graph displays the cyclical pattern of heavy usage Monday through Friday from April 2013 to

Figure 1. Customer usage of Orange County Property Appraiser's Web site, July 2012 to July 2013



July 2013 (average 25,000 daily users) and a drop over the weekends; notice the fourth of July.

Table 1 shows the top users in 12 of the office's primary user segments (as identified by their IP addresses), dominated by the FIRE (finance, insurance, real estate) and government sectors. This list excludes users that connect through Internet service providers, primarily home users and small businesses not having dynamic IP addresses. Page visits are monitored via Google Analytics.

Table 1. The 12 primary user segments of the Orange County Property Appraiser's office and the top five users in each segment

Local Government	Florida State Government	Federal Government	Education
Orange County City of Orlando City of Winter Park Comptroller's Office Supervisor of Elections	Department of Health Department of Transportation Department of Revenue Department of Environmental Protection Department of Motor Vehicles	Internal Revenue Service National Aeronautics and Space Administration Department of Homeland Security Department of Veterans Affairs U.S. Postal Service	Orange County Public Schools University of Central Florida Valencia Community College Rollins College University of Florida
Title Insurance	**Property Insurance**	**Mortgage Banking**	**Home Builders**
Fidelity National First American Title Old Republic National Title Stewart Title	State Farm Harry Levine Citizens Insurance Liberty Mutual USAA	Suntrust Bank of America BB&T Wells Fargo JPMorgan Chase	K. Hovnanian Homes Meritage Homes Pulte Homes U.S. Home Corporation KB Home
Legal	**Corporate**	**Survey and Engineering**	**Real Estate Companies**
Akerman Senterfitt Broad and Cassel Shutts & Bowen Provest Law Offices of Gerald Shapiro	Orlando Utilities Commission Disney Worldwide Service Lockheed Martin Florida Hospital Orlando Health Fedex Darden Restaurants	Bowyer-Singleton Lochrane Engineers AECOM Kimley-Horn and Associates SAIC	CB Richard Ellis Cushman & Wakefield Universal City Development Partners ITT Sheraton Knology

Figure 2. Magic Kingdom, Disney World, Orlando, Florida

Customer Need 1. Cartographically Appealing Cadastral and Tax Maps

The Orange County Property Appraiser's office has the responsibility for creating a contiguous parcel (cadastral) base map of the county, a total of 430,000 parcels. COGO (coordinate geometry) techniques are used to produce spatially accurate tax maps. However, these traditional tax maps appear rather flat and lack the cartographic elements required for an appealing, yet functional map product.

The office's approach is to create a multilevel cached base map by using advanced cartographic methods. This approach has resulted in an impressive cartographic base map, which now serves as a common platform for several applications (desktop, Web, and mobile). This map has taken the art of cartography from the desktop and made it available to all users.

Figure 2 is the base map of the Magic Kingdom, Disney World. Notice the granularity of mapping details, scale-based labeling, and thematic display of land use. Figure 3 is the base map of Lake Nona in Orlando, a mixed-used urban development.

Customer Need 2. Quantitative Cartography

Much of the quantitative information about parcels is unavailable on the tax map. How many acres is the parcel? How many rooms in the hotel or units in the apartment complex? How much traffic on the street? What's the par on hole 1 of this golf course?

The office has successfully integrated quantitative information about parcels on the cached base map. This approach requires advanced labeling and scripting methods, along with a synthesis of attribute data. Both the digital and printed map products now

Figure 3. Lake Nona, Orlando

Figure 4. Hole 14 of Arnold Palmer's Bay Hill golf course, Orlando

Figure 5. Hotel cluster near the Orlando International Airport

Figure 6. Winter Garden Village at Fowler's Grove, a 115-acre retail development in Orlando

display the quantitative information on the base map.

Figure 4 is the base map of hole 14 of the Arnold Palmer's Bay Hill golf course, 215 yards, par 3. The office is also interested in the price correlation between golf-course properties and non-golf-course properties. Figure 5 shows the hotels clustered near the Orlando International Airport; note the labeling of room capacity, ownership, and property name.

Customer Need 3. Qualitative Cartography

Much of the qualitative information about parcels is unavailable on the tax map. Who owns the parcel? Which businesses are located on the parcel? What is known about the homeowners association that the parcel belongs to? How are unit-level apartment addresses and related information displayed?

Figure 6 shows the Winter Garden Village at Fowler's Grove, a 115-acre retail development. Note the integration of tangible personal property accounts, accurately placed on the

building sketch. Figure 7 shows unit-level apartment addresses placed accurately on the building sketch. Public safety customers appreciate the ability to pinpoint the exact location of an apartment unit within a complex, in this case, 24 buildings and 560 apartments, in two phases.

Customer Need 4. Advanced Visualization Techniques

The assessor/appraiser has a great deal of data that are not easily visualized or useful for meaningful analysis. Where are the foreclosures? Who owns them? Where are the clusters/hotspots? Where is the new construction? How much new construction is added on the tax roll? What areas are experiencing a large dollar value of new construction?

By using the advanced visualization techniques provided by ArcGIS Server, the office can now visualize and make meaningful inferences from the data. This kind of visualization has not only benefitted the office but also generated public and media interest.

Figure 7. Apartment complex with 24 buildings and 560 apartments in Orlando

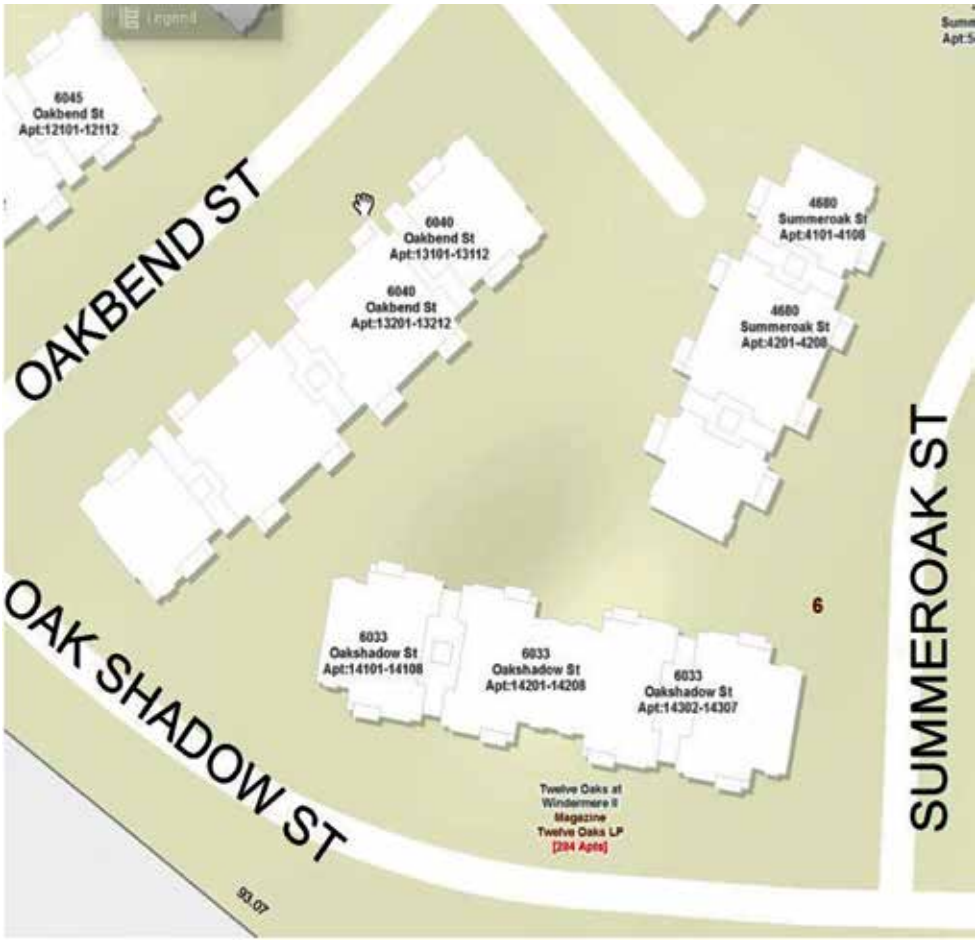


Figure 8. Example of advanced visualization technique that clusters two variables

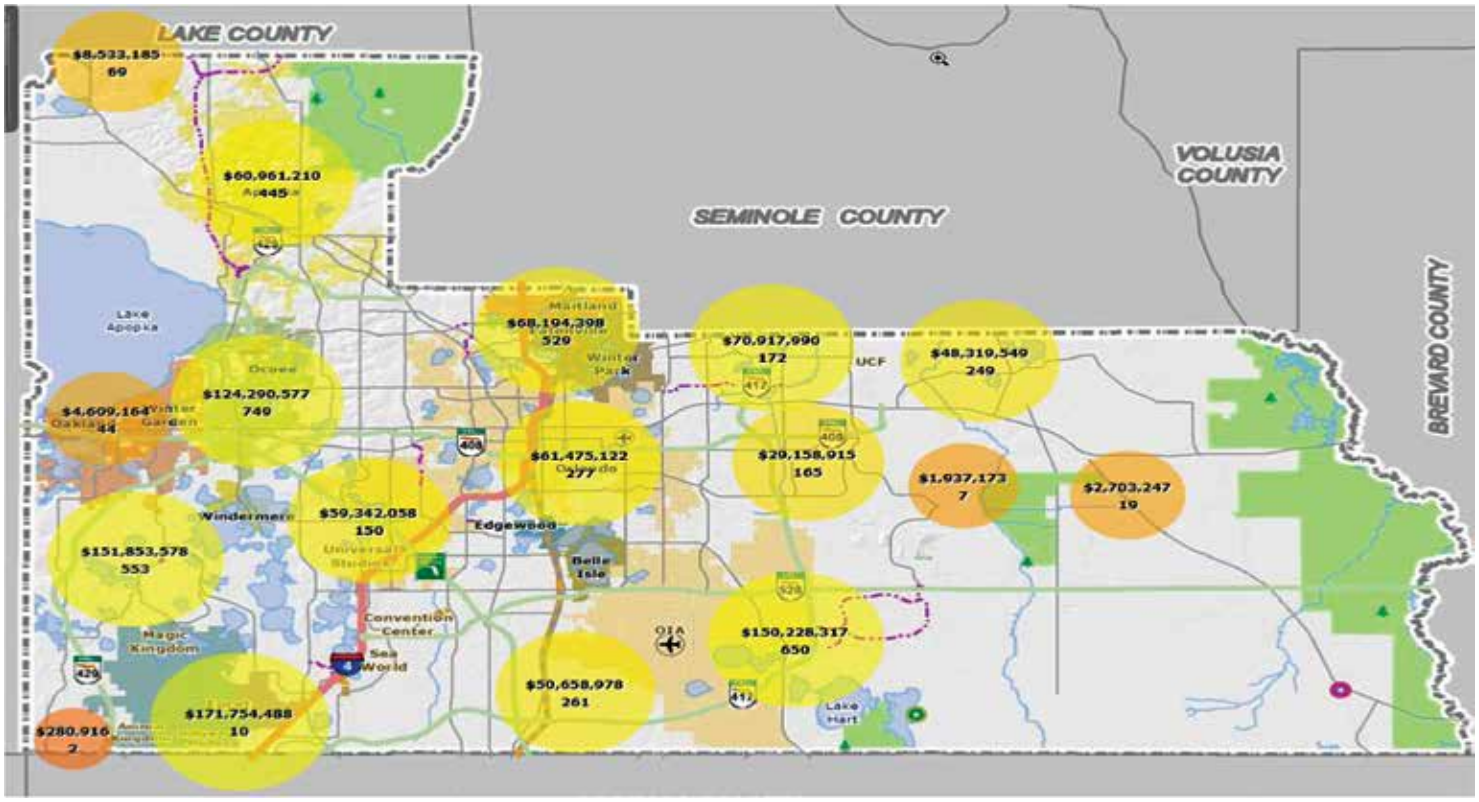


Figure 8 is an example of an advanced visualization technique that dynamically clusters two variables: value of net new construction and number of new construction properties. This is delivered through a Web application in which the clusters dynamically change to reflect the same variable as the user zooms in. The same techniques can be used to visualize foreclosures, permits, exemptions, and the like.

Customer Need 5. Quality Control Tools

As an agency with the responsibility for the yearly mass appraisal of 430,000 properties (both commercial and residential), the Orange County Property Appraiser's office must deploy methods that maintain the quality of its appraisals.

The two key performance indicators are the sales ratio (assessed value to the sale price), to understand the level of assessment, and the percentage change in value, to create a fair and equitable tax roll.

GIS tools and applications such as those shown in figures 9, 10, and 11 are currently used by appraisers in their work. These tools not only maintain quality control measures but also allow the office to serve taxpayers in a transparent manner. Figure 9 shows the display and labeling of sales ratios in the Web-based application. Figure 10 shows the basic GIS visualization of percentage change in value from prior year to current year; this tool leads to exploring the *why* in data analysis. Figure 11 is an example of the visualization of the *grade* variable; this tool helps identify variability in a fairly homogenous neighborhood.

Figure 9. Sales ratios thematically displayed and labeled in a Web-based map application

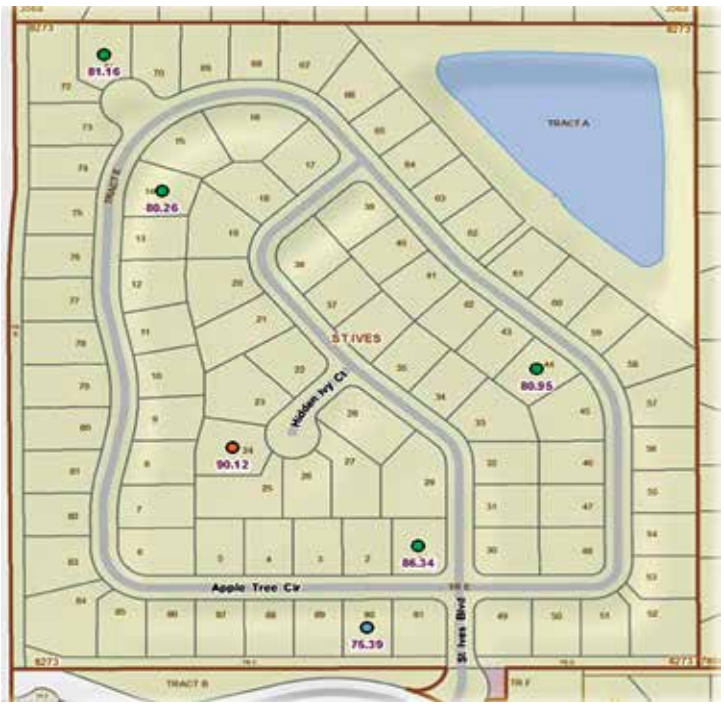


Figure 10. Example of basic GIS visualization of percentage change in value from prior year to current year

Figure 11. Example of visualization of grade variable

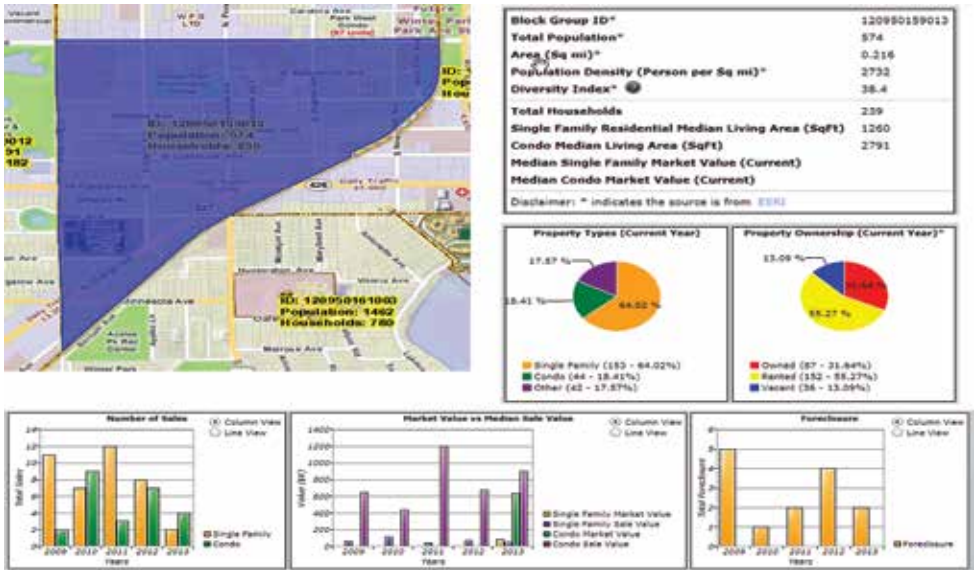
Customer Need 6. Business Intelligence Tools

One challenge faced by the appraiser's office is the integration of third-party data with land records and the publication of meaningful business intelligence reports on the Web. In addition, the intent is to maintain an intuitive user experience and a simple user interface.

Not only has the office been able to successfully integrate several external data sets into the land records (see figure 12), but also it has published effective business intelligence reports. Figure 13 shows how the Census geography and demographic data from a third party (ESRI) have been spatially joined with the office's property-related data, at the Census block group level, to create new value-added business intelligence reports. This effort requires a clear understanding of how much data to offer and how to keep up with the data refreshes.

Figure 12. Integration of Census block group boundaries with parcel base

Figure 13. Business intelligence reports



Customer Need 7. Optimized Field Operations

Field staff needs to visualize their work assignments so they can logistically plan their routes and workloads. This is primarily achieved through assigning the building permits, priority rechecks, certificate of occupancy, parcel-to-parcel inspection, and other field-related activities to appraisers in their respective work zones.

In order to implement a paperless initiative as well as increase both accountability and productivity in the field, a new field application has been introduced. This browser-based Web application is specifically designed to work on mobile devices (smartphones, tablets). Appraisers log in to visualize their assignments and zoom to a parcel (assigned or not) to capture photos and collect and verify attribute data.

Figure 14 is a screenshot of an appraiser's work assignment; dynamic cluster changes with zoom levels.

Customer Need 8. Comparable Sales Analysis Tool

The office's appraisal values must be explainable to taxpayers and defensible if petitioned. GIS is used extensively for valuation defense. A picture is worth a thousand words, especially when comparable sales are being displayed. The use of geospatial techniques to generate comparable sales makes it very easy for appraisers to work with taxpayers and their representatives. With the AGS Silverlight API and the .net platform, the office creates professional-quality reports for use in valuation defense.

Figure 15 shows GIS-based comparable sales data; users can choose the selection criterion: radial, subdivision, neighborhood, user-defined area, or manual. Figure 16 shows how users can customize their adjustments, sales year, and so on. Figure 17 shows a Web-based comparable sales report available to users. Figure 18 shows views of the subject property and comparables, which are also available to users.

Customer Need 9. Location-Based Information

Much of the property attribute data published on the Web is nonspatial. However, the office has moved beyond the traditional data components and integrated the *location* aspect of the property with the other nonspatial data. The key challenge is to present geospatial data in a well-designed Web page. Because location data are so crucial in real estate, an integrated approach—the ability to obtain all the parcel-related data in one place—is much appreciated by users.

Figure 19 shows the location information tab on the Orange County Property Appraiser's Web site. Based on design considerations and user feedback, this tab synthesizes several key location-related elements that customers find useful.

Figure 14. Web application map of an appraiser's work assignment

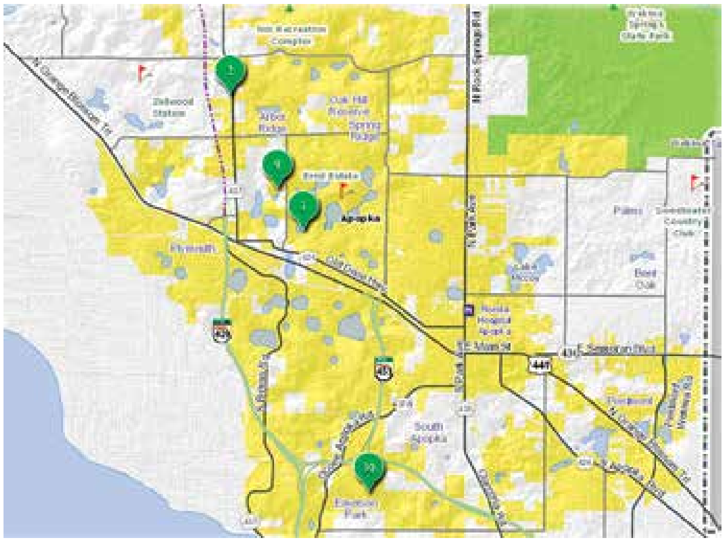
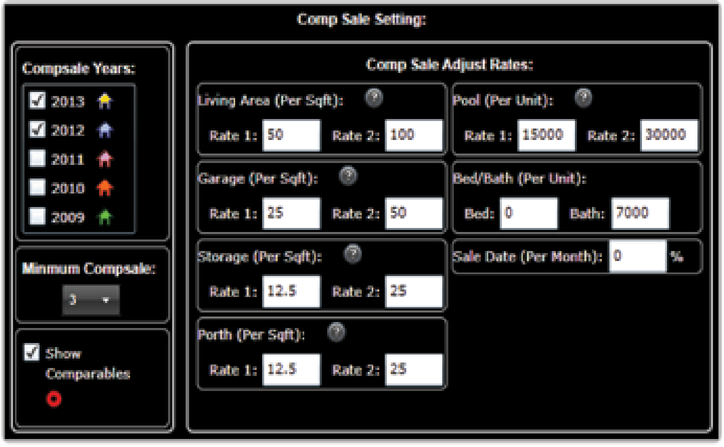


Figure 15. GIS-based comparable sales

Figure 16. Customization settings for comparable sales



Comp Sale Setting:

Compsale Years:
☑ 2013
☑ 2012
☐ 2011
☐ 2010
☐ 2009

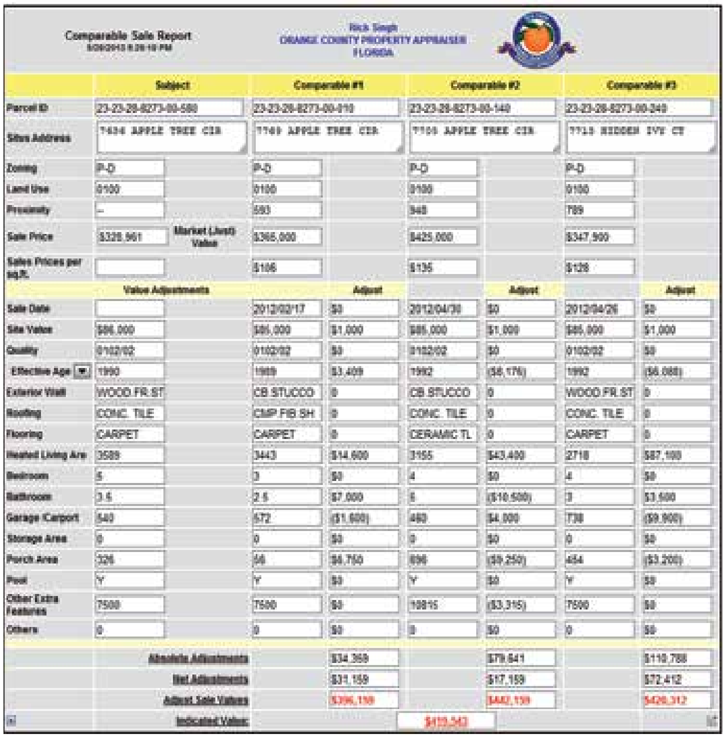
Minmum Compsale: 3

☑ Show Comparables

Comp Sale Adjust Rates:

Living Area (Per Sqft): Rate 1: 50 Rate 2: 100
Pool (Per Unit): Rate 1: 15000 Rate 2: 30000
Garage (Per Sqft): Rate 1: 25 Rate 2: 50
Bed/Bath (Per Unit): Bed: 0 Bath: 7000
Storage (Per Sqft): Rate 1: 12.5 Rate 2: 25
Sale Date (Per Month): 0 %
Porth (Per Sqft): Rate 1: 12.5 Rate 2: 25

Figure 17. Comparable sales report



Comparable Sale Report
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Rick Singh
ORANGE COUNTY PROPERTY APPRAISER
FLORIDA

	Subject		Comparable #1		Comparable #2		Comparable #3	
Parcel ID	23-23-28-8273-00-580		23-23-28-8273-00-010		23-23-28-8273-00-140		23-23-28-8273-00-240	
Sites Address	7634 APPLE TREE CIR		7709 APPLE TREE CIR		7705 APPLE TREE CIR		7713 HIDDEN IVY CT	
Zoning	P-D		P-D		P-D		P-D	
Land Use	0100		0100		0100		0100	
Proximity	--		593		948		789	
Sale Price	$328,961	Market (Just) Value	$365,000		$425,000		$347,900	
Sales Prices per sq.ft.			$106		$135		$128	
	Value Adjustments			Adjust		Adjust		Adjust
Sale Date			2012/02/17	$0	2012/04/30	$0	2012/04/26	$0
Site Value	$86,000		$85,000	$1,000	$85,000	$1,000	$85,000	$1,000
Quality	0102/02		0102/02	$0	0102/02	$0	0102/02	$0
Effective Age	1990		1989	$3,409	1992	($8,176)	1992	($6,088)
Exterior Wall	WOOD FR ST		CB STUCCO	0	CB STUCCO	0	WOOD FR ST	0
Roofing	CONC. TILE		CMP FIB SH	0	CONC. TILE	0	CONC. TILE	0
Flooring	CARPET		CARPET	0	CERAMIC TL	0	CARPET	0
Heated Living Are	3589		3443	$14,600	3155	$43,400	2718	$87,100
Bedroom	5		3	$0	4	$0	4	$0
Bathroom	3.5		2.5	$7,000	5	($10,500)	3	$3,500
Garage Carport	540		572	($1,600)	460	$4,000	738	($9,900)
Storage Area	0		0	$0	0	$0	0	$0
Porch Area	326		56	$6,750	696	($9,250)	454	($3,200)
Pool	Y		Y	$0	Y	$0	Y	$0
Other Extra Features	7500		7500	$0	10815	($3,315)	7500	$0
Others	0		0	$0	0	$0	0	$0
		Absolute Adjustments		$34,359		$79,641		$110,788
		Net Adjustments		$31,159		$17,159		$72,412
		Adjust Sale Values		$396,159		$442,159		$420,312
		Indicated Value:			$419,543			

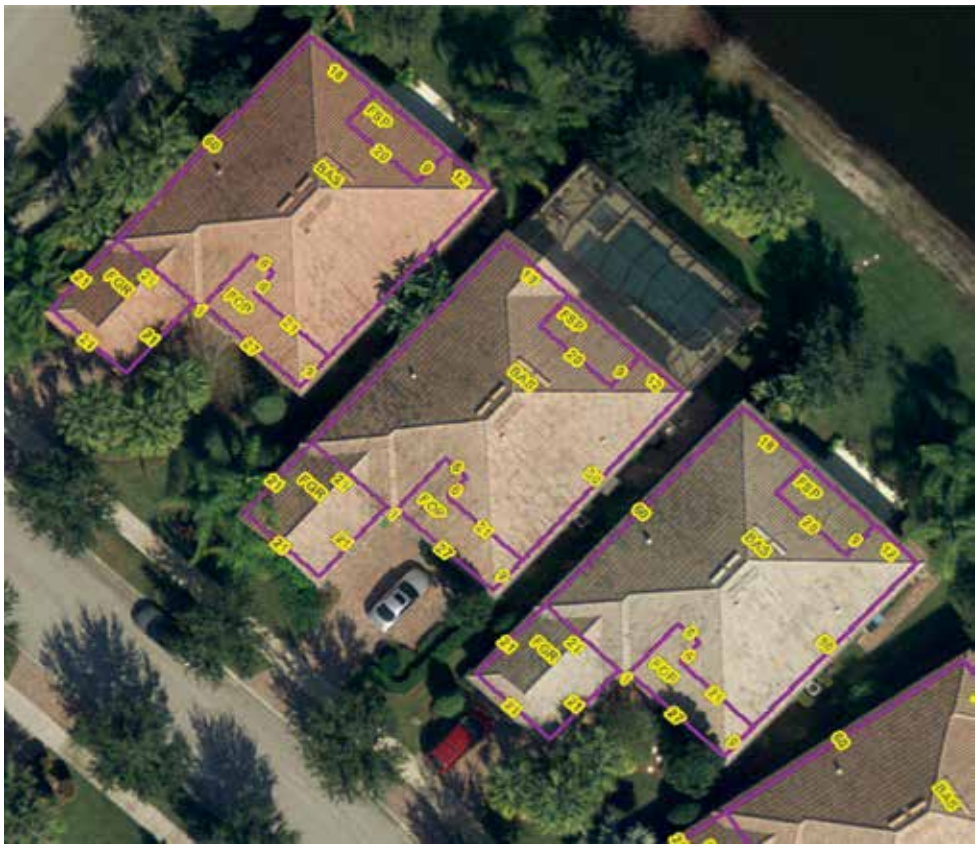
Figure 18. Visual presentation of subject property and comparable sales

Customer Need 10. GIS-Based Sketching and Sketch Visualization

Traditionally, buildings are sketched in a computer-assisted mass appraisal (CAMA) software package. These building sketches are not georeferenced, are often in proprietary formats, and are not interoperable. The challenge was to convert these sketches to the ESRI format and georeference them. The office is currently working to draw these sketches directly on the ESRI platform.

Figure 19. Location information tab on Property Appraiser's Web site

Figure 20. Georeferenced building sketch



Georeferenced building sketches have several benefits: accurate scale and rotation, the ability to verify missing building elements, minimal sketching errors and incorrect attribution, and, most importantly, interoperability. Users also find these georeferenced building sketches very valuable for their business needs. See figure 20 for an example of a georeferenced building sketch.

Customer Need 11. Historic Parcel Information

One data element frequently requested is historic parcel configuration and ownership. The capability for visualizing land use and ownership changes over time is often missing. The solution to this problem is based on the preserving the original parcel polygon (prior to the split or combination), along with the action number and attribute data—all stored as a spatial object in the parcel history layer. Figure 21 is an example of a progressive visualization of both land use and ownership changes: in January 2012 raw undeveloped land was sold as three out-parcels of developed land; the brown parcels compose the parcel fabric in January 2013; and the purple line denotes the prior parcel fabric. This visualization illustrates the land use change, the current and prior ownership, and changes to the parcel fabric.

Customer Need 12. Understanding and Improving Public Service Efficiency

Currently about 70 percent of applications for homestead exemptions are filed online. This is a win-win situation for both the office and its customers. Therefore, the goal is to increase that number. GIS helps identify neighborhoods with a low online filing participation so the office can reach out and serve those neighborhoods. Figure 22 shows the spatial distribution of homestead exemption filings; a clear

Figure 21. Progressive visualization of land use and ownership changes

Figure 23. Pie chart of type of filings for homestead exemption

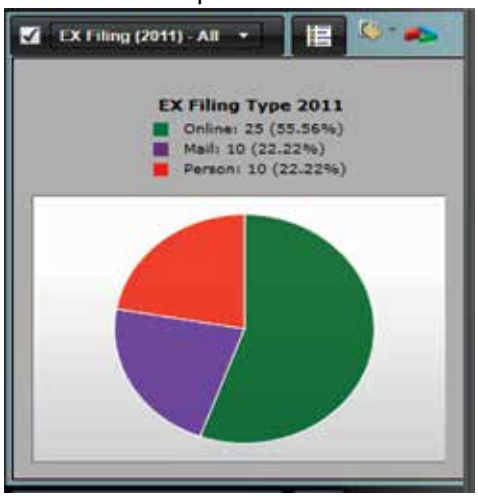


Figure 22. Spatial distribution of homestead exemption filings

Figure 24. Example of a 25.1-acre parcel with multiple land uses

pattern of online filing in high-value neighborhoods, as might be expected, has not occurred. Figure 23 is a pie chart showing the type of filing for homestead exemptions, as created in the GIS application.

Customer Need 13. Valuation of Multi-use Land Parcels

A primary challenge in valuation is multiple land uses on a single tax parcel. Often, the property owner is unsure how the land value is derived. The appraiser's office has innovatively mapped every unique land use polygon within a single tax parcel. This approach is a win-win situation for both the Property Appraiser's office and the property owner.

Figure 24 is an example of a 25.1-acre parcel with multiple land uses; each use is demarcated accurately to allocate correct acreage. Land lines are mapped by using surveys when available or high-resolution aerial imagery that is then verified in the field. Figure 25 is an example of a report on a parcel with multiple land uses; the user can identify associated land lines—lines 1, 2, and 4 are agricultural use, land 3 is residential use, and line 5 is submerged land.

Customer Need 14. Damage Assessment

Another responsibility of the Property Appraiser's office involves locating property damage from natural disasters. Appraisers identify the level of damage (minor, moderate, severe, destroyed), and the software estimates the value of damage based on preset percentages of replacement cost. These numbers are then aggregated

Figure 25. Report on a parcel with multiple land uses

Land Line Order #: 1 Land ID: 2594490
Land Dorcode: 6100 Zoning: IND-2/IND-3
MKT Value: $1,025,601 Unit Price: $54,150.00
Unit Code: AC Land Qty: 18.94

Land Line Order #: 2 Land ID: 2879609
Land Dorcode: 6100 Zoning: C-3
MKT Value: $77,976 Unit Price: $54,150.00
Unit Code: AC Land Qty: 1.44

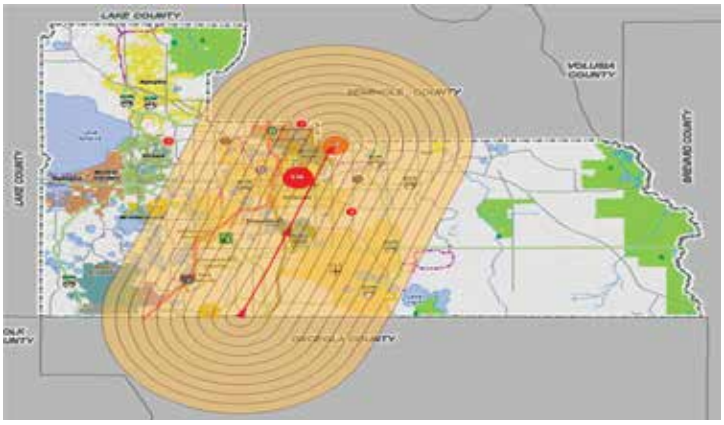
Land Line Order #: 3 Land ID: 2594491
Land Dorcode: 0100 Zoning: IND-2/IND-3
MKT Value: $42,540 Unit Price: $42,540.00
Unit Code: AC Land Qty: 1

Land Line Order #: 4 Land ID: 2906999
Land Dorcode: 6999 Zoning: IND-2/IND-3
MKT Value: $311 Unit Price: $100.00
Unit Code: AC Land Qty: 3.11

Land Line Order #: 5 Land ID: 2907000
Land Dorcode: 9500 Zoning: IND-2/IND-3
MKT Value: $6 Unit Price: $10.00
Unit Code: AC Land Qty: 0.6

and reported to local, state, and federal agencies. In-house applications for field data collection and dissemination have been created; the office also relies on cloud-sourced data and photos. Figure 26 shows the path of Hurricane Charley in August 2004 and a 10-mile radius; this map allows the appraiser's office to optimize damage assessment efforts. Figure 27 (page 13) is a point representation of damage, coded by severity (data are simulation-based). Figure 28 is a real-time dashboard of data entry and associated damage (data are simulation-based).

Figure 26. Path of Hurricane Charley in August 2004



Customer Need 15. Social Media and Outreach

Appraisers are constantly producing effective visualizations to model real world data, and thus need to promote the assessment profession and its message with high-quality storytelling. The Orange County Property Appraiser's office has successfully executed a social media strategy that has resulted in almost 1,800 *likes* in a short period of 6 months. Check out the Facebook page (figure 29), www.facebook.com/ocpafl, and please give it a *like*.

Figure 28. Real-time dashboard of data entry and associated damage estimate

Figure 29. Facebook page for Orange County Property Appraiser's office

Figure 27. Point representation of hurricane damage, coded by severity

Manish Bhatt is Chief Information Officer with the Orange County Property Appraiser's office in Orlando, Florida. He has been with Orange County since March 1999. He has implemented technology solutions in several industries. Manish earned an MBA from Goizueta Business School at Emory University. Prior to that he earned a master's degree in GIS and geophysics from the University of Texas, Dallas. A native of India, he graduated from the Indian Institute of Technology, Bombay, earning an MS in applied geology before moving to the United States. Manish can be contacted at mbhatt@ocpafl.org

Rick Singh was sworn in as the Orange County Property Appraiser on January 13, 2013, and has earned a Certified Florida Appraiser (CFA) designation from the State of Florida Department of Revenue. He is a real estate broker and a state-certified residential appraiser. Previously, he owned his own appraisal firm and started a real estate company. During this time, he hired, trained, managed, and reviewed numerous appraisers, brokers, and sales agents. A proud veteran, he enlisted in the U.S. Army and was assigned to the 1st Infantry Division Mechanized, working on Helicopter Armament Subsystems. Rick was honorably discharged in 1986 with the rank of Specialist 4. Rick can be contacted at ricksingh@ocpafl.org.