Report on Case Study

Jacobs Appraisal and Affiliates

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Acknowledgment to
Nathan Jimerson, former project coordinator
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Executive Summary

Jacobs Appraisal and Affiliates is a small real estate appraisal group based in Apple Valley, California, that provides raw land, residential, and commercial appraisals, and litigation and consulting services. The group, consisting of 10 appraisers at varying levels of expertise, certification, and specialty, operates mostly in San Bernardino and Riverside Counties, but has some projects in northern California, Arizona, and New Orleans.

The group has conducted its mapping work manually or by consolidating disparate web-based maps from government services, including county assessor offices, California Department of Fish and Game, and U.S. Geological Survey. There are problems of differing coordinate systems, scale, map projections, and identifiable reference points, as well as variable time points over which data are collected and maps produced. For instance, zoning maps produced in 2005 at 1:100,000 scale might be compared by eyeball to parcel maps from 2007 at 1:50,000 scale.

This report describes Jacob Appraisal's traditional approach, explains the advent of integrated GIS and GPS use at the group and the design of a prototype spatial system, and

describes the sources of geographic and attribute data, types of applications for customers, training, pitfalls, concerns, costs and benefits, organizational aspects, and the need for continuing leadership.

Introduction

Jacobs Appraisal and Affiliates is a loosely-associated group of ten land appraisers located in the Inland Empire Region of California. Each appraiser functions legally as an independent professional entity. All are licensed or in process of becoming licensed. Members of the group, however, coordinate and partner with each other on some projects. The group is led by Sam Jacobs (fictitious name), President of Jacobs Appraisal and Affiliates.

Members traditionally utilized hardcopy mapping as part of the property appraisal process, based on paper maps gathered from county offices and other sources, stored manually, and studied, analyzed, and reported on to clients.

Jacobs Appraisal affiliates sometimes used a large banker's box filled with maps provided by government and commercial sources. An appraiser would drive with the maps to a County Building Department or Planning Department to discuss the maps with county personnel. In the 1990s, the group switched the storage medium from hardcopy to microfiche.

As the internet and web became more prevalent, the appraisers advanced to gathering information from diverse web-based sources, mostly governmental, such as San Bernardino County Assessor's Office and Riverside County Planning Office. However, those sources presented problems of inconsistencies in geographic referencing, attributes, definitions, scales, and map projections. Hence, "eye-balling" the maps alongside each other was difficult and subject to errors. The problem was compounded as more disparate sources became available.

In October of 2008, in response to the issues raised by the web mapping services approach, a project was started between University of Redlands and Jacobs Appraisal and Affiliates to provide integrated GIS and GPS capability to the group. Funding was provided by SBA grant SBAHQ-06-1-0046. Several initial planning meetings were held, involving investigators James Pick and Richard Greene and former project coordinator Nathan Jimerson with the group of appraisers. A meeting held with Jian Lange, ArcPad Product Manager at ESRI Inc. focused on alternatives for data collection of land information on mobile devices in the field, including on handheld devices running the ArcPad software from ESRI, as well as on notebooks or laptops connected to inexpensive stand-alone consumer-level GPS devices.

At the conclusion of these early meetings, a plan was agreed upon by the Appraisers group and Redlands team to develop and implement GIS applications.

1. The GIS software is ArcGIS 9.2 from ESRI Inc. *Rationale*: this software allows the integration of previously scattered geographical layers into a multilayer geodatabase. As a result, overlays and other kinds of analysis can be done in a

single "master" geodatabase that includes the key geographic and attribute data required for appraisals. It can be enhanced with additional data in the future.

2. The first phase of the GIS-GPS development focuses on two goals: (a) training of the appraisal group up to at least lower intermediate skills in ArcGIS and (b) building a geodatabase by the SBA development team in close consultation and interaction/feedback from the group. *Rationale*: the appraisers entered the process with limited mapping skills for consumer web tools such as Google Earth and awareness but no hands-on skills in GIS. Training would be necessary and best focused on appraisal-specific applications. The geodatabase of appraisal-related layers constituted the core of the prospective value of a GIS approach. Hence building and gaining support for the geodatabase would precede field testing and use of mobile devices.

3. The approach to GPS would be to utilize mid-level consumer GPS devices, which have the capability to identify points in the field from pre-established coordinates, to record field points in the device, and to export them into ArcGIS, constituting a layer added to the geodatabase.

4. The second phase of GIS-GPS development would focus on utilizing the geodatabase in conjunction with consumer GPS devices in the field. This would involve some fieldwork to test and get feedback from the appraisers on the most effective GPS use. *Rationale*. For certain types of land appraisals, physical boundaries in the field need to be field-checked against boundaries of existing maps, and new points need to be entered to form new map layers.

5. A series of training sessions would be conducted by the Redlands team, culminating in producing a user's manual and full report on the project. *Rationale*: Training is essential. The manual and report would be helpful in documenting the project for continuing use and further development, once the formal SBA-grant consultation and pilot work are ended.

6. A cost-benefit analysis would be designed and conducted so assessment can be made of the prospective net benefits from GIS. *Rationale*: It is important with a GIS project to evaluate the actual benefits and costs that occur in order to assess continuing investment by the client organization in the project and to modify, build up, and strengthen aspects of it in the future (Maguire et al., 2008; Pick, 2008).

By July of 2008, the steps 1-6 were largely completed, although step 6 is scheduled to continue about 3 months following project completion, in order to evaluate post-GIS costs and benefits.

The report next turns to GIS for land appraisal, research goal and research questions, methodology, background on Jacobs Appraisal and Associates, the geodatabase, spatial analysis, training, field aspects, and cost-benefit analysis.

Appraisal Sector Background

Land appraisal is a crucial aspect of real estate and land ownership (Robbins, 1998; Weber, 1998, 2001a, 2004; ESRI, 2008). It occurs at key transaction points in the ownership and economic cycles of properties. In the United States, land appraisal is well established and practiced by about 177,000 professional real estate appraisers, many of whom are certified. The preponderance of real estate appraisers belongs to small often individual professional practices, and they are subject to turnover. The State of California Office of Real Estate Appraisal (www.orea.ca.gov) grants four levels of appraiser licensing: trainee license, residential license, certified residential license, and certified general license, based on training and testing. The Appraisal Foundation (www.appraisalfoundation.org), a nationwide nonprofit that represents the appraisal profession for real estate, personal property, and businesses, provides Uniform Standards of Professional Appraisal Practice (USPAP) for the U.S., which in turn support the California and other state licensing. Professional certification is achieved by the Appraisal Institute (www.appraisalinstitute.org), a national nonprofit for real estate appraisal, which grants the designations of SRA for residential appraisal and MAI for commercial appraisal.

The recent national mortgage crisis and credit crunch have somewhat reduced appraiser demand, but growth is expected in California. Residential appraisal demand is continually renewed by life-cycle changes of births, marriages, divorces, retirements, and deaths, as well as by changes in housing stock, and business turnover and changes. During the cycle of property development, every major life cycle juncture point requires appraisals, including for vacant land, right-of-way for vacant land, land development, subdividing the land for sales, and selling individual parcels. Requirements for licensing and certification have tightened in the past year due partly to mistakes made in the credit crisis. Sam Jacobs expects continuation of growth in the number of appraisers, because of overall population increase, expanded housing and property developments, and expansion in pipelines, power transmission lines, and roadways.

Likewise, changes in land boundaries and declaration of eminent domain stimulate appraisal demand. Foreclosure requires an appraisal in order to write it off. Another unique niche is handling land trust properties. Money cannot be spent from a grant to establish a land trust property without a current, full market value appraisal. The recent Federal Energy Act has stimulated appraisals to determine whether energy efficiency items proposed are actually in place and whether the efficiencies claimed have actually occurred. California's Public Utilities Commission has passed similar regulations, and is currently drafting rules for appraisers to evaluate adherence to them.

The goal of real estate appraisal is to provide valuation of real property. Five types of valuation are often considered: market value, value-in-use, investment value, insurance

value, and liquidation value (Robbins, 1998; Wikipedia, 2008). *Market value* represents the open market exchange value between a willing buyer and willing seller. *Value-in-use* is the value, usually net present value, for a particular owner for the property directed towards a certain use, and it is usually lower than market value. *Investment value* represents the value of a real estate property for a specific investor. It is often higher than the market value. An investor can be viewed as desiring the property so might have to pay a premium to purchase it. The *insurance value* is value that is registered by an insurance company. It excludes the value of the land, but includes the value of improvements that can be estimated in several ways. *Liquidation value* is the value of a real estate property as determined by bankruptcy proceedings. It is considerably lower than market since the seller must usually sell quickly.

For a particular appraisal project, the appraiser must determine one or more of these valuations. Three common techniques are utilized: cost, sales comparison, and income (The Appraisal Foundation, 2008). In the *cost approach*, the replacement cost is estimated for all the parts of the property minus depreciation. For s*ales comparison approach*, research is done to determine value based on comparable properties sold in the same geographic marketplace. In the *income approach*, the income stream is capitalized to determine value. For multi-year income streams, the technique of net present value (NPV) is applied. Another type of valuation is *highest and best use*. After the legal and feasible uses are analyzed and their values determined, the use with the highest value for the property is identified and considered the most productive.

GIS can be utilized as a tool to assist in determining valuation. Rather than automatically determining value, GIS provides more information and analysis that can supplement the appraiser in making valuations. GIS began to be applied to real estate valuation in the 1990s and today is frequently applied by large organizations, including real estate investment firms, state and federal government agencies such as the U.S. Bureau of Land Management and county assessor offices, timber companies, corporate real estate departments, large-scale land developers, and mortgage and financial firms. The latter use GIS to assist in compliance with federal regulations such as the Community Reinvestment Act (CRA) and Home Mortgage Disclosure Act (HMDA) (O'Rourke, 1998). GIS also supports appraisers in consulting and expert witnessing in litigation involving residential and commercial real estate (Mundy, 1998; O'Rourke, 1998).

However, GIS is not yet in common use among independent, professionally-certified land appraisers in private practice, such as Jacobs Appraisal and Affiliates. The reasons include scarcity of time and resources of independent appraisers to learn GIS, cost of the software and technology, time involved with assembling georeferenced and robust spatial databases, and market pressure to lower cost for the low-cost appraisals prevalent for the private practitioner (Castle, 1998).

Another perspective on GIS for property valuation considers that any valuation approach depends on the parties' information (Weber, 2001, 2004; Wachter et al., 2005). Since different players, including buyers, sellers, and governments, have information that may be similar or different, real estate valuation can be viewed as "a game of information

arbitrage" (Castle, 1998). In this context, GIS serves as an analytics tool for a player to distill the essential and accurate results out of a morass of information.

Some of the specific uses cited for GIS are as follows. For the sales comparison approach, GIS identifies the comparable properties based on geographical and socioeconomic properties. GIS can be applied in more complex spatial modeling of real estate markets to refine comparisons. This includes being able to account spatially for competitive supply of real estate, i.e. displaying alternative properties that a buyer would consider purchasing in place of a target property (Weber, 2004). For leasing, GIS similarly can help model the range of competing leasing alternatives for a target property. Furthermore, GIS-based models are available to determine market demand for real estate properties based on socioeconomic characteristics of small areas, often derived from the U.S. Census (Wachter, 2005). However, in other situations in which such data need to be gathered for a market analysis, GIS can provide a geographic framework to support survey research to gather the data (Weber, 2004). Even more elaborate real estate market models take into account spatial interaction, i.e. recognize two or more parties interacting with each other. Well known examples are gravity modeling and Huff models (Greene and Pick, 2006). In gravity modeling, the forces of attraction are inversely proportional to the distances from the subject property to other properties with known values. The Huff model has a more complex inverse distances functions of the subject property in relation to other entities.

For the highest and best use approach mentioned earlier, GIS modeling can identify the alternative productive uses of a property and help to determine the highest valued use (Weber, 2004). GIS modeling would be especially beneficial for complex properties, where best use alternatives must meet regulatory or industry standards. An example is a property being considered for best use among a range of commercial or shopping center options, but is subject to governmental regulations on zoning, size, and layout. Related to this application, GIS could also categorize properties by whether they meet certain thresholds for uses, sometimes termed "market delineation" (Weber, 2004). Several modeling techniques can be combined together. For example, Weber (2001) proposes combining the spatial regression model for valuation based on socioeconomic characteristics with cyclical trend models that recognize the impact of the business cycle on submarkets.

Another GIS appraisal realm is to identify erroneous valuations, analyze problematic properties, and resolve valuation disputes (Weber, 2001). Weber (2001) cites the example of the leasing valuation of a vacant shopping center. Although valued by two appraisers with the assumption that the shopping center would be fully leased within 1.5 years, as it turned out the center was only one third leased after that time period. GIS could have provided a more accurate market demand estimate. Another cited example was to appraise the value of a quadruplex property in a neighborhood of San Bernardino, California (Weber, 2001). This valuation was inflated by the appraiser taking advantage of the considerable variation among properties within the neighborhood. The appraiser intentionally did not recognize that the property was located in a poorer section of the

neighborhood. Using GIS at the census tract level would have accurately shown the sub-neighborhood socioeconomic differences and resulted in a lower and more correct valuation. Appraisers who specialize in resolving differences between divergent appraisals, known as review appraisers, can utilize GIS combined with the most recent and accurate data to reconcile such differences.

Another specialized uses of GIS for appraisals is to assess supply and demand for ecologically reserved land and to determine real estate valuations relative to the extent of contaminated properties. An example is to appraise brownfields, i.e. physically contaminated urban areas that have potential for restoration (Weber, 2002). In California, the law dictates that for certain endangered species, open habitat land areas known as "mitigation land" must be purchased in specified ratios to land being developed. For instance, for the desert tortoise common in the Mohave Desert, a 6:1 mitigation ratio is mandated and enforced by the State of California Fish and Game Department. For the land developer who acquires at a 6:1 ratio, six acres must be purchased that include one development acre, and the species habitat must be present on the other five contiguous acres. Without GIS, it is difficult to identify and value the mitigation land. For instance, since mitigation land is more valuable if it adjoins other mitigation land, GIS is useful in visualizing the "jigsaw puzzle" of mitigation land parcels and in planning the purchase of sufficient aggregated habitat.

The automated valuation model (AVM) and computer assisted mass appraisal (CAMA) techniques usually depend on GIS to value large numbers of properties on a timely and

efficient basis (Robbins; 1998; Wachter et al., 2005; The Appraisal Foundation, 2008). An AVM is based on a GIS combined with a statistical valuation model, often regression analysis (Wachter, 2005). Applied increasingly in the private sector by large enterprises, such as property investment companies, it estimates future sales prices from a database of past sales prices, usually combined with geographic information. CAMA is utilized by municipal assessors to perform mass appraisals for a metropolitan area or community based on governmental data (Wachter, 2005). These models link property value to such attributes as lot size, property age, area income, area education, and number of bathrooms (Wachter, 2005). However, the methods sometimes do not include spatial relationships.

AVM and CAMA have the advantage of lower price per valuation and elimination of subjective bias (Wachter, 2005). However, AVM output is not regarded by the Appraisal Foundation and other governing bodies as an genuine appraisal. Rather AVM can be included as a support item in an appraisal report along with description of the method used, assumptions made, data recency and accuracy, and extent that the user can customize it (The Appraisal Foundation, Advisory Opinion 18, 2008). The analogy might be a population projection done for a city. It is not hard fact, but an estimate dependent on an imperfect method, the recency/accuracy of the data, and the extent to which it can be customized to include local factors. The small independent appraiser is unlikely to apply AVM for the following reasons: (a) his/her projects rarely involve appraising massive numbers of properties, (b) understanding the statistical methodology may be time-consuming requiring training and education, and (c) the client might be uninterested in AVM results or not consider them credible.

GIS for real estate appraisal has pluses and minuses (Castle, 1998; Robbins, 1998). Among the pluses are greater accuracy; use of spatial methods such as overlays, proximity, buffering, and spatial modeling; visualization of spatial patterns and relationships; and cost savings once the GIS system is operating. Minuses include higher fees for clients; too much complexity for the average client; cost and time for training and education; cost and time for operating the GIS; and cost of GIS software, services, and hardware (Castle, 1998). More generic aspects of costs and benefits are reviewed later in the report under "costs and benefits."

Research Goal and Research Questions

The research goal of this study is to determine the best uses of spatial technologies for Jacobs Appraisal and Affiliates, to train the appraisal group in GIS and GPS methods, and to develop and implement a prototype. The specific research questions are the following:

1. What are the history, background, experience, and capabilities of a small land appraisal group?
2. What spatial applications are most important for a small land appraisal group?
3. What geographic and attribute data are most useful for a small land appraisal group?
4. How can a small land appraisal group feasibly utilize GPS devices in the field as part of a GIS application?
5. What are the costs and benefits to a small land appraisal group of implementing GIS and GPS?

Methodology

The methodologies are case study, spatial analysis, and cost benefit analysis. Case study methodology (Yin, 1994) consists of defining the study focus, framework construction, interviews, data collection, and case analysis. Case studies are used to achieve insight into enterprises and their decision-making processes, often with greater depth than can be done through large sample surveys (Yin, 1994). Case study investigation typically has small sample sizes (Yin, 1994).

Jacobs Appraisal and Affiliates was selected for case analysis on a convenience basis. The SBA grant project included review for case study analysis of over one hundred potential small enterprises. Using screening criteria, five small enterprises were selected for in-depth study and prototype implementation. The enterprises had in common high motivation to explore the potential of GIS applications, business duration of at least 15 years, and a workforce size of 5 to 15 employees. The other four organizations selected so far consist of a home accessories firm, a small government-funded financial credit firm, a bridal magazine company for the Latino market in California, and a firm that develops and implements websites for small organizations.

For Jacobs Appraisal and Associates, the case study approach is to interview all appraisal associates, including the group leader. The interview is based on the questionnaire protocol given in Appendix A. Interview results were tape recorded and transcribed in writing. The transcripts were sent to the interviewees for factual correction. Secondary

materials were requested from Jacobs Appraisal and provided by the group. Other secondary business materials were obtained from company websites and standard business information services.

The second methodology, spatial analysis (Clarke, 2003; Longley and Batty, 2003; Greene and Stager, 2005), is applied in this research to create a prototype implementation of GIS and GPS for the appraisal group. The group was closely consulted during the development of the prototype. The software used is ArcGIS 9.2 from ESRI Inc. The GPS equipment is standardized on Garmin Nuvi equipment. Software was obtained from Garmin that enabled export of recorded points into ArcGIS as a shape file.

The methodology utilized in the cost-benefit analysis is standard assessment of costs and benefits for GIS (Obermeyer, 1999; Pick, 2005, 2008; Maguire et al., 2008), but with the added detail of activity based costing (Kaplan, 1990). These methods are explained in the cost-benefit section.

Summary of Results

This section describes and discusses the findings of the study.

Interview Results

Jacobs Appraisal History

The case study subject organization, Jacobs Appraisal and Affiliates, is an offshoot of the former Champion Research Corporation in southern California, which performed heavy

construction and land acquisition, and was structured through limited partnerships. Sam Jacobs (fictitious name), the one person left from the original Champion firm, started the limited partnership of Jacobs Appraisal in 1991, headquartered in Apple Valley. Other appraiser affiliates have joined in since then. The affiliates are licensed individually and retain their own offices, centered in the High Desert area of the Inland Empire and including Running Springs, Hesperia, Phelan, and Victorville. One appraiser is located in Rancho Cucamonga. Appraisers are both part of the group and independent, since each appraiser in California must sign his/her own name to effect a valid appraisal. Sam has served as the mentor of most of the other affiliates, training them and readying them to take various levels of state licensing and certification exams as required by the State of California Office of Real Estate Appraisers and The Appraisal Foundation. The group has progressed well towards these goals under tutelage of Sam. Achieving a new licensing designation often takes 2 to 4 years of effort. Once fully licensed, an appraiser affiliate "can go off and do their own thing or stay in the nest and continue the relationship" (Sam Jacobs, 2007).

Organization and Scope of Current Business

Although initially the group focused on appraisals in the Mohave Desert and on its water resources, the group now includes specialists in water, vacant land, multiple family, commercial, industrial, church, eminent domain, hotels and motels. The group also provides lease-market studies, cost-benefit analysis, litigation and expert witness support. One affiliate also specializes in appraisal review, i.e. review for the Federal Housing Administration (FHA) of prior appraisals that might be flagged for variances with norms

or with each other. The group can perform highest and best use appraisal studies that focus on the objectives not only of profit, but sometimes also of conservation easements, rights of way, and furtherance of certain species. The group has capability to provide appraisals all over southern California, and occasionally in northern California, Arizona, and New Orleans.

Customers, Competition, and Market for Jacobs Appraisal

The approximate division of the group's customers is as follows: lending institutions (60 percent); litigation support (20 percent); municipal governments, California State Fish and Game, other local, state, and federal agencies, conservancy groups, commercial entities, individuals (20 percent). Customers request a mixture of residential, commercial, open land, and consulting services. Based on the number of appraisal reports, raw land is included in 95 percent of reports, built residential property in 50 percent, and commercial or industry property in 15-20 percent. However, the percentages shift by project length and complexity. Clients tend to find Jacobs Appraisal by referral or word of mouth.

The group also conducts special-use studies including mini-storage, cemeteries, feasibility studies, cost-benefit analysis, lease market studies, and highest-investment-use analysis. For the latter, appraisal is done both as if the land were vacant and for the land as currently improved. The highest use for investment depends on its current zoning, i.e. subject to legal constraints. For legal alternatives, financial feasibility is analyzed. In the end, the use deemed "most productive" for the property is usually the most profitable, but might in special situations be gauged by conservation goals or the public good.

The justification for having a group of affiliates is that their synergies are important. Most data sources and some projects and contracts can be shared among two or more members. For larger shared projects, Sam Jacobs often serves as the leader. Although each appraiser maintains an individual office usually at his/her residence, none of the appraisers has office staff. Every appraiser spends some time in the field.

The group indicates that industry demand and profitability have multiple drivers, including life cycle changes, the current mortgage crisis, etc. Some appraisers in specialized niches focus on land trusts or energy efficiency audits from the Federal Energy Act. For all affiliates, work demand is affected by fluctuations in property ownership from various causes that continuously drive the industry. The recent spate of foreclosures is one example of such a driver.

The central role of Jacobs Appraisal in the group has several pluses for both Sam Jacobs and the affiliates. Affiliate advantages include access to prior appraisals; prior files; contacts; shared data resources, includes multiple listing service (MLS) and ESRI data; other networking information; the extensive appraisal library of Sam Jacobs; and enhanced potential for joint projects. Sam Jacobs benefits from the capability of the group to undertake larger jobs and backup for his projects when he is on vacation.

The group competes with other licensed appraisers, who are on approved lists for a particular locality. Most appraisers work independently, so he/she is at risk if taken off

the job by illness or vacation; group membership helps here. Appraisers may be specialized and are sought after in niche markets. For instance, one affiliate of Jacobs Appraisal is specialized in real estate in New Orleans, and spends part of his time there.

The affiliates pointed to "competition" from the AVM systems, which are prevalent among California's lending institutions and apply crude methods to appraise large or massive amounts of properties. AVM is criticized in not recognizing foreclosures, the condition of housing, or zoning (Robbins, 1998). It fails to recognize the difference between mass manufactured versus custom homes. It is slowly being recognized that AVM valuations need to be reviewed by human appraisers. Nevertheless, AVM has grown in the state and poses a threat to Jacobs Appraisal due to its low cost and prevalence among lenders.

Data and Data Providers

The essential success factor cited by the group is data, particularly with respect to its accuracy and relevance for presentation to the client. One affiliate mentioned, "The better you report, the more concisely, and more accurately, the more the client gets for his/her dollars." A standard in California for appraisers is that the gathering of data needs to be replicable from the data source. This has implications for GIS, since a strong and accurate spatial data base leads to replicable data that cannot be challenged.

There are inconsistencies in data sources and retrieval. In the present study for instance, file types and attributes are differ between Riverside County and San Bernardino County.

The Riverside County Assessor provides data as Microsoft Access data files, while San Bernardino County provides them as shape files, which are GIS-ready. On the other hand, Riverside County files include considerably more assessor and other attributes for each parcel.

An advantage of the integrated GIS approach in the present project is that the geodatabase can acquire data from a city or county source once, add it to the geodatabase, and reuse it many times. This multiplies the potential productivity of the group's GIS use many-fold.

Background on manual data collection for Jacobs Appraisal and Affiliates

The pre-GIS policy of data collection has been that minimal regular data are collected, since a large-scale data collection would require massive storage capacity. Since each appraisal project varies significantly, the policy has been to collect data sources each time an appraiser has an assignment and to retain each of them in hard disk storage only to the extent that each one is needed for the project. With this policy, some data gathered that turn out not to be necessary are saved in paper format. This process of weighing the relevance of data and deciding on the appropriate retention demonstrates that a "weighted thought process" has been used, which is the standard sought in the case of questioning by the State of California Office of Real Estate Appraisers (OREA), the agency responsible for licensing.

In initial planning with the SBA team, the group pointed to data gathering problems and challenges in the pre-GIS environment that could be solved by GIS and GPS. For appraisal of open land use, the maps referenced physical property boundary markers, but the field markers were often difficult to locate, especially without GPS equipment, and were often inaccurate by contemporary standards. Other problems cited were: lack of computerized data, inconsistent standards for data retrieval, lack of integration of data, and deficits in having certain types of data. Particular problems were: (1) Lack of locations or probable locations of an endangered species, the desert tortoise, based on the geographical patterns of flora that are eaten by the tortoise. The appraisers are unaware any prior mapping of these data. (2) Difficulties and barriers to access to government data on soils, geology, topography, and zoning that were georeferenced, (3) Inexact coordinates of property boundaries.

For appraisal of commercial and industrial properties, the problems cited were: lack of zoning information, lack of cooperation from data providers, confusion intentionally created by owners and developers who rapidly divide and combine properties, occasional untruthfulness in providing data by government and private services, and lack of government support staff, widely varying scales for hardcopy maps, and inconsistencies in hardcopy and web-delivered maps multiple agencies and sources. The latter include land parcel maps, US Geological Survey quadrangle and topographical maps ("quads" and "topos"), maps of hazards, wells, earthquake, and hydrology, as well as information from multiple listing services (MLSs), some of which had inaccurate data. Real estate market data sometimes came from uncooperative or even fraudulent sources.

In sum, for all types of appraisal, the factors mentioned caused lower productivity.

Background on information technology

At the beginning of the SBA consultation, Jacobs Appraisal had limited IT capability consisting of several desktop and laptop computers. GPS units were in use by half of its affiliates. Most had local wi-fi wireless networks. The lead appraiser, Sam Jacobs, had a server for a local network in his office. Although each appraiser handled his/her own computing equipment, an on-call IT maintenance and support consultant made reasonably-priced office and house calls to the members of the group.

The group has established computing standards for common software and file exchange between members. These standards established that all appraiser affiliates must have the same program as the one on Sam Jacob's computer or a program outputting files that can be read by Sam's computer.

Computing applications in use in the group, at the start of the SBA consulting, were as follows:

1. GPS applications. GPS devices are auto-mounted or handheld and used to locate points, but minimally applied for full visualization of maps. The group plans to upgrade to more recent and accurate GPS units with enhanced accuracy that connect to laptops.
2. Accounting
3. Word processing
4. Appraiser training and licensing
5. Education
6. Web access to real estate and map services, including Google Earth and Multiple Listing Services (MLS)

The starting applications were simple, easy to use, and low cost. Not much training was involved. This simple base underscored the need for training in GIS software, which is more complicated than what the group was used to.

In the physical assessment of open land, the pre-GIS approach described in the last section was time consuming. First, specific types of maps were ordered depending on the location of the property. The sources included U.S. Geological Survey (USGS) topo or quad maps, and county maps of land parcels identified by parcel number, also known as APN number. For instance, one of the appraisers who focuses on open land took a GPS device into the field for open land appraisal. The pre-GIS approach emphasized preparation in the office using hardcopy maps, including USGS quad and topo maps, water maps, hazard maps, wells, earthquake faults, and soils maps. This was time-consuming, since the maps had to be located manually and compared by "eyeballing" often at different scales and projections.

Once in an open land area, the appraiser followed physical section markers, which had been placed by the USGS or other agencies. The process is as follows. First, a known section marker is located. From it, the appraiser followed the legal description to reach subsequent land markers. However, a problem this appraiser pointed out is that "you're never quite sure" if you're on the correct path. This is exacerbated by fires in southern California which have burned markers, making it difficult to keep on the path.

The markers and triangulated paths to new points allowed the appraiser to identify parcel boundaries, which he/she marked by putting physical location stakes in the ground. The average cost to a client just to know these "appraiser" boundaries was $200 per appraisal and was usually adequate for a client report involving "due diligence." However if the client intended to build a structure on the property, a surveyor needed to be brought in as a consultant to measure exactly and place surveyor pins in the ground. The surveyor charges for the client were $2,000 per appraisal on average.

Time scheduling of the appraiser needs to be well thought out for open land appraisal. Depending on the situation, the appraiser might conduct a quick drive-by of a property without customer contact, but in other cases perform extensive field work, meetings, and verbal presentations to the customer. For open land valuation, client meetings are rare, so the appraiser has freedom to determine his/her schedule. The scheduling steps for open land are:

(1) Locate the subject property and either photograph it from the car or walk the property to document conditions.
(2) If valuation is called for, find and inspect comparable property. Note: this step can take days for larger subject properties with scattered comparables, but time can be saved by using aerial images.

Maps of water rights are also important. One type of water right map gives the current location of rights. However, water rights can often be displaced. For instance, a Mohave River right might have emanated from Apple Valley but is now located in Newbury Springs. In this movement of the water right, the water also changes, e.g. high quality water may be altered and become extreme salt water. A second paper map shows hydrology, which implies the level of water quality.

In the field, digital photography documents physical features for analysis and records. However, a pre-GIS/GPS problem was that the exact location and direction for the photo were not known. One reason for the group's interest in GPS is that through use of GPS devices, the exact-coordinate field locations of photos are known.

Company Strategies for Jacobs Appraisal and Associates

This section describes the middle term and long term strategies of Jacobs Appraisal and Affiliates, as reported in the interview study. For the group, geography is inherently important, since its core business is tied to the land, its dimensions, value, and characteristics. Greater depth of knowledge and rapid access to information on land and its characteristics can make the group more productive, efficient, and accurate. The combination of GIS for a rich spatial data-base and GPS for pinpoint accuracy in the field can strengthen competitiveness. It can help Jacobs Appraisal undertake more complex projects, extend more easily to areas outside of its core counties, offer new products and services, and even market its newly-found GIS and GPS capabilities as a separate service.

Sam Jacobs stressed the need for shared data in the firm's strategic vision. This could support quality, efficiency, and speed of projects. Since the individual appraisers aspire to share experiences, there needs to be improved networking and support for sharing of map information. Consequently appraisers could act as a group more, rather than each acting individually. Such improved interactions would allow the group to serve a wider variety of clients with new and improved products and services.

The group expressed the need to improve the perception beforehand of what the appraisal problem is, in order to be able to chart the solution in advance. Respondents from the group used the analogy of the challenge a physician faces in diagnosing a patient and charting out a course of treatment.

Another strategy for the group is to develop its litigation capability for expert witnessing by expanding into trial coaching and evidence preparation. Geographically, land appraisal could expand into more counties, once good quality GIS data for those counties become available and the group has more competence in spatial technologies. Training is a key according to Sam Jacobs, who perceives GIS use to be challenging to learn including the interfacing of GIS with other computer programs.

In considering five-year strategies, the group foresees marketing to span several additional counties and other states including Nevada, Arizona, and possibly Hawaii, by first advertising with printed fliers and web pages to bring in customers. "A lot depends on the economy and how the Feds handle it, but mostly it depends on us and our abilities to expand our capacities through education, uses [of GIS], and ability to work together to make each profitable. Sounds a little utopian, but our group thinking is that we have greater strength if we cooperate than if we do not" (Sam Jacobs, 2007).

The crucial goals that need to be achieved are:

- Make things simpler, faster, and more accurate
- Seek seamless integration of data
- Streamline processes
- Obtain better quality for each worker.

In turn, the steps that can lead to the strategic goals are:

- Reduce cost by increasing productivity
- Capture more business.

Sam Jacobs (2007) identified the key strategic decisions as:

Get into GIS. Decided, as of 11/15/07.

Continue certification and education. Two more affiliates will take the State of California exam for certification in December of 2007. All affiliates are taking additional continuing education to develop their interest areas. The trend in the profession is to add more educational requirements as well as specializations.

Introduce databases for business management. The group is looking for an acceptable software product to consider developing this area. The constraint so far is that most of the products are designed for larger enterprises with tracking of employees and products/orders, but are overkill for the group.

Altogether, these factors point to quality electronic data and GIS combined with GPS as the solution to their integrated data vision. This is offset by concern for the considerable training and investment.

The goals and aspirations of Jacobs Appraisal and Affiliates.

Sam Jacobs summarized the group's goals and aspirations as follows: "To dominate the marketplace in southern California. To be important in the marketplace of New Orleans."

Spatial Analysis to support appraisals

To implement GIS and spatial technology at Jacobs Appraisal, the SBA team worked intensively with the group. Beginning with planning meetings to understand the group, its organization, challenges, needs, and vision, the team then arranged for the group to meet with ESRI, a major vendor firm to discuss alternatives for mobile technologies. Together the SBA team and Jacobs Appraisal decided on the following GIS solution. A spatial data-base known as a geo-database (ESRI, 2008) will be developed and implemented. This data-base contains seventeen geographical layers for counties, census tracts, topography, job centers, streets, USGS topos, urban clusters, urbanized areas, ZIP codes, land parcels, soils, and flood control. These layers are linked to rich data-bases of attribute information, for instance for land parcels, dozens of assessor characteristics are available; and for census tracts, many dozens of census characteristics. The group will be trained to perform spatial analysis of extensive geographical and attribute information in order to support and enhance their appraisal and consulting tasks, and reach their GIS aspiration.

A further aspect of the design is that appraisal coordinates recorded in the field via handheld GPS systems can be loaded into the geodatabase as a new layer. At the same time, in the office, appraisers can identify key land coordinates for field work and load the coordinates into their GPS devices to check out and confirm field features. This gives the advantage of being able to precisely locate key points used during particular field visits. For instance, in a test of this capability at a remote desert parcel, having the exact

GPS location of a key boundary point for a property, led to a 350 foot greater accuracy than was obtained by prior physical landmarks.

Through the SBA project, the Jacobs Appraisal Group now has available a robust and accurate, 17-layer geodatabase for Riverside and San Bernardino Counties; training in how to utilize it; skills in GIS analysis; and capabilities to apply GPS to precisely locate points in the field, add the points as a layer to the GIS, and export key coordinate points for fieldwork projects. The group feels that this approach is a major advance for them, giving advantages over competitors which have had little experience with GIS.

The next section describes in detail the GIS that was designed and built as a prototype for Jacobs Appraisal. It gives the results of mapping and spatial analysis. The detailed training in the GIS applications is available in the *Training Guide in GIS, Jacobs Appraisal and Affiliates* (Greene et al., 2008).

Geodatabase: description, development, and uses

A geodatabase is an integrated database of layers of spatial and attribute information. It is accessed by ArcGIS software from ESRI Inc. It is a more modern type of spatial data storage than the shape file, with the file extension .shp, which is a single geographical layer with associated attribute information. The SBA team built the geodatabase of geographical layers and associated information useful to appraisers, utilizing data from the U.S. Census Bureau, U.S. Geological Survey, Counties of San Bernardino and Riverside, and aerial photography, satellite imagery, and street networks provided by

suppliers to ESRI. This spatial information is stored in a geodatabase folder called "Layers."

In addition, specialized layers can be developed by the Appraisal Group for specialized projects and stored in a separate folder, "Appraisers." For instance, a single land parcel of interest in Apple Valley was compared to land-ownership patterns in surrounding census tracts. That land parcel was stored in the "Appraisers" folder as a layer, which is called a feature class in a geodatabase.

Table 1. Feature Classes in Appraisers Geodatabase

Feature Class	*Source*
Layers Folder	
Census Tracts 2000	U.S. Bureau of the Census
Census Tracts In Inland Empire	U.S. Bureau of the Census
Contours500	U.S. Geological Survey
Counties7	U.S. Bureau of the Census
Flooding	
Inland Empire	SBA Grant Project
Inland Empire Job Centers All	SBA Grant Project
Soils	
Streets	ESRI
StreetsSB	ESRI
Topo Grids	U.S. Geological Survey
Urban Clusters 2000	U.S. Bureau of the Census
Urbanized Areas 2000	U.S. Bureau of the Census
ZIP Code Points	ESRI
ZIP Code Polygons	ESRI
Appraisers Folder	
Parcel044001213	SBA Grant Project
ParkerWayPcls	SBA Grant Project

From a design standpoint, an appraiser in the group who has undertaken a specialized application project for a small geographic area can add that information to the geodatabase as a specialized feature class in the Appraisers folder. Likewise, if a new standard layer is added, such as earthquake risk, it constitutes a new feature class in the "Layers" folder. This allows standard governmental data to be separated from the appraisers' own project data, while combining both types of data in a single integrated geodatabase that allows overlays and spatial analysis of any or all of the layers. This overcomes a problem the appraisers repeatedly stressed of time-consuming "eye-balling" and inconsistent mapping.

Most of the feature classes were brought into the geodatabase as separate shape files or geodatabases from online sources, such as the U.S. Census Bureau (www.census.gov),

U.S. Geological Survey (www.usgs.gov/pubprod), ESRI (www.esri.com), and California Spatial Information Library at UC Davis (http://archive.casil.ucdavis.edu).

Land Appraisers frequently focus their work on the land parcel as unit of analysis. Parcels are commonly provided by county assessor's offices, either in downloadable form or as web services provided solely for viewing but not exporting. Parcel data were obtained by the SBA team from San Bernardino and Riverside County Assessor Offices. In the case of San Bernardino County, a shape file of parcel boundaries and associated attributes was provided on CD from the Assessor's Office (www.sbcounty.gov/assessor), while for Riverside County, a shape file of the parcel boundaries and corresponding text file of attribute information were obtained by downloading from the website of the Assessor's Office (http://riverside.asrclkrec.com/acr/SV.asp). Attributes in the text file were converted into a .dbf file by reading them into Microsoft Access (MS-Access) and procedures given by the SBA Team (documented in Exercise 5 in the *Training Guide in GIS, Jacobs Appraisal and Affiliates*, 2008). In short, Access allows a person to identify fields for each attribute, name the fields, and convert the text table into a database file.

Spatial Analysis with ArcGIS

After building the 17-layer geodatabase, the following spatial analysis procedures were developed for the prototype:

1. Georeferencing a scanned image of parcels to a satellite imagery layer
2. Digitizing a scanned image of parcels into their own layer
3. Thematic mapping of census information overlaid with a selected parcel

4. Downloading Inland Empire topo maps (USGS) by using Google Earth to access the UC Davis Map Library
5. Converting a Riverside County Assessor text file to data-base format for input into ArcGIS
6. Joining the Riverside County Assessor dbf file to the county's parcel map
7. Thematic mapping of assessor characteristics of parcels for Riverside County
8. Importing GPS-collected way points into ArcGIS

Each of these procedures was incorporated into training about ArcGIS, GPS devices, and Assessor and other data files.

Georeferencing a scanned image of parcels to a satellite imagery layer

If maps of certain parcels in a county are available as images but are not yet available as a shape file or geodatabase, they can be georeferenced to the Street map for the county and then rectified exactly in place using ArcGIS. An example is a 6-parcel scanned image of an area on Parker Way in Riverside County (Figure 1 shows the parcels highlighted in black and the surrounding neighborhood). By identifying location by selecting the Parker Way street name, the image can be overlaid on the satellite map roughly at the exact satellite location of the parcels. Next, using ArcGIS's Control Point tool, the parcels can be rectified to their exact coordinates, overlaying the satellite layer. The 6-parcel image is shown overlaid on a satellite map at its approximate location that has been selected by street name. Figure 2 shows the parcels, transparent and rectified over the identical parcels in the satellite layer. In this example, the Streets layer is of limited usefulness in achieving exact rectification, because the satellite layer is much more precise to the actual ground location of the Streets layer.

Figure 1. Six-parcel Non-Transparent and Non-Rectified Image Overlaid on Satellite Layer of Six Residential Land Parcels on Parker Way in Riverside County

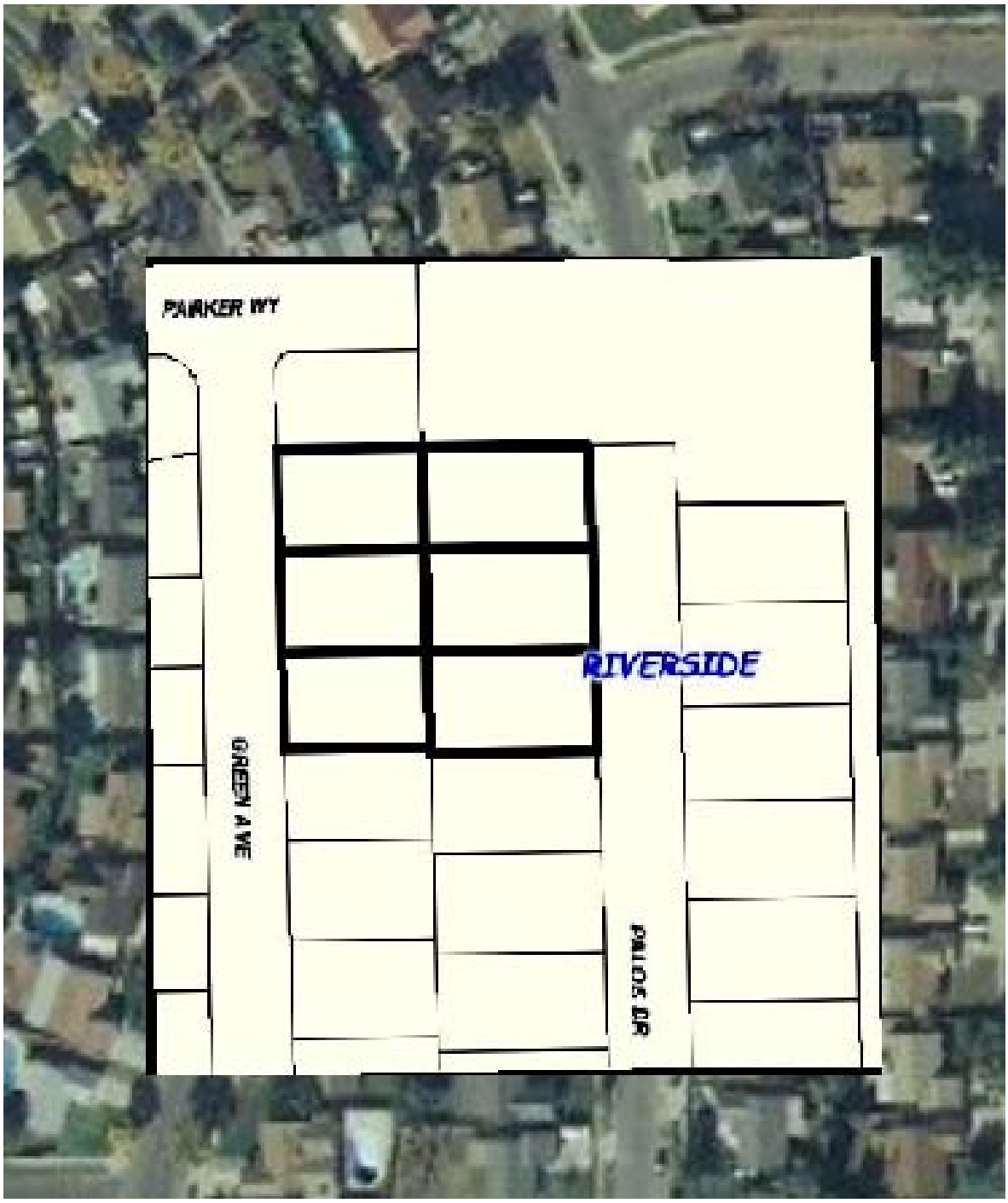

Figure 2. Transparent Six-parcel Rectified Image Overlaid Precisely on Aerial of area in Riverside County

Once rectified, the boundaries of the parcels can be hand-digitized using ArcGIS's Editor and Pencil tools. The GIS polygons are saved as a shape file layer and can be used for further GIS analysis in conjunction with the complete 17-layer geodatabase. The process of rectifying the parcels and creating polygons for GIS use is referred to as "geo-referencing."

Thematic mapping of census information overlaid with a selected parcel

Much of the work of appraisers involves studying the property market and property values with respect to other comparable properties. The assessed value differs from the market value, since the former is based on government valuation procedures for taxation purposes. The rules for assessed value vary by state. In California the rules are consistent throughout the state and represent the market value of land and improvements at the time of most recent sale, plus adjustments that take into account inflation in the economy. Due to a landmark legal ruling in a case outside of California but applied nationally, country assessor offices must provide to the public the valuation for land parcels. The method of publicly disseminating assessed values is changing. Originally it required personal visits to assessor offices. Later the method transitioned to assessors' web-based systems enabling the public to view but not download parcel information.

Today in most California counties the electronic data are provided in the form of a parcel geographic layer, associated assessed values for the parcels, and other associated parcel attributes, such as land type, legal description, and acreage of property. A citizen can

request data be downloaded or sent on CD as geodatabases, shape files, database files, and/or data in text format. Regardless of how data are provided, they can be integrated into a GIS with other layers and attributes to constitute a useful tool to compare assessed valuations and support appraisal reports. For the present case study, San Bernardino County provides the entire county parcel layer, assessed values, and 27 other attributes on CD in the form of a shape file. By contrast, Riverside County Assessor's Office provides the attribute data for 64 attributes in an online download of a text-delimited file, while Riverside County's parcel layer can be downloaded as a shape file. The attributes available at the parcel level from the two counties are seen in Tables 2 and 3.

Table 2. San Bernardino County Assessor Parcel-Based Characteristics

Characteristic	*Description*
FID	Sequential ID No. - ESRI
Shape	Type of Shape in Layer - ESRI
ObjectID	ID No. - ESRI
APN	Assessor Parcel No.
APNCode	
CodeNum	
DateNum	
Report No.	SB County code of report no.
APN_1	12-Digit APN No.
APN9	Assessor Parcel No.
Name1	Owner
Sit St No	Address info.
Sit St Dir	Address info.
Sit St Nam	Address info.
Sit St Suf	Address info.
Sit Comm	Address info.
Sit Zip	Address info.
Street City	Address info.
Zip	Address info.
Legal Desc	Legal description
Land Type	code for land type
Size Range	code for size range
Use	code for use
Land	assessed value of land
Impr	assessed value of improvements
Pers	
Exem	tax exemption amount
Hox	presence of homeowner's tax exemption
TRA	tax rate area
Acre Area	acreage of property
Tax Status	code for tax status

Table 3. Riverside County Assessor Parcel-Based Characteristics

Characteristic	*Description*
Assessment No.	
Conveyance No.	county no. for conveyance of property
Conveyance Month	month property conveyed
Conveyance Year	year property conveyed
Real Property Use Code	47 commercial, agricultural, and residential codes
PUI Code	over 100 property use identifiers. More detailed property use codes.
Base Year	
Business Use Code (BUI)	125 codes for types of busineses, such as FCJ for contractors
DBA (Doing Business As)	name of business
Mail Name	address info.
Mail Address	address info.
Mail City/State	address info.
Mail Zip Code	address info.
Situs House No.	address info.
Situs House No. Suffix	address info.
Street Direction	address info.
Street Name	address info.
Street Name Suffix	address info.
Unit No.	address info.
ZIP Code	address info.
City Name	address info.
Assessment Description	legal description
Taxability Code	status of taxability and city or other tax jurisdiction
TRA	tax rate area
Parcel No.	assessor's parcel no. (APN)
Recorder's Type	
Recorder's Book	
Recorder's Page	
Other County Code	
Lot Type	
Lot Type	
Block No.	
Portional Flag	
Add'tl Description Flag	
Subdivision Name or Tract	
Acreage Amount	
Portion of Frist Section	
First Section	section, township, range information
First Township	section, township, range information
First Range	section, township, range information
First Range Direction	section, township, range information
Portion of Second Section	section, township, range information
Second Section	section, township, range information
Second Township	section, township, range information
Second Range	section, township, range information
Secord Range Direction	section, township, range information
First Assessee Name	
Second Assessee Name	
Third Assessee Name	
Fourth Assessee Name	
Value Type	13 types of value that may be present
Sold-to-State Year	
Sold-to-State Sale No.	
Sold-to-State Suffix	
Came-From	
Went-To	
Tract	
District	
Precinct-NBR	
Special-District	
Came-from Parcel No.	

An example of using the San Bernardino County Assessor information is to identify a particular parcel of interest, examine the assessed values for its land and improvements, and analyze and compare the surrounding census tracts in the percent of home ownership. SB County Parcel 044001213 located in Apple Valley was chosen and is seen as a white parcel with a thick black border south of the runway of the Apple Valley Airport (lower left in Figure 3).

Thematic mapping of census attributes can be broadly used to analyze comparability based on a variety of socioeconomic, housing, and parcel characteristics. In this example, Parcel 044001213 is in the second lowest quartile on proportion of home ownership, in the range of 0.329 to 0.548. The example illustrates that comparables based on home ownership would be located mostly to the north and east. Dozens of other census attributes, alone or in combination, could be thematically mapped for such comparison, as well as a parcel-based attributes, such as land type, size range, and property acreage.

Figure 3. Map of San Bernardino County Parcel 044001213, Relative to Property Value Levels of Surrounding Parcels

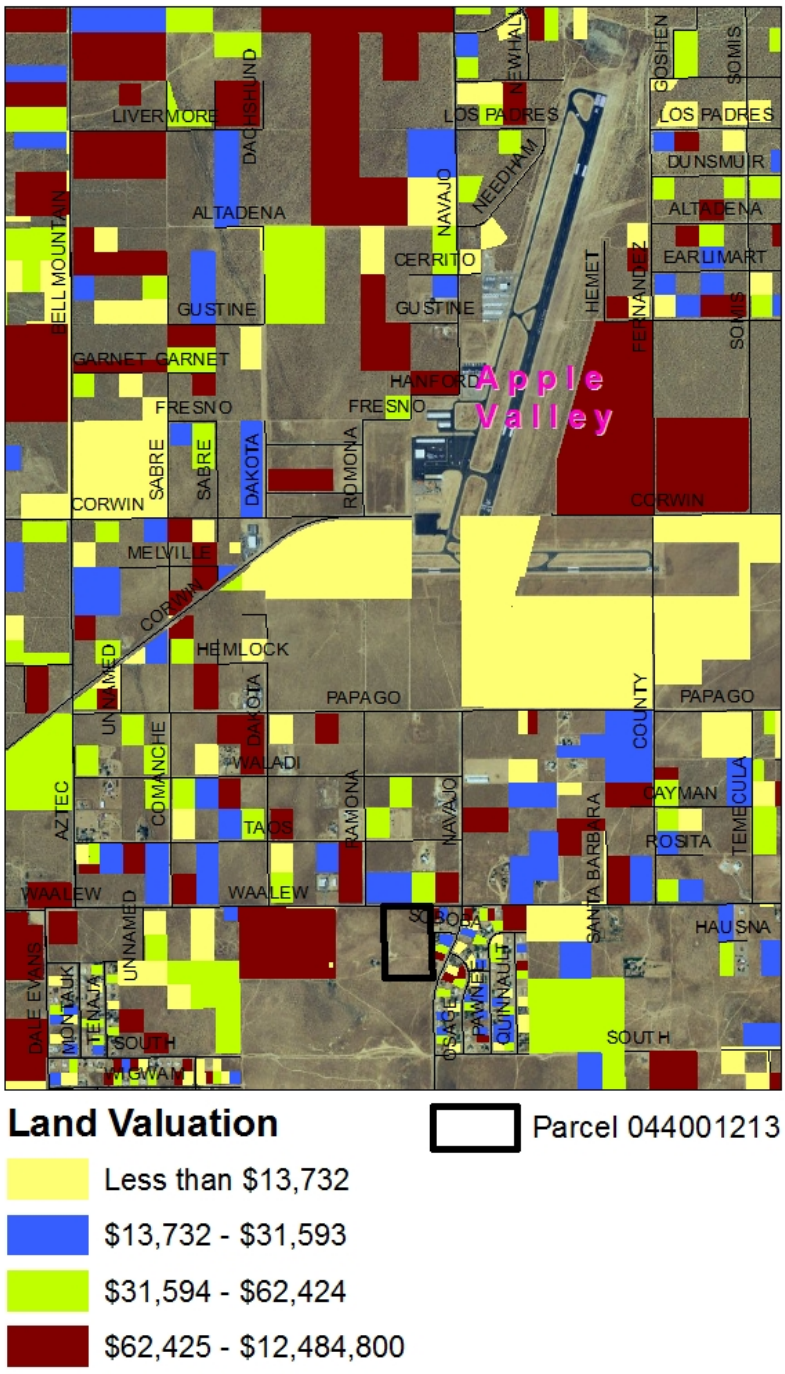

Figure 3. San Bernardino County Parcel 044001213 Relative to Land Values of Surrounding Parcels.

Figure 4. Map of San Bernardino Parcel 044001213 and Surrounding Area Juxtaposed on Levels of Home Ownership by Census Tract

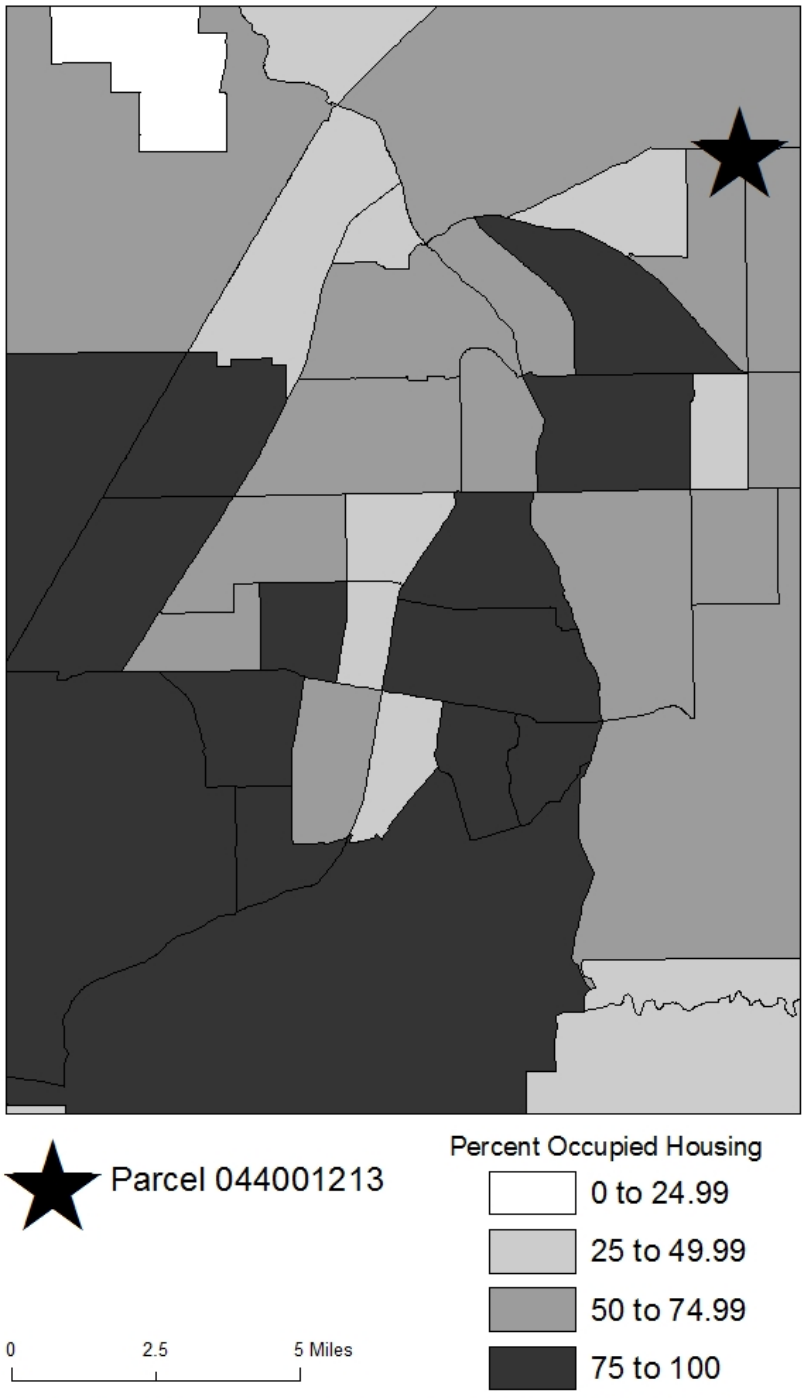

Figure 4. San Bernardino County Parcel 044001213 and Home Ownership by Census Tract.

This analysis could also be enhanced by including multiple properties and examining comparables in circular or other buffer zones around them.

Downloading Inland Empire topo maps (USGS) by using Google Earth to access the UC Davis Map Library

Topographic maps ("topos") are produced by the USGS. They show a variety of land features that can be useful to open land and other appraisals. The SBA team wrote an application in .kml, the Google Earth macro language, in order to assist the appraisers in gaining access to electronic versions of topo maps. This application automatically accesses Google Earth which in turn accesses UC Davis's Inland Empire topos through the map library of USGS topos hosted by UC Davis. Figure 5 shows the UC Davis map library application which displays southern California with labels the complete set of topographic maps.

Figure 5. Screen shot of UC Davis Interactive Library of Topographic Maps

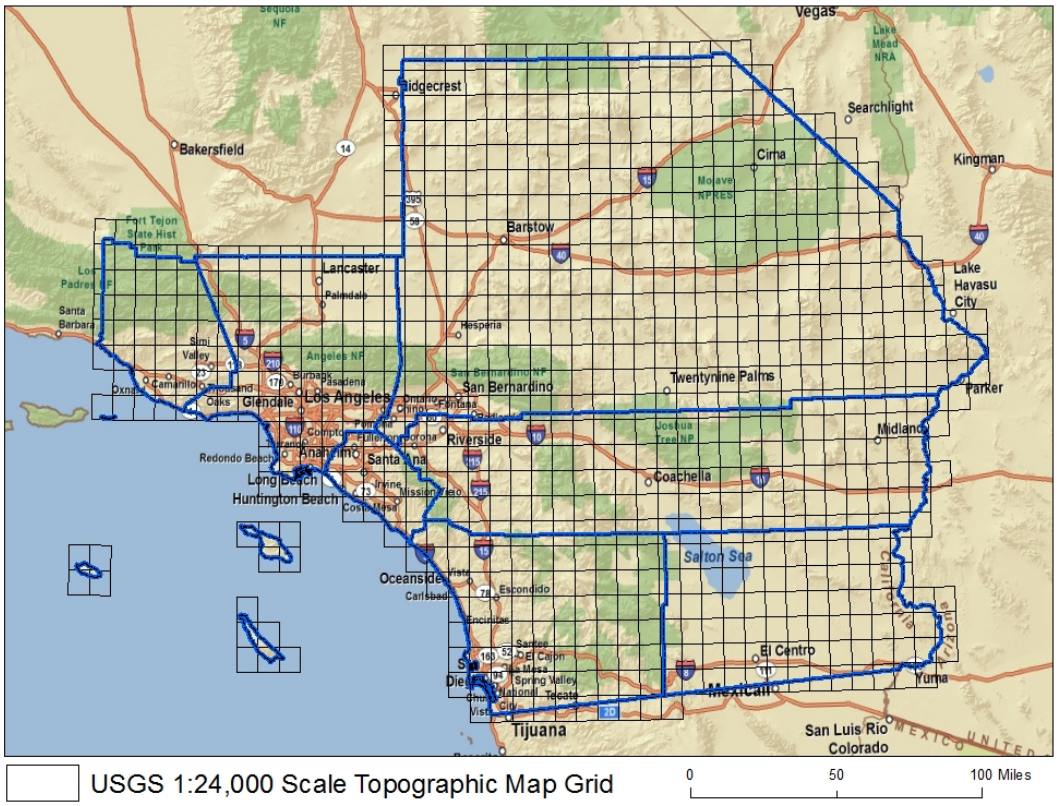

Figure 5. USGS 1:24,000 Scale Topographic Map Grid for Seven Counties of Southern California.

Clicking on a particular topo number on this map and right clicking allows the user to save the maps as three files, with extensions .tif, .aux, and .tfw, which together form an image of the topo. The topo can in turn be added as a topo layer in the geodatabase. It will be rectified to the exact coordinates of the other layers. Figure 7 shows a topo overlaid on a parcel map. This can be useful for appraisers in comparing the physical environment of subject parcels.

Figure 6. Example of a Topographic Map Overlaid with a Parcel Map

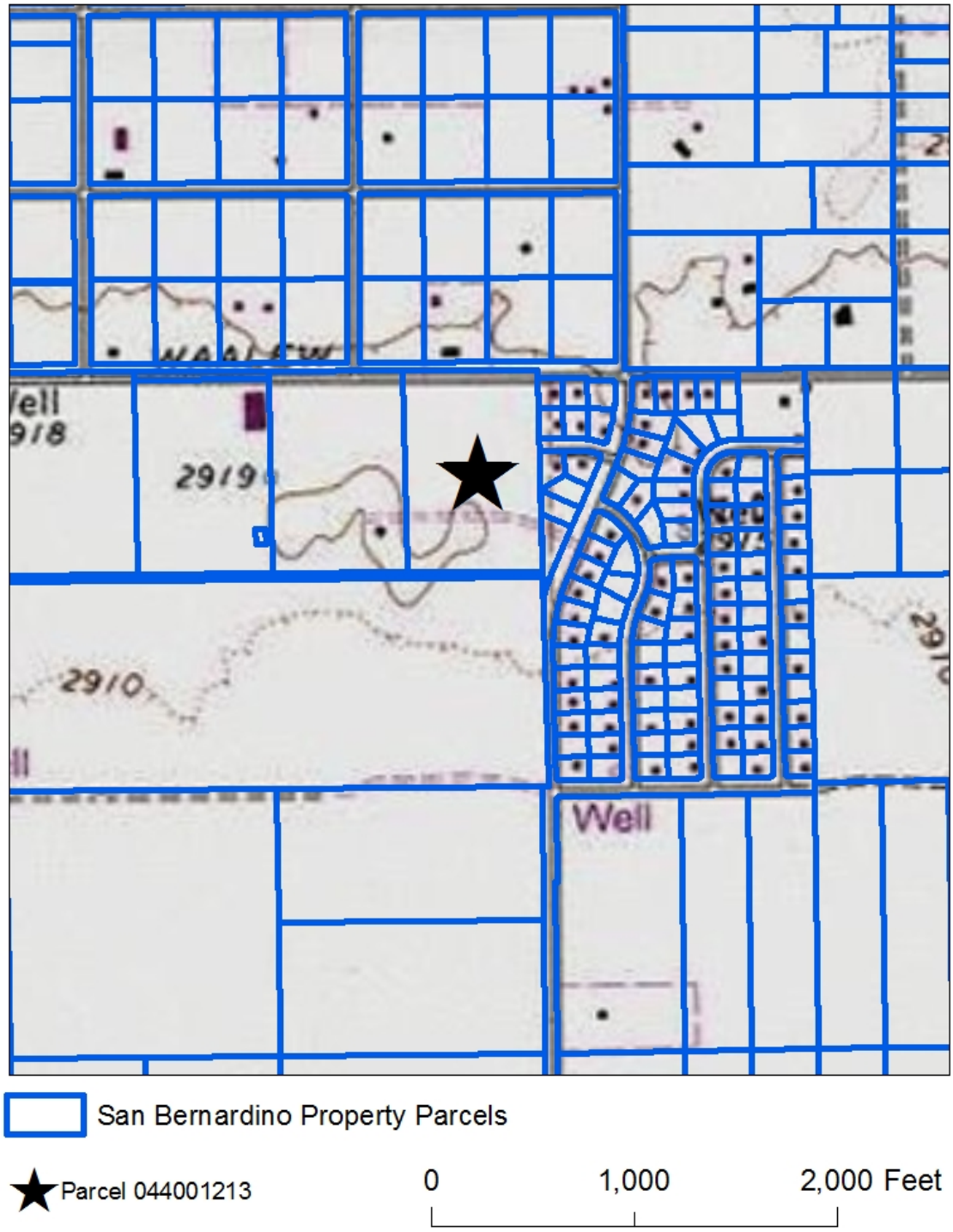

Figure 6. San Bernardino County Parcels and USGS Apple Valley North Topo Map Sheet (1:24,000 series).

Since as seen in Figure 6 multiple topos cover the region of southern California, this process would need to be repeated for each topo area of interest. The detailed steps are described in the *Training Guide in GIS: Jacobs Appraisal and Affiliates* (Greene et al., 2008).

Converting a Riverside County Assessor text file to database format for input to ArcGIS

As mentioned earlier, Riverside County disseminates to the general public parcel-based attribute information in the form of a text file with blank delimiters between the attributes. For import into ArcGIS, the file needs to be converted into a standard database file in .dbf format. The SBA Team accomplished this through Microsoft Access (MS-Access) software. The basic steps are listed below, and the details are given in the *Training Guide in GIS: Jacobs Appraisal and Affiliates*.

Steps to convert a space-delimited text file into a standard database file (.dbf)

1. Read the space-delimited text file into MS-Access as a fixed width file.
2. Refer to the "codebook" from the County of Riverside Assessor's Property Data Center to measure the record position for each field in the file.
3. Use a MS-Access feature to insert separator lines to delimit all the fields.
4. Enter a name for each field.
5. Define Assessor Number as the primary key. The primary key will be used in ArcGIS to link the .dbf file with the parcel shape file.
6. Save the file in .dbf format

Joining the Riverside County Assessor dbf file to the county's parcel map

The original shape file for the county's land parcels is downloadable from the Riverside County Assessor's Office, but has only a few attributes. The prior section has shown how a .dbf file can be created that contains 64 attributes by parcel. ArcGIS's Join feature conveniently allows the .dbf file to be joined to the shape file, using the common primary key of parcel number. This is done by first adding the parcel layer and database into ArcGIS. The Join feature is invoked to connect them. After the Join, the shape file has available all 64 attributes plus the geographic ones from the original shape file. The user instructions to do this are documented under Exercise 6, Part 1 in the *Training Guide in GIS: Jacobs Appraisal and Affiliates*.

Thematic mapping of assessor characteristics of parcels for Riverside County

Riverside County's joined parcel layer constitutes a powerful mapping tool for appraisals in the county (see Table 3). Thematic and category maps can be created and analyzed for parcels organized by such features as conveyance pattern, property uses, business codes, property tax features, and sales history. Thousands of varieties of parcel maps and analyses can be produced depending on the location, type of appraisal, attributes of interest, and completeness of the data. A constraint is that these maps focus on assessed value, rather than on market value. However, for certain types of appraisals in particular, assessed value can be useful. It also can be combined with maps of market value information, if available, such as transaction prices from multiple listing services (MLSs).

Figure 7 demonstrates an analysis that highlights all business-owned parcels in a neighbourhood surrounding Central Avenue in Riverside. Gental Dental, one business of interest and identified on the map, has its 64 potential map features are available to the appraiser. Other comparable dental properties can be selected by choosing the Business Use Code FED which designates "Dentists/dental clinics." Their assessed values and other attributes can be compared to those of Gental Dental.

Another example shown in Figure 8 is to select residential properties in Riverside and Corona that are designated "condos or planned unit developments" for which each unit has a private entry (i.e. designated by a Use Code equal to "RC") and have assessed valued over $100,000. They can be mapped thematically by five valuation ranges. This example underscores that GIS can give the Jacobs affiliates sophisticated analysis capabilities that surpass what was possible pre-GIS.

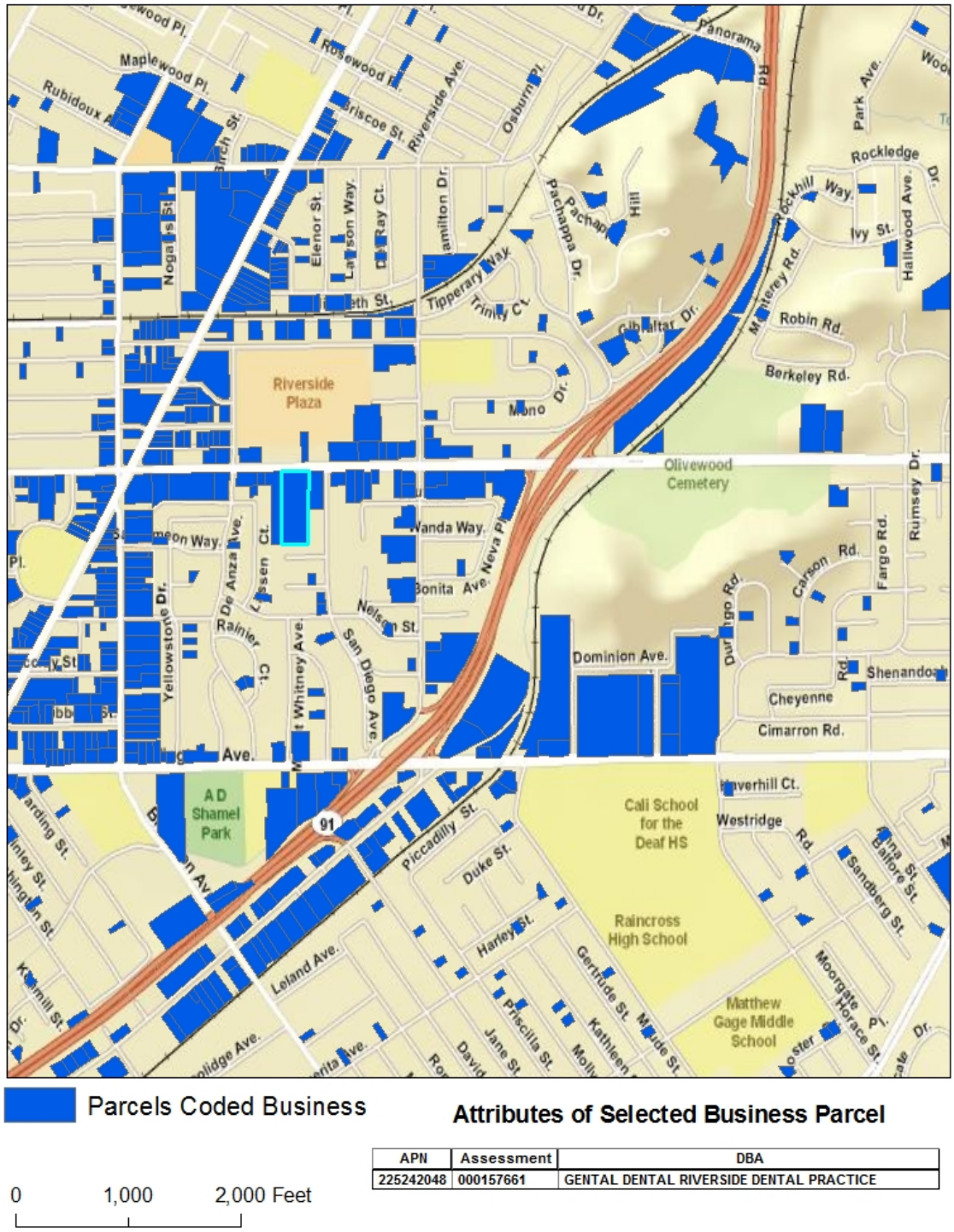

Figure 7. Business Parcels in the Central Avenue Neighborhood of Riverside Showing Attributes of a Parcel.

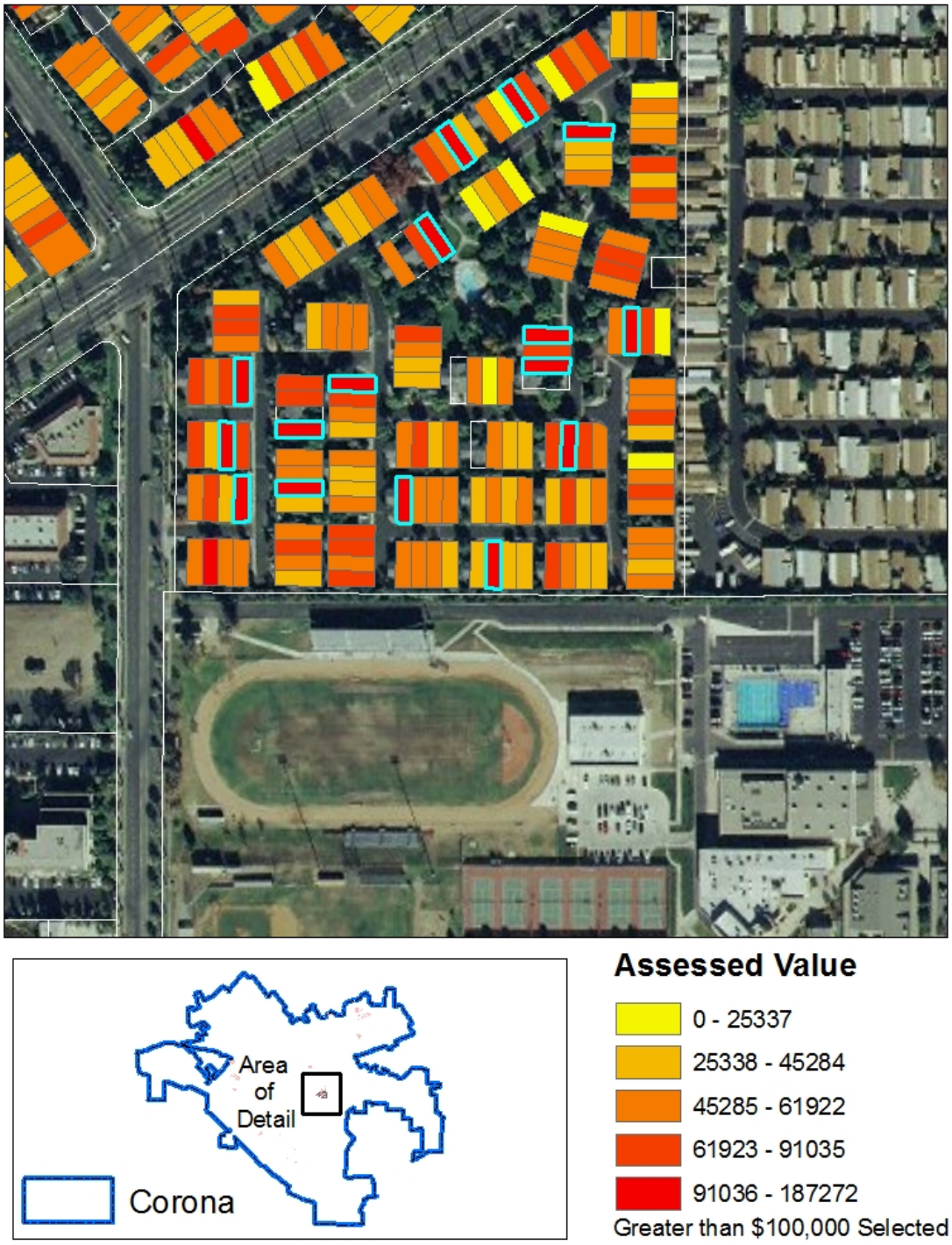

Figure 8. Assessed Values of Condos or Planned Unit Parcel Properties Having Private Entries in Corona.

In short, the rich set of assessor attributes available for Riverside County illustrates powerful thematic mapping and analyses that can be useful in comparisons of properties throughout the county.

Mobile Capability with GPS for the Field

Importing GPS-collected way points into ArcGIS

Appraisers stressed in the interview their requirement to be able to collect exact point locations with GPS in the field. Former methods used by them were not sufficiently accurate. For open land, the appraisers originally used physical markers with their known coordinates, as the basis for georeferencing points. The strategy was first to locate a known physical marker and then use triangulation methods to determine the coordinate location of nearby points. Inaccuracies weaken this approach. Most of the physical markers in open land areas were marked prior to GIS by surveyors and do not have the several-meter accuracy of GPS. The triangulation method resulted in further error propagation.

GPS can resolve these issues. For the case study, handheld GPS units at mid-range of cost were selected as optimal for Jacobs Appraisers. After consultation with an ESRI expert, Jacobs Appraisal and the SBA team concurred on this type of unit. The SBA team recommended the Garmin Nuvi portable GPS series costing from $200 to $350, a cable to connect the Garmin Nuvi to a laptop, and accompanying $40 Garmin software that allowed waypoints to be exported as a geodatabase. The GIS software could be installed on laptops already owned by members of the group, saving on equipment costs.

Waypoints refer to a series of points recorded during data collection in the field, for example on an appraiser's half-day visit to a desert area. GPS units at the high end, costing $1,500 per person for the handheld equipment, software, and cable, were rejected by the Jacobs group as too expensive. The high-end equipment and software would. Low-end GPS units costing $75 to $150 had too few features and did not support export of waypoint layers.

On a testing field trip to a remote area of Mohave Desert in January of 2008, waypoints were collected and exported to a geodatabase using Garmin equipment. The detailed instructions for recording and exporting waypoints are given in Part 2 of Exercise 3 in the *Training Guide in GIS: Jacobs Appraisal and Affiliates* (Greene et al., 2008). The environment of open land appraisal during the trip is seen in Figure 9 for a remote area of the Mohave Desert. During the trip, the group also observed habitat locations of the desert tortoise, a protected species. These locations are important for appraisers to record since they can constrain or stop land development and would also be able to be entered as coordinates into the handheld GPS unit.

Figure 9. Mohave Desert Field Testing of GPS-based Appraisal of Open Land

In summary, the GPS solution used in this prototype project addresses a key goal sought by the appraisers, namely to have field capability of GPS linked to GIS. The solution is also affordable, and even more so since it exports information into laptops already owned by the group members.

Cost Benefit Analysis

The key to the cost benefit analysis of the impact of GIS on the Jacob's Appraisal Group is to properly identify and document the costs and benefits associated with the implementation. Costs and benefits are each divided into two categories: tangible and intangible. Tangible costs and benefits are those that were easily quantifiable in dollar amounts. For example, a tangible cost associated with the appraiser group is the cost of data. Intangible costs and benefits on the other hand are more subjective. An example of an intangible benefit for the appraiser group is the high quality maps and graphs that can

be completed using GIS programs. A preliminary table of intangible and tangible costs and benefits follows.

Tangible Costs	*Intangible Costs*
Cost of Data	Stress or Difficulty in Learning a New System
Time	
Cost of Handheld GPS Unit	

Tangible Benefits	*Intangible Benefits*
Reduction in Time	High Quality Graphs, Maps, and Reports
	Higher Accuracy
	Consolidation of Data

It should be noted that time can be reduced as a benefit or increased as a cost. For Jacobs Appraisers, this recognizes the fact that time is one of the biggest limiting factors to appraisers and one of their largest costs. By relating time to hourly salary the reduction in cost due to GIS can be converted into a monetary benefit.

Appraisal Data Collection Methodology

In order to accurately track and record the time impact of GIS implementation on the activities of the appraisers, before and after time-activity sample studies were conducted for each category of appraisal project. In a time-activity field study, an appraiser's activities and associated time allocated are tracked and recorded for a sample time slice of a project. Three types of appraisal projects were tracked for different appraisers who specialize in the distinctive areas: residential, commercial, and open land. The advantage of using a time-activity study is that it allows the study to use primary data collection

instead of relying on possibly biased information from secondary or tertiary sources. Although it would be ideal to conduct multiple time-activity studies for each of the ten appraisers of the Jacob's Appraisal group, for every type of project covered by each appraiser, and for a variety of projects, it was determined that because of investigator time constraints, a sample project would be chosen to represent each of the three categories of appraisal specialties: residential, commercial, and open land. Because of the differences in steps and activities for each type of appraisal, they were separated into representative groups in order to better understand the GIS impact on each specialty. The samples were also collected for three different appraisers.

John Miller, the first affiliate chosen to be observed for the time-activity study, specializes in open land appraisal which is hypothesized to be one of the appraisal types most impacted by the implementation of GIS. In the sample session, Mr. Miller conducted each step of a pending open-land appraisal, as an observer from the research team looked on. A summary table of the general steps in the time/activity sample study for Mr. Miller is as follows.

General Steps for a Typical Open Land Appraisal by John Miller

1) Receive Order
2) Gather overview data of the subject property (size, location, year built, and # of rooms)
3) Gather lots to become potential comparable properties
4) Research potential comparables to determine whether they are similar enough to be considered comps
5) Walk subject and comparable properties to gather more information (such as proximity to water, power, and roads)
6) Generate report based on information from the walk and values for comparable properties

Times, activities, problems, and questions were noted by the field observer. Care was taken to accurately record the time taken for each step.

Cost-Benefit Methodology

After the data were collected from the time-activity study, the tasks were divided into common groups representing the types of tasks the appraisers face in a typical appraisal. The categories chosen were (1) research, (2) mapping, (3) walking the property, (4) data input, and (5) reporting. Research (1) includes the appraiser locating and gathering various data such as property size, owner, previous selling price, and number of rooms. Mapping (2) consists of visually comparing the size and location of lots on zoning and plat maps. This is predicted to be the area of potentially largest benefit for GIS to the appraisal group because of the significant differences in accuracy and time between manually mapping the properties and using GIS software. Walking the property (3) consists of printing driving routes, driving to and from the property or properties, and walking the property(ies) to visually determine necessary attributes, such as views from the property and proximity to utility lines, streets, and amenities. For this step, before GIS, data input was negligible. After GIS is implemented, the data input (4) includes the GPS coordinates of lot(s), and associated attribute information for points on the lot for present and future mapping and analysis. Reporting (5) represents the tasks associated with generating the appraisal reports for the clients. The appraisers have stated that the reports need to be as complete, accurate, and as visually demonstrative as possible.

Once the categories were determined, the time-activity data were analyzed to determine the total amount of time for all the activities for each group. These data are collected for sample appraisals both pre-GIS implementation and post-GIS implementation. The

representative pre-GIS times are then compared to the post-GIS times to determine the increase or decrease in the amount of time per activity, as well as total increase or decrease in overall appraisal time. Table 12 (a) represents the pre-GIS times, post-GIS times, and the decrease in the amount of time for each category. All times in Table 12 (a) are listed in minutes.

Table 12 (a). Time Allocation of Appraiser Time, by Activity and Appraisal Categories, for three appraisers.

Time (in minutes)						
Pre-GIS						
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	54	27	64	0	30	175
Residential	69	3	63	0	120	255
Commercial	240	30	139	0	150	559
Post-GIS	(Hypothetical)					
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	34	17	64	20	30	165
Residential	40	3	63	20	120	246
Commercial	200	20	139	20	150	529
Decrease						
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	20	10	0	-20	0	10
Residential	29	0	0	-20	0	9
Commercial	40	10	0	-20	0	30

Pre-GIS proportions were determined by comparing the amount of time for each category to the total amount of time taken for the complete appraisal. These proportions represent the ratio of time the appraiser spends on each of the five pre-determined categories of activities. The post-GIS times for each activity were also compared to the pre-GIS total times for the complete appraisal. This more accurately demonstrates the effect the GIS implementation has on the proportion of time for each activity than if the post-GIS

activity times were compared to the post-GIS total time. These percentages are displayed in Table 13.

Table 13

Percentages						
Pre-GIS						
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	30.86%	15.43%	36.57%	0.00%	17.14%	100.00%
Residential	27.06%	1.18%	24.71%	0.00%	47.06%	100.00%
Commercial	42.93%	5.37%	24.87%	0.00%	26.83%	100.00%
Post-GIS	(Hypothetical)					
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	19.43%	9.71%	36.57%	11.43%	17.14%	94.29%
Residential	15.69%	1.18%	24.71%	7.84%	47.06%	96.47%
Commercial	35.78%	3.58%	24.87%	3.58%	26.83%	94.63%
Decrease						
	Research	Mapping	Walk	Data-Input	Reporting	Total
Open Land	11.43%	5.71%	0.00%	-11.43%	0.00%	5.71%
Residential	11.37%	0.00%	0.00%	-7.84%	0.00%	3.53%
Commercial	7.16%	1.79%	0.00%	-3.58%	0.00%	5.37%

The time-activity studies did not collect the data on Reporting, since reporting was not done on the same day as the sampling. The reporting took place over several days including the written report and oral report to the client. These data have been added by recollections from the subject appraisers. Even though this is a limited sample, reasonable conclusions can be drawn from the present data. For example, research was consistently one of the categories with the highest percentage of total appraisal time. Also, the data demonstrate the differences in time for each category that the appraiser of each type faces. For example, the commercial appraisal's higher need for revenue and cash flow research

causes it to have the highest research percentage of the three samples. Even though this is a limited sample, it does indicate that the most time-consuming activities were walk-about and research. The highest walk-about percentage was for open-land, followed by commercial and residential. This may reflect the greater amount of distance between the subject and the comparables that an open land appraiser must face, along with the more hidden and complex roads and trails leading to each site. Commercial appraisals tend to have a higher walk-about time that residential appraisals because commercial properties are more complex and need more time to examine the complex building and structural assets, whereas residential has less complex structures.

For Research, time allocations are in the opposite order i.e. open land is the highest, followed by residential and commercial. Information on open land and the comparable properties, especially in remote areas, is less accessible from government and private sources, so is more time-consuming. Residential properties are intermediate, since county assessor and MLS data-bases are available. Though commercial properties tend to have more complete county assessor and business information available, more revenue and cash flow are needed than for either open land or residential appraisals. Mapping has higher weighting for open land and zero or nearly zero for residential and commercial. The reason is that web services quickly provide mapping for residential and commercial properties, whereas open land frequently requires the appraiser to refer to existing hardcopy or web-services maps, to actively check boundaries and points through GPS, triangulation, or other methods. Although a limited sample, this time-activity based costing model allows a preliminary comparison of differences of categories of activities,

which can be costed according to standard categories rates for a locality or an individual appraiser, who might be more or less experienced.

Though an activity might expand in time allocated, there may be an increase in intangible benefits that offset this increase in cost. For instance, increases may be anticipated in the mapping activity, which increases the costs of appraiser time, but may yield much higher accuracy and great depth of insight. Although this technique does not completely provide costing by the time allocated to activities, it will better quantify the cost and present it in a way that better demonstrates the effect of the GIS implementation.

This analysis also shows the benefit that reducing time has upon the appraiser's hourly rate for projects. By taking the dollar value per appraisal divided by the total time per appraisal, it will demonstrate the hourly rate of pay received by each appraiser. The pre-GIS figure will then be compared with the post-GIS figure. This simple measure will demonstrate the direct increase to the appraiser's hourly pay rate.

Table 5. Price and Average Duration of Appraisal Projects, by Appraisal Category

Hourly Rates						
	Price Per Appraisal	Total Time (Pre-GIS)	Hourly Rate	Total Time (Post-GIS)	Hourly Rate	Difference
Open Land	750-1250	2.92	257.14-428.57	2.75	272.73-454.55	15.59-25.98
Residential	350-450	4.25	82.35-105.88	4.10	85.37-109.76	3.02-3.88
Commercial	3000-4000	9.32	322.00-429.34	8.82	340.26-453.69	18.26-24.35

As the table shows, though the decrease in overall time per appraisal may not change much (10.2 minutes for the open land appraisal) the total difference in pay can be substantial. The $15.59-25.98 difference for open land can potentially lead to a $31,180 to $51,960 increase in annual salary.

Although the present limited sampling method is not comprehensive enough to estimate yearly impacts, future research could expand sampling sufficiently to allow such estimates.

Intangible costs and benefits.

Intangible benefits are currently being investigated as part of the field work with affiliates. On a preliminary basis the following is working list of intangible benefits:

Intangible benefits of GIS at Jacobs Appraisal and Affiliates
Greater sharing of data among the group
Visualizing complex data
Timeliness of information and quicker response
Improved decision making
Larger volume and quality of data
Better scanning of the environment for appraisals
Reduced error
Improved brand image
Potential to expand the group's services offer GIS training
Greater overlay and integration of spatial information

These intangible benefits respond to some of the priority needs expressed by Sam Jacobs and other in the interviews, in particular having larger and more accurate data shared among the group. Also, the intangible benefits can improve the competitiveness of the group by strengthening the brand image and potentially broadening the services offered.

Conclusion

GIS offers independent appraisers and small groups the potential to integrate spatial information and associated attributes to replace slow, tedious, and often scattered data sources. Use of GPS in the field can increase ground accuracy and allow waypoints to be imported into the spatial database for analysis. Promising local and regional

government databases, such as Assessors' parcel and attribute information, can be activated in the GIS for mapping, analysis and decision making.

This project has the objective to introduce GIS and GPS to Jacobs Appraisal and Affiliates as a prototype application. The first steps to develop a robust geodatabase and provide ArcGIS training to the group. Eight training sessions have improved the group's knowledge and skills to use the software, geodatabase, and GPS data gathering in the field. Currently the affiliates are in process of incorporating GIS and GPS as part of their methods and tools for appraisals. A cost-benefit analysis has been designed and is in process of being conducted by time-activity sampling of appraisers before and after GIS. The analysis will show the extent and types of impact of GIS on the activities and time allocations of appraisers.

Returning to the case study's Research Questions, the results are as follows:

1. *What are the history, background, experience, and capabilities of a small land appraisal group?*

   Jacobs Appraisal, under the leadership of Sam Jacobs, has developed into a varied group of mostly licensed appraisers covering major appraisal categories and centered in San Bernardino and Riverside Counties. The members are loosely associated, sometimes collaborating and other times acting individually. The group's starting IT level was simple, with limited mapping from hardcopy and web mapping sources.

2. *What spatial applications are most important for a small land appraisal group?*

   Parcel mapping, zoning, assessor data, water rights, soils, and GPS capability in the field were identified as the most important potential applications.

3. *What geographic and attribute data are most useful for a small land appraisal group?*

Data from the USGS, U.S. Census Bureau, San Bernardino and Riverside counties, multiple listing services, and past project data by the group members are considered most useful.

4. *How can a small land appraisal group feasibly utilize GPS devices in the field as part of a GIS application?*

   The group can acquire medium-level handheld GPS equipment that has the capability to export sets of way points into GIS software as geographical layers. This approach links up GPS with the GIS already present on the laptops of most group members.

5. *What are the costs and benefits to a small land appraisal group of implementing GIS and GPS?*

   An activity-based benefit analysis currently is being conducted through time-activity sampling of different types of appraiser projects, i.e. for residential, commercial, and open land, before and after GIS use. In addition costs of GIS are being estimated as well as intangible benefits. The results will show which activities and types of appraisal have the most impact from GIS and what intangible benefits are considered most significant.

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Appendix A
Protocol of Questions for Interview

Company background

History of firm

1. Can you tell us about the history of Jacobs Appraisal and of the Associates? (probe… how long have they been in business?)

Organization

2. Who are the key people in your organization and what are their roles? (probe… structure, reporting relationships, relationship between Jacobs Appraisal and the Associates, how many people, how many in field)

Scope of current business

3. What are your major services and products?
4. What are the geographical boundaries of your business? (Probe: territorial constraints?)
5. Who are your customers? (probe: age, income, location – what do they know about their customers.. what is mix of individuals and businesses)

Industry Background

Industry Trends

6. What has been the growth rate in your industry the last 5 years? Last 1 year? What are your expectations for the future?
7. What drives industry demand and profitability? (if needed prompt – reductions in new home construction?)

Competition

8. Who are your major competitors? Describe them with comments on their strengths and weaknesses relative to the strengths and weaknesses of Jacobs Appraisal and Associates. Can we start with the Group's strengths and weaknesses?
9. Is there competition from local, regional, or national appraisers (probe: does the internet play a role?)
10. Is it easy for a new firm to enter your industry? (probe: have you had new entrants?)
11. What are the barriers firms face when they want to enter your industry?
12. What helps firms succeed in your industry?

Details of Jacobs Appraisal

Land Appraisal

13. How did you do land appraisal prior to having either GIS or GPS ("old approach")?
14. What were the problems and issues with the old approach?
15. What percentage of the overall land appraisal is for raw land? Built residential properties? Commercial and industrial properties?

16. What are the challenges that Jacobs Appraisal and Affiliates has in doing land appraisal for raw land?
17. What are the challenges that Jacobs Appraisal and Affiliates has in doing land appraisal commercial and industrial properties?
18. Are you utilizing maps in the field? If so how are you using them?
19. Are you utilizing GPS in the field? If so, how are you using it?
20. Are you utilizing digital photography in the field? If so hare are you using it?

Suppliers of Information

21. Who are your suppliers of information? (probe: single, multiple sources etc..).
22. Are the data being gathered from web sources?
23. If Yes for 17, what are the pluses and minuses to this system for information?

Marketing

24. How do you make contact with your customers? (probe: do they contact you? You seek them out? Etc.)
25. What promotional activities does your firm do?

Operations

26. Describe the work flow in your business, starting with making contact with a customer (probe: do appraisers in the group work separately or together; are any activities outsourced ?).
27. How do you schedule your trips for estimation/installations etc.

IT

28. What is your IT capability? How many pcs, laptops, desktops, printers, servers, etc. do you have?
29. Who is responsible for operating and maintaining the IT capability?
30. How many appraisers use computers? How many do not?
31. Before starting the U. Redlands training in GIS, what was the knowledge level of GIS for Jacobs Appraisal and Associates?
32. How do you use the computers for non-appraisal uses, i.e. for business purposes?
33. What data do you collect on a regular basis?
34. What data do you not have that would you help you make better decisions? (Can collect info specific to the project here)

Additional Questions

We want your comments on where Jacobs Appraisal and Affiliates see your practices going from here. What is your vision for the Group 5 years from today?

Are there strategic decisions that you are considering? Any business management debates?

What are the goals and aspirations of Jacobs Appraisal and Associates?