

# *Using Maps to Promote Health Equity*

This report is one in a series of papers on best practices for using maps to promote health equity. Commissioned by The Opportunity Agenda, in partnership with the Health Policy Institute at the Joint Center for Political and Economic Studies, this project was made possible by The California Endowment. The complete volume of research and case studies is available on-line at:  
<http://www.opportunityagenda.org/mapping>.

## **GIS and Business Applications**

**Paul Amos**

**The Wharton School**

**University of Pennsylvania**

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## Introduction

Geographic Information Systems (GIS) and mapping have been deployed by many diverse organizations throughout the public and private sectors. There are many examples that show how government and nonprofit organizations are using GIS to add value within the public sector. While these organizations are more open and public about disclosing their GIS activities because of the nature of the environment that they operate in, companies in the private sector are less forthcoming with information about their technology systems because of fears that their competitors may copy their technology systems, and thus the company will lose a competitive advantage that makes them better than their competitors.

This paper provides examples of how companies have integrated GIS technology to improve strategic business decision making. It cites five industries: Marketing, Transportation/Logistics, Real Estate, Financial Services, and Insurance. The paper provides one to three case studies of how GIS is used to benefit firms in each of these industries. The case studies highlight specific activities in each industry where GIS has been implemented to solve a spatially oriented problem, increase productivity of operations, or improve a business process.

First, it is useful to describe the infrastructure of a Geographic Information System and how the components interact within a business environment. The basic GIS components are:

- *Hardware*—the equipment used to collect, store, and output geographic information such as personal computers, servers, printers, GPS, and other peripheral devices. GIS has been greatly aided by the overall technological transformation of the computing industry such as faster computational power and inexpensive mass storage for large databases. The ability to access more information in an accurate and timely manner has increased the overall productivity for the private sector.
- *Software*—computer programs from commercial GIS vendors as well as operating systems, database management systems, statistical, imaging, and other software used to visualize, manage, manipulate, and analyze geographic information. GIS software is a computer program for mapping and provides a full array of tools to analyze and present the geographic distribution of data. Initially, GIS software had a high learning curve for a user to become proficient with the software. GIS software vendors have been making the software more user-friendly and easier to learn; they have developed custom software programs for specific functions that reduce the learning curve of the software.
- *Data*—a collection of facts stored in a database that can be tabular or spatial. Tabular data provide descriptive characteristics of geographic features and are organized into the traditional structure of fields and rows in a database. Spatial data consist of geometry that represents geographic features of real-world locations and attributes about these features. One of the great advantages of GIS is to see the difference of presenting data in a table of rows and columns and viewing the data presented in the form of a map. For some industries, such as oil and gas, more than 75 percent of data are spatially referenced (Dougherty, 2008).

The ability to visualize this information can provide valuable benefits to a company.

- *Procedures*—the methodologies or techniques that are used in a GIS to analyze and manipulate spatial data to improve business decision making. Linking location to information is a procedure that applies to many aspects of a business (Harder, 1997) such as locating and viewing where customers live or how to route a delivery truck. Companies that develop procedures that increase productivity and save money will gain a competitive advantage over competitors that are not developing similar procedures.
- Lastly and most important, *people*—trained professionals who understand how to use the hardware, software, and data to develop procedures that can solve business problems that are spatial. GIS specialists in the private sector require a multidisciplinary approach that merges geographic and business principles to solve problems in a timely and cost-efficient manner. The convergence of geography and business has given rise to a title of “Business Geographers” to denote professionals who possess the skills needed to use GIS to solve problems in the private-sector environment.

## **Marketing and Advertising**

Marketing and advertising professionals have been aided by combining GIS software with demographic databases and consumer lifestyle segmentation systems to analyze the distribution of the population. The traditional source of demographic data in this country is the U.S. Census Bureau’s Census of Population, which is released every 10 years. The Census Bureau began releasing the American Community Survey on an annual basis; it is a nationwide survey that supplements the population and housing data from the decennial census to provide communities with a look at how they are changing between the ten-year census periods. Demographic data providers such as Nielsen-Claritas, Acxiom, and Geolytics provide their own estimates and projections of population between the decennial censuses based on their proprietary demographic models.

Consumer lifestyle segmentation systems are created based on the fact that people with similar incomes, backgrounds, lifestyles, and tastes tend to live near one another and have similar buying habits. Consumer lifestyle segmentation databases combine demographic, consumer behavior, and geographic data to summarize complex consumer profiles in a way that is intuitive and easy to communicate. Once these data are combined, they define every U.S. household in terms of a grouping of demographically and behaviorally distinct types, or “segments.” The segments help marketers to better understand consumers by incomes, tastes, and spending patterns within each lifestyle segment. The consumer lifestyle segments tend to have catchy names such as “Shotguns and Pickups” or “Sun Seeking Retirees” that provide memorable images and behavioral snapshots, bringing the segment to life for marketers. The segments describe the household characteristics such as the type of cars owned, leisure activities, TV shows watched, and eating habits.

There are many examples of GIS and consumer lifestyle segmentation systems being used in the marketing and advertising fields. Consumer lifestyle data along with GIS mapping can be used to define market segments, optimize promotional programs, acquire new customers, and retain existing customers. Marketers can better understand their customers and prospects, where these customers or prospects are located, and target them with tailored messages designed just for the target segments.

The Martin Agency, the third-largest advertiser agency in the United States, has a long history of utilizing geo-demographic research and location intelligence to advise its clients on where to advertise and through which type of medium. The agency will map a client's best customer's locations along with consumer lifestyle data. It will show where these target customers live and which new markets they should target to find more of them. The agency's mapping capability enables it to illustrate and communicate its research and analysis to clients. This analysis enables the media department to prioritize markets and determine the weight of advertising, which results in the most advertising dollars being spent in the most profitable markets. The agency's direct response department uses demographics and consumer spending potential to define specific delivery zones to target for direct mailing campaigns rather than blanketing a wide region, which can be very costly (Pitney Bowes MapInfo, 2008).

Cox Target Media, the industry leader in the local cooperative mail, offers its Valpak blue envelopes in North America which contain valuable coupons and special offers. For one of its clients, a home repair services company, Cox developed a Valpak promotion geared toward households most likely to pay for plumbing services by mapping demographics and consumer lifestyle segmentation data. One million households were targeted in specific geographic areas for the direct mail campaign. The results showed a 76 percent lift in response versus the benchmark rate, and the ROI ratio was 1:23, meaning \$23 in revenue was generated for every dollar spent on the mailing. The total cost of the program was \$24,020; it generated total sales of \$572,959 for the home repair services company (Nielsen-Claritas, 2009).

With decreasing subscription bases, it is becoming increasingly necessary for newspaper publishers to become innovative with tools such as GIS and consumer segmentation systems. These tools would allow them to increase subscribers, increase advertising revenue, and provide location intelligence to their advertisers for targeted marketing campaigns through a better understanding of the consumers who read their papers. The *Washington Times* mapped the location of each of its paid subscribers to identify the zip codes with the highest concentrations of subscribers. Subscriber penetration rates were calculated by dividing the number of subscribers by the number of households in the zip codes. The market penetration analysis produced 89 zip codes that the paper would target in the Washington-Baltimore metro areas. The subscriber records were then assigned a consumer lifestyle classification code to refine the readership profile. Nearly 46 percent of all paid subscribers fell into three consumer lifestyle segments; analysts at the *Washington Times* discovered a great opportunity for new customer acquisition within eight additional segments that were similar to the three core lifestyle segments. One of its largest consumer lifestyle segments noted that residents preferred drinking Starbuck's coffee and owning their own espresso/cappuccino machines. The *Washington Times* placed additional newspaper boxes near coffee shops

and coffee repair shops in these zip codes, which resulted in an increase in the number of newspapers sold (ESRI, 2005).

## **Transportation/Logistics**

The Transportation and Logistics industry can implement GIS technology to improve delivery schedules and to reduce shipping costs associated with delivering products, fleet management, and vehicle tracking. GIS technology provides network algorithms to compute optimal routes, not just the shortest route, along a transportation network saving both time and money. Accurate street data are critical for supporting geocoding and routing functionality in a GIS application.

Sears, one of the largest retailers in the United States, was one of the earliest adopters of GIS technology to solve its Technician-Dispatching and Home-Delivery problems. Sears delivers more than five million products to homes annually and is the largest product repair provider, with 14 million service calls made annually. The company's initial deployment of GIS began in 1994 with the goal of improving its home delivery routing and reducing the delivery window that Sears provides (Bowman and Lewis, 2006).

The Sears GIS application replaced a computerized, route-planning system that required truck dispatchers at each of Sears' 52 distribution centers to have extensive knowledge of roads and traffic in their regions. The GIS automates the route planning, and therefore no local road knowledge is required. Sears can plan all of its routes in less than an hour, instead of the eight hours it used to take (Swenson, 1996). The GIS application assigns the best technician for the job, reduces mileage and overtime, and enhances customer service by making sure technicians arrive within the service window assigned to the customer.

The initial results from the GIS application in the home-delivery service were a 10 percent reduction in mileage. The home-delivery service centers were consolidated to 12 facilities because local knowledge was no longer needed. The routing process used to take an average of five hours per facility, but now takes 20 minutes, resulting in a \$30 million saving. On-time performance has increased from 78 to 90 percent. Customer satisfaction has increased from 84.7 to 87.2 percent. In the home-services area, driving time was reduced by six percent and overtime reduced by 15 percent, which saved the company \$9 million per year. Sears was able to replace canceled calls while increasing the number of completed calls by 10 percent (Murphy, 2001).

Subsequent GIS applications at Sears included a warehouse optimization application and a service-area planning application. Sears recently implemented a wireless field solution that provides its home service technicians with an in-vehicle navigation and mapping system that leverages on-board GPS, satellite, and terrestrial data communication; verbalized directions; and a ruggedized laptop with a touch-screen interface. The Sears Smart Toolbox (SST) application was developed to run within an Internet Explorer browser interface with a stationary mode and a navigation mode. When the vehicle is stationary, users have the option to view their daily routes, view current progress along the route, geocode new stops, and modify routes in the local database. When the vehicle begins to move, the mapping component switches into navigation mode

and takes over the entire screen of the laptop. In navigation mode, the application displays the vehicle's current position on the route, provides turn-by-turn navigation symbols, and gives verbal directions as the vehicle approaches a turn. The technician is prevented from interacting with the application while in navigation mode and must stop the vehicle to switch back to stationary mode (Bowman and Lewis, 2006).

On top of the vehicle, a Mobile Base Station (MBS) communications device wirelessly transmits data back and forth to the Sears Command Center, which houses the GIS server and a work-order management system. Every four seconds, a GPS device collects point information and transmits the x and y coordinates to the GIS server for tracking vehicle movement and routing. The system allows a wireless laptop to download the day's route, individual stops, and related work-order information dynamically throughout the day. If a new route needs to be provided to technicians on a same-day basis, the information can be quickly delivered to the SST, and the overall route can be dynamically updated. A current stop can also be uploaded and sent back to the GIS server for reassignment (Bowman and Lewis, 2006).

By providing the optimal route from stop to stop and by guiding technicians visually or by voice to the next stop, the SST reduces mileage, the time traveled between each stop, and the possibility that a technician may get lost. The new system replaces the need to purchase paper map books and the need for a technician to look up a customer stop prior to departure. SST gives field crews the next navigation instruction as soon as they finish a work order and begin moving to the next work order. Field crews work with up-to-date street information, which is updated quarterly by Tele Atlas. In addition, a nationwide ATM location database resides on each laptop that allows SHC technicians to find the closest ATM to deposit cash they may have collected. Similarly, a database of parts suppliers is available, enabling the technicians to change a route to add a supply stop (Bowman and Lewis, 2006).

## **Real Estate**

GIS is particularly well-suited for real estate practitioners where "location, location, location" is the motto of the industry. Real estate professionals, especially restaurants and retailers, use GIS for market analysis, store location research, store assessment, market cannibalization, and market optimization studies. Market analysis involves studying geographic areas to determine if there is a large concentration of potential customers and possibly weak competition to identify areas for an expansion opportunity. Store location research is the process of identifying the ideal parcel of real estate to build a new store. Store assessment concerns an evaluation of the existing stores held by a company. Market cannibalization is the process of when a new store is opened, how its sales will affect sales from existing stores and competitors because patrons of other stores will alter their shopping patterns and shop at the new store. Market optimization is the process of identifying gaps in a market where a new store could serve an existing population base that the retailer is not currently serving.

GIS can analyze markets at macro- and micro-economic levels. At the macro-level, GIS can prioritize markets and submarkets based on demographic, competitive factors and traditional economic factors. GIS can aid with store location research by

allowing retailers to view demographic information, compute trade areas, and view customer information on a map or report. The data that are generated by a GIS analysis can show attributes that positively or negatively affect the sales for a retail store. Many third-party consulting firms offer sales forecast modeling services and market cannibalization studies that help retailers determine the estimated sales impact at a particular location and the sales cannibalized from other locations near the target store.

Retailers and restaurants have provided many case studies of using GIS to help companies improve their store location process for new stores. The time between acquiring a new site to the opening of a new store can be lengthy from a retailer's perspective. The costs associated with selecting a poor location, which may be in the millions of dollars for a new store, usually outweigh the costs of the data and software of a GIS that can aid in the analysis of a site for a future store.

The home improvement retail giant, Home Depot, has become the "category killer" in home improvement and is the second-largest retailer in the United States behind Wal-Mart (Francica, 2006). With sales exceeding \$81 billion and 260 million square feet of retail space in over 2,000 stores, Home Depot has relied heavily on location analytics during its expansion. It has utilized GIS and sales forecasting methodologies to drive its exponential growth since the mid-1990s. It is currently executing its expansion goals into new markets, urban environments, and internationally.

Home Depot contracts GIS retail consultants to provide a site selection strategy for its mega-store format. For Home Depot, the process of acquiring a new site, building a new store, and merchandising the store floor is a 42-month engagement. That means the sales forecasting, based on the most current demographics and sound spatial interaction models, must be able to closely predict when the market can support the investment in another store unit. In high-growth areas such as the Southwest and Florida, building contractors are putting up homes in a 90- to 120-day cycle. Ideally, Home Depot wants to be open in these areas when residents start moving into new homes and planning their first trip to the "orange box" (Francica, 2006).

Home Depot also uses GIS as a tool for:

- Screening new markets so that it can identify those markets with the greatest potential. For 2006 and beyond, Home Depot is looking to add 400 to 500 new stores and to expand into China.
- Strategizing markets to ensure optimal store development.
- Reviewing its store network in existing markets to identify opportunities for additional stores. Each year all existing stores go through a rigorous process of evaluating their positions in the market.
- Forecasting future trends to assess the implications of competitive and demographic changes within markets.

The IHOP family restaurant chain developed a Market Optimization model to determine the optimal strategy number of its restaurants to serve a market. IHOP has more than 1,200 locations in 48 states and Canada. It utilized GIS to perform a store assessment of its existing stores and identified a number of "real world" variables that served as a key predictor of an IHOP's performance:

- Customer profiles and market demographics/psychographics.
- Direct and indirect competition, including sales transfer from existing IHOP locations.
- Site characteristics (visibility, parking, site layout, traffic counts, co-tenants, etc.).
- Trade area size by type of market (urban, suburban, rural).

Based on these factors, IHOP can determine the number of restaurants that can adequately support a market. The Market Optimization model determines the sales potential of prospective sites and evaluate whether existing restaurants are properly positioned in a market to capture the full sales potential. IHOP can identify “green field” deployments in markets with no existing locations and identify the most profitable “in-fill” opportunities in the context of existing locations or if an existing location were to be closed (Pitney Bowes MapInfo, 2005).

In 2003, IHOP shifted from owning its restaurants to a franchisee-financed development model. The deployment of a franchise model increased the need to develop a Market Optimization model to adequately locate franchisees within a market to ensure they are not cannibalizing sales from other IHOP franchisees. For example, a new IHOP was recently opened in South Philadelphia located exactly five miles from another franchisee’s location in Northeast Philadelphia. By locating these two stores close to one another in the Philadelphia market, the potential exists for the new store to attract customers that patronize the existing location, causing one franchisee to take sales away from a different franchisee’s restaurant. Another IHOP was located less than five miles away in New Jersey, which was not deemed to be in the Philadelphia market, so the impact of the new IHOP would have very little impact on the New Jersey store’s sales.

Commercial real estate companies use GIS technology to target specific retailers to lease space in new and existing shopping center developments. Edens & Avant, a private real estate company based in South Carolina, has an existing real estate portfolio of more than \$2.5 billion in assets comprising more than 250-owned and -managed shopping centers in 18 states (ESRI, 2006). Edens & Avant uses GIS to evaluate locations for new shopping center development or acquisition similar to the retail site selection case mentioned previously. Edens & Avant reverse-engineers the site selection process with GIS for its own shopping centers to give retailers a complete understanding of the market for each of its shopping centers.

Edens & Avant created a Website (<http://www.edensandavant.com>) that allows retailers to perform an online property search of Edens & Avant’s shopping center locations to find space that matches their specific search criteria. Shopping center information can be viewed online, which eliminates the need for costly printed brochures (Boyles, 2002). The Website provides leasing representatives and retailers with GIS functionality to create customized reports showing demographics, competition, aerial photographs, and site plans for each shopping center. The company supplements commercially available databases with its local knowledge such as present shopping center competition, planned and active housing development, traffic counts, zoning, and new road projects in the local area of their shopping centers. The Website has improved the search functionality for its existing clients as well as for clients proactively looking for space. The use of GIS at Edens & Avant enhances its ability to target specific retailers

for its shopping centers, optimizing the tenant mix and minimizing the amount of vacant space in the shopping centers.

## **Financial Services**

The Financial Services industry has benefited from GIS in similar ways noted previously for business processes such as branch site location and target marketing of specific financial products to customers. Financial service organizations differ from retail firms because they often have large, rich databases on their customers that contain geographic elements. These databases exist because a product or service is purchased by a consumer, allowing the bank to collect personal and sensitive information about the customer that he or she may otherwise be unwilling to provide to a retailer. For example, demographic information such as annual household income and a credit score is collected when a consumer applies for a home mortgage. Customer information can be geocoded, and the location of the bank's customers can be displayed on a map for analysis.

Financial institutions have utilized GIS for regulatory purposes to display residential mortgage lending activity on maps to comply with the *Home Mortgage Disclosure Act (HMDA)* and the *Community Reinvestment Act (CRA)*. The *HMDA*, enacted by Congress in 1975, requires lending institutions to report public loan data to determine whether financial institutions are serving the housing needs of their communities and to identify possible discriminatory lending patterns. The *CRA*, enacted by Congress in 1977, encourages depository organizations to lend money in the same communities where they take deposits. The *Community Reinvestment Act* is intended to encourage depository institutions to help meet the credit needs of the communities in which they operate, including low- and moderate-income neighborhoods, consistent with safe and sound banking operations. The *CRA* requires that each insured depository institution's record in helping meet the credit needs of its entire community be evaluated periodically. This understanding is extended to the geographic distribution of lending patterns, loan approvals, and denials. The legislation was created to prevent banks from avoiding loan approvals in specific geographic areas such as areas with a high percentage of minority residents or areas with low-income households. This geographic pattern of avoidance is known as "red-lining." As a result of the *CRA* and *HMDA*, financial institutions must generate detailed reports on how they have served the credit needs of the neighborhoods where they operate and generate maps to provide a visual display of their lending activities within their communities.

National City Bank, which was recently acquired by PNC and operates in Illinois, Kentucky, Michigan, Missouri, Ohio, and Pennsylvania, developed a compliance solution that features complete data access and integrations tools, geocoding, analysis, Web reporting, batch processing, and data exploitation. The bank has over 1 million customer records, each with more than 100 fields of information about each customer. It developed a strict data management protocol to bring discipline and consistency to its customer database. Customer addresses are geocoded using GIS, and the resulting latitude and longitude coordinates are stored with the customer's record. These data can be aggregated to a standard geographic unit such as a census tract or block group and displayed on a map to show compliance with *HMDA* and *CRA* regulations. Senior

managers at National City Bank have instant access to reports via the Internet that show income and minority distribution in areas of interest (SAS, 2005).

Financial service companies were among the first companies to develop Web-based GIS applications to display locations of automated teller machines (ATMs). Visa and MasterCard pioneered the development of Web-based GIS locator applications that allowed their customers to search for the nearest ATM, based on their location. MasterCard owns the Cirrus ATM network with over 900,000 ATMs in 120 countries. MasterCard deployed an online ATM locator on its Website, Mastercard.com, in 1997. The ATM locator Website has been integrated with MasterCard's phone-based ATM locator. The locator service gives customers ATM information by phone, the Internet, and wireless technology, driving profit-generating traffic to participating banks. According to Tatiana Mulry, Vice President of Information Products and Services at MasterCard International, the ATM service generated revenues exceeding \$5 million in 2004 for a service that was once costing the company money and has a five-year projected return on investment of 1,152 percent (Pitney Bowes MapInfo, 2004). The successful launch of these online locator applications has now proliferated to the business sector overall, as many retailers have online store locator applications built into their Websites to help customers locate the store closest to them.

## **Insurance**

Insurance companies are continually seeking ways to minimize their risk and maximize their operational performance. Insurers must calculate the risk associated with particular events and spread that risk out while charging a fair premium. Innovative insurers and reinsurance companies have recognized that GIS technology, geospatial analysis, and detailed asset modeling are strategic resources.

The Florida Farm Bureau Insurance Companies specializes in writing automobile, homeowners, dwelling fire, farm, and business owner's lines of insurance for members of the Florida Farm Bureau Federation. In 2004, the Farm Bureau had 145,000 members, had \$216 million in earned premiums, and insured \$22.7 billion in property. The bureau utilizes GIS throughout the insurance process—from accurately quoting policies to customers to assisting with disaster recovery efforts from a catastrophic event (Pitney Bowes MapInfo, 2005).

The bureau created a customized GIS application called GeoVerify that integrated GIS and geocoding software with databases containing regulatory, rating, and proprietary data. GeoVerify was used to geocode all of the policyholder addresses and to determine the location for each policyholder. The policyholder's location was compared to spatial databases representing various rating territory regions to assign the correct rating code for each policyholder. The results were compared to the existing policyholder codes to identify policies that were miscoded in the policyholder database. The policy codes were changed in the policy database, and the changes were applied at the next policy renewal (Pitney Bowes MapInfo, 2005).

Using GeoVerify, the Farm Bureau was able to efficiently and accurately determine rates for its customers and decrease the amount of time and effort involved in

the underwriting process. It experienced a net return on investment of more than 900 percent in the first 10 months that the GeoVerify was running. In addition, one-third of the company's premiums decreased while two-thirds increased, meaning the ROI was really generated by only one-third of the total policies (Pitney Bowes MapInfo, 2005). Furthermore, the Farm Bureau uses GIS to identify high-policy concentration areas. It can easily evaluate how much exposure it can handle in a specific area, taking into account factors such as profitability, market penetration, rate adequacy, and potential catastrophe risk. It uses GIS in the actuarial facet of its business to provide a comprehensive view of its policies and determine new territory boundaries and rates (Pitney Bowes MapInfo, 2005).

In the aftermath of the devastating 2004 Florida hurricane season, the Farm Bureau relied on GIS technology to help provide hurricane victims with faster claims support. Maps were created to provide a visual representation of the current claims that enabled the bureau to quickly locate areas with the highest concentration of claims and to deploy the necessary resources, such as adjusters and temporary claims offices. The bureau has created disaster models with GIS to predict potential losses associated with hurricanes by overlaying event information, such as a storm's current track and wind speed, against its policyholder points on a digital map (Pitney Bowes MapInfo, 2005).

The Munich Re Group is one of the world's largest reinsurers and the second-largest primary insurer in Germany. Reinsurance is a means by which an insurance company can protect itself with other insurance companies against the risk of losses. Individuals and corporations obtain insurance policies to provide protection for various risks (hurricanes, earthquakes, lawsuits, collisions, sickness, death, etc.). Reinsurers, in turn, provide insurance to insurance companies. The Munich Re Group serves more than 60 reinsurance subsidiaries, branches, service companies, and liaison offices; globally, 5,000 insurance companies in approximately 160 countries rely on Munich Re's expertise and financial strength (Siebert and Shimetschek, 2008).

The Munich Re Group offers an array of reports, tools, and services to demonstrate its knowledge and risk expertise. It has developed a comprehensive set of GIS layers and Web services that allow a user to geocode an address, run scenario simulations, and perform accumulation analysis. The Munich Re Group provides a Catastrophic Loss Estimation Service that estimates weather-related losses caused by wind and hailstorms (Siebert and Shimetschek, 2008).

The Geo Data Service (GDS) at the Munich Re Group is an extensive warehouse of spatial data and hazard information, along with a geo-toolkit that geocodes addresses and provides mapping functions. The Natural Hazards Assessment Network (NATHAN) disseminates data from the Munich Re Group's GDS through an Internet mapping Web service. A free public version of NATHAN is available at <http://mrnathan.munichre.com>. NATHAN is composed of three modules: Natural Hazard map, Major Disasters, and a Country Profiles system. The Natural Hazards module allows a user to place a hazard pointer anywhere on Earth's land surface and generate a qualitative estimate of the natural hazard situation at that location. The Major Disasters module provides information on economic and human losses from current and historical natural catastrophes worldwide. The Country Profiles system generates an overview of a selected country's geography, population, and economy, together with its overall natural hazard profile. The Munich Re Group has added a Risk on Earth service that provides aerial and

satellite photography for underwriters to gain a better understanding of their portfolio situation by adding images to their risk maps (Siebert and Shimetschek, 2008).

The Munich Re Group's Geographical Analysis of Portfolios (GAP) service assesses customer portfolios based on geocoded data and enables the identification of areas of concentration or accumulation. GAP's multiperil analysis of property insurance portfolios makes it possible to identify previously unknown and unidentified accumulations or hot spots. Primary insurers are using this information for traditional hazard-related analysis but also for managing their sales operations and client acquisition strategies to ensure that they are not overexposed in risky areas (Siebert and Shimetschek, 2008).

## **Healthcare Implications**

The case studies referenced in this paper provide examples for healthcare institutions to benefit from the use of mapping and GIS for improving decision making. For example, healthcare facilities can use GIS to view their patient locations and identify population trends over the areas they serve. Healthcare facilities can geocode their patient addresses to display a map of the locations of their patients. This analysis could reveal if patients are concentrated in certain geographic areas near the facility's location. Demographic information such as population, race, and income can be overlaid on the map to see if there are areas that are underserved within a community. Similar to the case studies of retail site selection, policymakers can determine if additional facilities are needed to accommodate areas that are underserved by the existing healthcare facilities.

Patient data can be assigned consumer lifestyle profiles to determine if there are dominant lifestyle classifications. Healthcare facilities that offer specialized services could analyze the consumer lifestyle segments to market their services to specific consumer segments. The advertising of these services can take the form of radio, television, or newspaper ads; or direct mailers to zip codes where specific consumer lifestyle segments reside.

Healthcare facilities can use GPS and routing functionality to track and compute optimal routes for emergency vehicles. Ambulances can be equipped with mobile GIS functionality similar to the Sears toolbox that would provide the quickest route from a facility to the location of the emergency. In life or death cases, minimizing the amount of time driving to and from the emergency could make a big difference. Drive-time analysis can be performed with GIS to show the coverage area of a facility in minutes or miles along a road network. For example, a hospital could map out the distance to the hospital in five-, 10-, and 15-minute drive-time increments to show the coverage area for the hospital. This could be used to identify gaps in a market where a potential in-fill healthcare facility could locate to serve a population that is too far from any existing healthcare facility.

GIS can track and display potential threats. GIS and maps can display specific ailments from a patient database, show migration of a disease, and analyze the spatial correlation of infected persons. An example that is already available is from the U.S. Centers for Disease Control and Prevention that provides historical statistics and maps on its Website (<http://www.cdc.gov>) of West Nile virus activity and, most recently, the

Swine Flu. GIS can perform “hot spot” analyses to view the spatial autocorrelation of patient cases for a particular disease that may help identify the location and cause of such a specific disease.

Internet mapping services, similar to those in the Mastercard.com case, can be developed that allow consumers to search for specific healthcare providers based on their location. The Web mapping service can show the locations of hospitals, primary care physicians, and specialty services such as pediatrics. The Web mapping service should include checkboxes that denote a specific type of facility to enable the user to view specific facilities or specialists on a map relative to the location of the user.

## **Conclusion**

This paper presented case studies of GIS and mapping applications that have been implemented in the private sector to inform and guide strategic decisions. GIS technology has grown and permeated into business applications from its roots in the public sector. The abundance and breadth of application in the private sector will continue to develop with technological advances. Declining prices for hardware and data storage while increasing functionality from GIS software products will make GIS more affordable and user-friendly for end-users. GIS software providers such as ESRI and MapInfo are now delivering software functionality and data through the Internet as web mapping services which can eliminate the need for in-house expertise which is very cost efficient. Companies are no longer required to own the software or data as they can subscribe to a web mapping service that delivers only the functionality and data they are seeking. Software companies such as Google are developing Internet mapping applications such as Google Earth that continues to integrate GIS functionality into the product for the mass market.

Companies in the private sectors are increasingly focusing on the Return on Investment (ROI) that GIS technology can provide. As GIS technology continues to grow into larger deployments and has a wider adoption among organizations, it will become increasingly important for companies who are not familiar with GIS to understand the costs and benefits of a GIS implementation. The applications presented in the case studies demonstrate that companies in the private sector can earn higher profits by reducing costs, increasing revenue, or improving production as a result of implementing GIS technology.

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