[DA-010] GIS&T and Real Estate

Abstract

Real Estate GIS concerns all dimensions of real estate that can be better understood or operationalized by knowing its geospatial context. Improving real estate decisions via GIS and related geospatial technologies is now expected by management of all industries, as well as home-renters and home-buyers in the residential market. Real Estate GIS Specialists are individuals who have applied knowledge and skills across the disciplines of business geography, the practice of real estate, and the application of geospatial technologies to support decision making in this realm. There is a good reason why the mantra of “location, location, location” is a long-standing tenet within the business of real estate.

Keywords: business, distance, property, real estate, spatial equilibrium, von Thunen

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Explanation

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1. The Meaning of Real Estate GIS

Real estate is property comprised of land and the capital on the land; it includes the natural resources of the land such as farmed crops and livestock, water, minerals on the surface and below. Real estate is generally divided into large categories of residential, commercial, industrial, and agricultural land and parcels, as well as the many subsets of these large categories.

Residential real estate includes undeveloped land suitable for habitation development, houses, condominiums, and apartments (Bible & Hsieh, 1996). Purchasing a house is the largest lifetime expenditure that a typical household makes, and the real estate decision is critical to the house purchasers’ lifetime financial wellbeing.

Commercial real estate includes office buildings, warehouses, and retail stores. Industrial real estate includes factories, mines, and farms. A substantial portion of the assets of a typical business is real estate. Thus without being to take advantage of the locational information and all of the other associated geospatial data via GIS, this asset is invisible to the business, underappreciated, perhaps in the wrong place, or not contributing to the

profitability of the business.

Real property is a broader term which includes land, buildings and other improvements, the rights of use and enjoyment of the land and its improvements. What is included with real estate is often that which must be available to accomplish an objective important to the decision maker for acquiring the real estate asset. Often the contract to buy, rent, or sell will specify what is or is not included with the real estate asset.

Real Estate GIS falls under the larger umbrella of Real Estate Information Systems. If the geospatial components are not included or considered, Real Estate Information Systems is equal to items such as asset management, amortization, maintenance schedule, and returns on investment (ROIs). Once locational context and other meaningful geospatial components are added, the “big tent” of Real Estate GIS is possible. Real Estate GIS is concerned with all things about real estate that can be better understood or operationalized by knowing the geospatial context.

GIS and related geospatial technologies have provided the opportunity to visualize and analyze the geospatial context more quickly, more accurately, and less costly than a printed book multiple listing service (MLS) book ever could. Consumer applications like Zillow.com and Realtor.com are GIS-driven, with software developers preselecting what data is to be accessed, how it is manipulated, and how it is visualized. Location-based goods and services that employ GPS and related technologies have revolutionized business geography, especially now that the information is most often accessed via mobile devices.

2. From Whence Came Real Estate GIS

Individuals who focused their research and activities on the valuation of land, real estate, and real properties contributed to what has become Real Estate GIS.

2.1 Land-Economist Johann Heinrich von Thünen (1783-1850) is remembered for his objective to calculate the best (most profitable) land use by location (Thünen et al., 1966). He hypothesized there to be a mathematical relationship in which agricultural land rent or relative land value was determined by productivity of the land, namely yield, cost of production which included labor wages and cost of capital, and cost of transport to the market. This mathematical relationship allowed Thünen to verify his hypothesis and perform “what if” experiments using different numerical values for the exogenous variables which in turn affect his endogenous variable, rent. As rents changed, Thünen’s map simulation of prevailing land uses changed. His objective was to derive a procedure to optimize business decisions: determining the highest valued and best land use by location. The motivation for which land use prevails at a given location arises from the profit maximization behavior of the decision makers in Thünen’s model: land owners and land users.

Thus, Thünen was blending general theory, geospatial mathematical simulation, the business decision, to be what we call Real Estate GIS today (Wofford & Thrall, 1997; Clapp, Rodriguez, & Thrall, 1997). Through his meticulously reasoned solutions, he became a pioneer in “marginalist” theory in economics, econometrics, and mathematical simulation of spatial phenomena. Thünen rightfully deserves the distinction of being called the father of location theory in real estate, economics, and geography.

2.2 Homer Hoyt (1895-1984) was a land economist, real estate appraiser, and real estate consultant. His academic research, including his doctoral dissertation and book - One Hundred Years of Land Values in Chicago - created many opportunities for his work as a real estate consultant. In 1934, he joined the then-new Federal Housing Administration (FHA) as the Principal Housing Economist. The FHA is a government agency created by the National Housing Act of 1934 that sets standards for construction and underwriting and insures loans made by banks and other private lenders for home construction. While at the FHA, Hoyt supervised a team of economists to create mylar-transparency maps of the largest US cities on which were to be drawn points or polygons of employment centers, line vectors of urban infrastructure including sewers, local streets and major highways, rapid transit, and polygons demarcating areas of racial and ethnic composition. The frequency of mortgage default was calculated for each map object.

The economists under Hoyt's supervision calculated the relationship between neighborhood dominant race, or mixed-race composition, and predicted risk of mortgage default. Some minority groups were revealed by calculation to present a high likelihood of financial loss. Those high-risk neighborhoods (polygons) were emphasized on the transparencies by thick red grease pencils, giving rise to the term redlining. Hoyt eventually left the FHA and after some years in academia, became a full-time consultant in 1946.

Hoyt's legacy at the FHA was internalization that space (location) and demographics were important in finance and real estate. Under Hoyt, the FHA measured and documented the extent of the problem of mortgage failure on financial institutions, predicted where defaults would occur, and proposed guidance on how to resolve the problem of mortgage default. Hoyt was an innovative pioneer in his understanding of place and value and used these talents to accomplish what the FHA had requested. While he helped save some financial intuitions from further failure and set some of the necessary conditions for post-World War Two economic growth and prosperity, not everyone benefited, and Hoyt also remains associated with redlining, urban poverty, and gentrification.

The basic methods that Hoyt and his FHA team employed remained in place well into the later 20th century, even though the results represent an example of ecological fallacy. An ecological fallacy means conclusions are made about individuals based only on analyses of group data. Hoyt was assigning a probability of mortgage default by polygon (census tract). All households within that polygon were considered equally likely to default; all neighborhoods enclosed by a polygon with similar demographic composition would be a priori assigned the same risk. Since ZIP codes and Census Tracts are commonly used aggregation areas for demographic data, errors of ecological fallacy continue to be problematic today in business and social sciences.

Only decades later did the FHA move beyond these original methods to others designed to evaluate a household's individual risk versus assigning the household a neighborhood risk index. In economics today, this becomes one type of agent-based modeling (Yates, Thrall, & Hangen, 2010).

2.3 The concept of spatial equilibrium, models of which have been developed by economic geographers and spatial economists, builds from the understanding that high amenities are likely to be offset by high prices. This strongly affects real estate markets. Colby (1933) and Casetti (1971) were two geographers whose work around on spatial equilibrium particularly influenced the creation of the Consumption Theory of Land Rent (CTLR) (Thrall, 1987). In

Land Use and Urban Form: The Consumption Theory of Land Rent (1987, 2017), Thrall demonstrated how by using a mathematical language that placed emphasis on the processes and problem definition, his general theory could apply to a variety of urban settings where the variables of income, transportation, housing costs, and socioeconomic factors varied widely. Linking the CTLR with GIS is a powerful combination for decision making.

3. Real Estate GIS and Academia

For several reasons, relatively few academic programs exist that prepare students to go into the field of Real Estate GIS specifically or directly. Only a fraction of universities have geography departments, and while those that do might employ someone to cover economic geography, it's less likely that a student would also gain expertise in business geography and GIS, much less finance and statistics. Academic content related to Real Estate is generally part of a finance department's curriculum. Because of long established student and market demand, qualified faculty in a finance department are likely to be among the highest paid in a university, but even so, individuals with this area of expertise are more likely to work in the private sector (rather than academia), where their salaries are inevitably higher, and they would not be under burdensome expectations to publish research in finance-related academic journals. Thus, finance departments have not typically maintained faculty with extensive experience in Real Estate GIS.

Real Estate GIS represents the highest academic challenge of the combined geospatial and economic sciences. Business Geography and Real Estate GIS can be as academically rigorous as any business science or social science, such as Economics and Finance. The fields are intellectually challenging as well as acknowledged as being critical to the economy and global competitiveness. However, the combination also represents a relatively new academic subject and it is unashamedly multi-disciplinary. A well-qualified Real Estate GIS faculty member must be thoroughly proficient in multiple disciplines: Economics, Economic Geography, Finance, Mathematics, Statistics, Real Estate, "Big Data," Social Demographics, and GIS technology. Real estate GIS requires both the traditional scientific knowledge of the academic professor and the entrepreneurial aggression of the practitioner scholar.

Programs that provide this mix in business, economic geography, and spatial analysis via GIS are not common, but graduates with these combined skills will be highly sought after in emerging new career streams. The Applied Geography Specialty Group of the American Association of Geographers maintains a webpage that highlights several of the available programs. With experience and continuing education, graduates from such programs may become a Real Estate GIS specialist. Some of that continuing education may be obtained from the institute that certifies Commercial Real Estate professionals to become a Certified Commercial Investment Member (CCIM). The institute designs, writes, and offers courses that fill the profession's needs, and which are required to obtain the CCIM designation. Likewise, students in finance, business, or economics can also pursue additional GIS training, such as a GIS Certificate, to gain the mixed skill set.

4. Expected Activities of a Practicing Real Estate GIS Specialist

People who practice Real Estate GIS successfully demonstrate an applied skill set along with his or her academic knowledge, as this is a rigorous and relevant field of research as well as a consumer application area. Ideally, the Real Estate GIS specialist – whether he or she is a professional and/or an academic – will be fluent with GIS technologies, geospatial analysis, economics, finance, and big data. The specialist should have personal, direct experience in the field as well as being keenly adept in nonlinear thinking. The practitioner must anticipate and take advantage of changing markets and changing value platforms of all kinds.

Another key skill is being able to communicate well with geospatially-challenged decision makers about geographical patterns and spatial analysis, sometimes even to the point of court litigation. The Real Estate GIS specialist is critical to the due diligence of a business, and the pay is generally proportional to his or her value added to the business. Real Estate decisions can have tremendous financial implications: millions, even billions of dollars can be at stake—lost if a bad decision or opportunity lost, or earned if a good decision or opportunity taken.

There are several standard analyses that the Real Estate GIS specialist should be prepared to produce and share, rapidly and accurately, in coordination with team members (Thrall, 2002; Rodriguez, Sirmans, & Marks, 1995). When a Real Estate GIS specialist performs these analyses, he or she will focus on one or several real estate product types such as housing, factories, retail stores, etc., and rely heavily on databases that their organization has produced, or that has been made available by their local or regional government. The International Association of Assessment Officers (IAAO) categorization of real property types are followed by most counties in the US, as well as many governmental units elsewhere in the world, when creating their data bases of real property (see Additional Resources).

The Real Estate GIS specialist may not themselves derive the four key items; however, the Real Estate GIS specialist should be prepared to evaluate the data and procedures used by those who calculate these four items, listed in order of usual calculation: 1) Trade Areas; 2) Competitive Supply; 3) Demand, and 4) Absorption Analysis.

4.1 Trade Areas are the geographic areas within which a business draws most of its customers, and as such, they can be estimated in a variety of ways (Lucas, 2018). Some approaches include the drive time between a destination and an origin (Thrall, 2010a); the radius of a circular trade area determined via a spatial interaction model (Haynes & Fotheringham, 1984); a Voronoi Polygon (Thrall, 2010b); Wedge Casting models for trade areas of irregular shape; and spatial discontinuity models (Patel, Fik, & Thrall, 2008; Thrall, 2007).

4.2 Measuring **Competitive Supply** means understanding what properties are available currently with the same Real Estate use codes (commercial, residential, industrial, etc.), or use codes whose property can be easily and quickly converted to the use of the target property within a given trade area or submarket, such as within 1.5 miles from an interstate exit or entrance ramp. If one were considering single-family residences in a market, for example, the competitive supply would include the existing supply of houses, vacant land that could be available for residential development, and even properties nearby that could be converted to future residential use (Schram, 2006). In addition to evaluating existing housing stock, building permits would allow the Real Estate GIS specialist to calculate

future supply. Fortunately, increasingly building permits are available to be reviewed online.

4.3 Evaluating **Demand** requires measuring variables such as population and employment change by demographic profiles within a trade area. Generally, only a segment of the total population will become consumers. Esri's Tapestry Segmentation, for example, enables nuanced understanding of localized psychographic profiles with different propensities to consume, apart from more readily available socio-economic data around race, income, education.

4.4 Absorption Analysis is the calculation of the rate at which the real estate product is likely to be rented or sold, such as the number of houses sold each month. A variation on the theme of absorption is **Gap and Leakage**; namely, an estimate of the amount that likely could be sold, now, were there local supply. Underserved demand can be the consequence of population increase, introduction of a new product or value platform, change in taste preferences, or simply opportunities overlooked by entrepreneurs. Absorption, Leakage, and Gap calculations take into consideration Competitive Supply, and Demand, within the Trade Area.

The burden falls upon the Real Estate GIS specialist to provide appropriate analyses to the management team or decision maker with whom he or she is working. They should be prepared to provide sufficient maps, graphs, and textual information to allow their audiences to understand the geographic context of the real estate asset. The Real Estate GIS specialist cannot be idle waiting for other team members to request analyses from him or her. The most experienced and successful Real Estate GIS specialists do not limit themselves by relying only on canned software and data; they leverage the full functionality of GIS software (Marks, Stanley, & Thrall, 1994). In our information age, the team and decision makers with the most rigorous and relevant information will prosper, which is the objective of business.

References

Bible, D. S., & Hsieh, C. (1996). Applications of geographic information systems for the analysis of apartment rents. Journal of Real Estate Research, 12(1), 79-88.

Casetti, E. (1971). Equilibrium Land Values and Population Densities in an Ideal Setting. Economic Geography, 47, 16-20.

Clapp, J. M., Rodriguez, M., & Thrall, G. I. (1997). How GIS Can Put Urban Economic Analysis on the Map. Journal of Housing Economics, 6(4), 368-386.

Colby, C. C. (1933). Centrifugal and Centripetal Forces in Urban Geography. Annals, Association of American Geographers, 23, 1-20.

Haynes, K. E., & Fotheringham, A. S. (1984). Gravity and Spatial Interaction models (Vol. 2). Beverly Hills, CA: Sage.

Lucas, B. (2018). GIS&T and Retail Business. The Geographic Information Science & Technology Body of Knowledge (1st Quarter 2018 Edition), John P. Wilson (ed).

Marks, A., Stanley, C., & Thrall, G. I. (1994). Criteria and Definitions for the Evaluation of Geographic Information Systems Software for Real Estate Analysis. Journal of Real Estate Literature, 2(2), 227-241.

Patel, A., Fik, T., & Thrall, G. I. (2008). Direction Sensitive Wedge-Casting for Trade Area Delineation. Journal of Real Estate Portfolio Management, 14(2), 125-140.

Rauterkus, S., Thrall, G., and Hangen, E. (2010). Location Efficiency and Mortgage Default. Journal of Sustainable Real Estate 2(1).

Rodriguez M., Sirmans C. F, and Marks, A. (1995) Using Geographic Information Systems to Improve Real Estate Analysis. Journal of Real Estate Research, 10(2), 163-174.

Schram, J. F. (2006). Real Estate Appraisal. Bellevue, WA: Rockwell Publishing, Inc.

Thrall, G. I. (1987). Land Use and Urban Form: The Consumption Theory of Land Rent. Oxford, UK: Routledge, Methuen, Taylor and Francis.

Thrall, G. I. (2002). Business Geography and New Real Estate Market Analysis. New York, NY and Oxford, UK: Oxford University Press.

Thrall, G. I. (2007). Location Value Part 3b.

Thrall, G. I. (2009). Market Analysis of Urban Built Environments. Module 2, Part 1. ESRI Business Analyst Demonstration. [Video].

Thrall, G. I. (2009). Market Analysis of Urban Built Environments. Module 2, Part 2. ESRI Business Analyst Demonstration. [Video].

Thrall, G. I. (2009). Market Analysis of Urban Built Environments. Module 2, Part 3. ESRI Business Analyst Demonstration. [Video].

Thrall, G. I. (2010a). Trade AREAS - ESRI Business Analyst Demonstration.

Thrall, G. I. (2010b). Many Methods to Calculate A Trade Area. Last accessed 7/6/18.

Thuenen, J. H., Hall, P., & Wartenberg, C. M. (1966). [Der isolierte Staat.] Von Thuünen's 'Isolated state' ... Translated by Carla M. Wartenberg, edited with an introduction by Peter Hall. Oxford: Pergamon.

Wofford, L., & Thrall, G. I. (1997). Real Estate Problem Solving and Geographic Information Systems: A Stage Model of Reasoning. Journal of Real Estate Literature, 5(2), 177-201.