State of play of GIS usage in the Real Estate Industry

James Culley – james.culley@tkk.fi

Abstract: *Like any business in the commercial world success in the Real Estate industry is reliant upon being able to make better and more informed decisions quicker than your competitors are able to do. A key component of this is having the latest and most complete data available and also having the correct tools to be able to interpret and analyse this data to its full potential. GIS enables its practitioners to reveal trends and patterns in data that are unlikely to be revealed using statistical and tabular analytical techniques alone. The aim of the current paper is to try and assess all aspects of GIS usage in the Real Estate industry. The paper will be primarily conducted through face to face interviews with GIS practitioners in the corporate real estate industry. We will also speak to GIS data and service providers as well as third party GIS companies who offer an analysis service to the real estate industry.*
As well as asking about techniques and data that GIS practitioners use, the paper will also take into account the position of GIS in the organizational structure as well as problems and perceptions of GIS within the industry.

Note: This project is currently ongoing and the aim of this paper is to give a structure to the project as well as report on some of the findings so far.

Introduction

GIS is one of a number of new technologies that have emerged in the last couple of decades to be incorporated and adapted for use in the real estate industry. Essentially a suitable, all purpose definition for describing a GIS is as "a computerised database management system used for the capture, storage, retrieval, analysis and display of locationally defined data that is referenced by spatial or geographic coordinates."(Fryrear et al., 2001). The term GIS itself is generally understood to mean Geographic Information Systems although it originally had alternate definitions such as Geographic Information Science.

The integral part to understanding GIS is to decipher what we mean by the term 'Geographical Information.' This term carries with it its own difficulties not least in the differences between what we mean by 'data' and 'information'. If we understand data to refer simply to 'records of facts' then in order for data to become information we need to assimilate, interpret or analyse the data in some aspect (Wyatt and Ralphs 2003). The key characteristics of a geographical dataset is that it contains information about attributes pertaining to the data and information describing the location of that data in its relative position on the earth's surface (Harris, Sleight and Webber 2005)

Like any business in the commercial world success in the Real Estate industry is reliant upon being able to make better and more informed decisions quicker than your competitors are able to do. A key component of this is having the latest and most complete data available and also utilising the correct tools to be able to interpret and analyse this data to its full potential. GIS enables its practitioners to reveal trends and patterns in data that are unlikely to be revealed using statistical and tabular analytical techniques alone.

The reasons why GIS has been targeted as a suitable tool for real estate analysis are numerous. The adage "location, location, location" pertains directly to property development decisions (Wyatt and Ralphs 2003). Every property is unique, if only in terms of its geographical location, and so it logically follows that geography plays a central role in most property decisions. ESRI, a specialist GIS

software provider, adversities the main advantage of GIS as being the ability to add spatial intelligence, and hence a competitive advantage, to real estate procedures such as site location, planned market expansion and matching tenants to properties[1].

The Royal Institute of Chartered Surveyors have recently published a set of Standards on the subject of Geospatial Information and the surveying profession. In the introduction they note that whilst property professionals are adept on topics such as cost/benefit analysis, a lot of work is still done in an analogue and paper based environment. The authors note that the use of GI will impact RICS members as the majority of the information they work with will have a locational element of some kind (RICS Practice Standards 2010)[2]. Much like Hernandez and Thrall, who describe portfolio management and associated location decision making as a combination of subjective and objective analysis, the ability to determine how factors interrelate using GIS is seen as a way to reduce the reliance on "intuition and promote a 'more scientific' approach to location analysis and decisions"(Hernandez and Thrall 2007). This is not arguing that experience and intuition should be removed from real estate analysis.

The relationship between GIS and real estate has a long history. In America commercial real estate functions, namely the retail and service industries, adopted the use of GIS technologies as early as the early 1990's (Hernandez and Thrall 2007). In the UK GIS was quickly became commonplace in use by Local Authorities, particularly in the planning departments. In 1991 16.5% of Local Authorities used GIS but by 1993 that had risen to 29%. A survey in 2000 showed that 94% of Local Authorities in the UK had implemented or were implementing, a GIS (Wyatt and Ralphs 2003).

The aim of this paper is to investigate the ways in which GIS is currently being used by Real Estate Companies in the UK. The primary focus is on the use in corporate companies as opposed to the public sector.

Method

This project is still ongoing and the topics discussed below come from the results of conducting interviews with around twenty real estate consultancy, investors, developers and data providers in the UK, Finland and US. These topics are based on the majority of the discussions with UK based firms. The structure of the paper follows that of the discussions although there was a strong element of free flowing discourse in the interviews. In the main we spoke directly with GIS practitioners although in several cases we also had the opportunity to speak to their managers.

There will be further discussions with real estate companies in the UK and Finland who it was not possible to schedule a meeting with on the original dates as well as an interpretation of the results of a web survey. We felt the results of the first round of the web survey were not numerous enough to form a representative sample and are discussing a change in the distribution method to produce a more conclusive second round.

This paper will focus on the set up of GIS departments and systems within the real estate companies before moving on to a closer look at the systems, data sources and data storage facilities. This will be followed by a look at data visualisation methods and a brief outline of some of the more common analytical techniques and methods. The paper will conclude with a look at the perception of GIS within the company, the problems that GIS faces and finally what the future may hold for GIS within Real Estate.

[1] http://www.esri.com/library/brochures/pdfs/gis-sols-for-comm-realestate.pdf
[2] http://www.rics.org/site/scripts/news_article.aspx?categoryID=339&newsID=1338

GIS Corporate set up

Position of GIS department in firm's organisation

One of the first aspects we wanted to try and understand was the position of the GIS personnel and tools in the firm's organisation. The position it occupies, whether as an independent team or incorporated in one or more departments, will have an impact on how it is utilised as well as the personnel who use it and perhaps to some extent the effectiveness that a GIS system can add to any kind of real estate analysis or procedure.

The location of the GIS systems and personnel varied amongst the firms we spoke too and appears to depend on a number of factors, not least the inherent differences in organisational structures between firms. There was not a general consensus within companies to have a specialised GIS department indeed, with the exception of a few large retail organisations, the majority of companies do not have a specific department to deal with GIS. The most common location for GIS practitioners is within either the retail or the research team. There may be a specialised sub- section of the department but more often they sat within the same organisational structure as the other analysts. Otherwise GIS practitioners were located within a variety of departments based on wherever it tends to be the most used. In these cases the GIS practitioner was using it as a skill set that assisted them in their day to day duties rather than as their specific role.

Several of the firms also had their GIS system, or part of their system, located on a central server where it could be accessed by personnel in other departments and even personnel in different European offices. These tended to be the type of system referred to by Harris, Sleight and Webber as Geodemographic Information Systems. These systems are designed to be user friendly and to accomplish specific tasks for users with less familiarity and knowledge of GIS systems. In these cases there was still a designated GIS person, with greater knowledge of the subject, who handled GIS questions from other users and worked on more specific and complicated tasks.

One thing that has been revealed in this study is that there are number of companies that will outsource their GIS. This was especially prevalent amongst developers, both commercial and residential, and property investment firms. When we contacted these companies they informed us that they carried out no GIS analysis in-house but frequently used external companies to cater for their GIS needs. There were a range of justifications explained to us for taking this course of action. The most common reasons given for this practice where perceived cost benefits of outsourcing rather than having their own department, the greater expertise and data sources of a specialised GIS service provider and also the perceived validity and non-bias of third party knowledge and information. This was particularly important to companies who were trying to push schemes through planning who were wary of being accused of producing results that coincided positively with their arguments. This was also partly due to the current economic climate with companies cutting back on their research departments.

Personnel

Of the GIS practitioners that we have spoken with so far in this study we found that less than half have come from a purely GIS background. It was in fact more common to find that people were coming from a geographical, real estate, economic or business background. Discussions with academics and professionals reveal that this trend is likely to continue in the future. In his personal blog Dr Muki Hackley of University College London discusses the changing approach to teaching GIS in universities. He discusses whether we are seeing the end to what he refers as the 'ARC/INFO driving licence era' when students took an MSc in GIS to learn how to use the complex GIS packages available, which at the time needed a

significant amount of training to operate successfully due to their complexity and the level of technical knowledge required. He now expects that the definition of the pure MSc in GIS to be extended, to incorporate areas such as web GIS APIs, but more importantly for the future use of GIS in the real estate industry he also believes that there will be a far more integration of GIS within other fields of study where it is taught as a tool for use within that field.[3]

Whilst the backgrounds of the practitioner may not have been pure GIS they had often studied some aspects of GIS at university. An analysis of Real Estate Programs offered by top universities in the United States found that all the curriculums agreed that students should be able to use all the latest technologies, GIS being one of the key areas. They also all agreed that graduate programs needed to keep their programs as up to date as possible with the rapidly changing technology available for use in real estate (Weinstien and Worzala 2008).

However in our study there were practitioners who had first come across GIS in the working environment and gained their experience on the job and through training provided by, or paid for, by their company. This circumstance generally corresponded to companies where their GIS was used more sparingly or was introduced as a new feature and the emphasis was more on display of information and only light spatial analysis. Unsurprisingly in these cases GIS was generally used as a skill set to supplement their other role, usually as a property consultant. However practitioners who had worked for a large retail firm, and gained their knowledge of GIS whilst at that firm, tended to have a good knowledge on the subject and usage of GIS due to the prevalence of its use and were comfortable carrying out more advanced analyses.

An area that nearly all of the interviewees agreed upon that whilst having a GIS system enabled them to provide a more robust quantitative analysis for use in real estate decision making, there was always a subjective view taken at the end of any output and the key strengths of their firm was that that these outputs would be viewed by skilled and experienced personnel who can adjust it if needs be. This corresponds to Hernandez and Bennison's article on retail location decision making that concludes "Location decision making is likely to always remain both an 'art' and 'science'."(Hernandez and Bennison 2000).

Cost centre or fee earner department

In much the same manner as there was no consensus about where GIS was located in an organisations structure a similar result was found in the question of whether GIS was a fee earner or a cost centre. In the majority of cases it was described as a mixture of both. We were told that GIS had no set fee level that it was expected to attain but that there should be a charge made to the client, or incorporated into a larger project fee, when GIS was used to analyse or report on aspects related to a job. The rest of its use was still supported to a large extent by the company. This was due to the users saying it was very hard to put a figure on how much value GIS added to their work. Some interviewees described GIS as a very useful, even vital, tool to have especially when they saw it giving them an advantage over their competitors, whilst others admitted that it is not their core business and as such can be seen as a bit of a luxury.

Systems, data sources and storage

Systems

[3] http://povesham.wordpress.com/2009/10/29/the-end-of-the-%E2%80%98arcinfo-driving-licence%E2%80%99-era/

In most cases companies that we spoke to had what can be described as two types of systems; Geographic Information Systems, such as ESRI ARCGIS and MapInfo, and Geodemographic Information Systems (GDIS), such as Experian Micromarketer and CACI InSite. GDIS can be viewed as systems that are specifically built for tasks such as neighbourhood profiling and micromarketing. The systems usually come with a geodemographic database built in and have less functionality than a full GIS system. However as Harris, Sleight and Webber write "it is in our opinion wrong to view GDIS as simply a 'slimline' GIS. To do so is to overlook the important differences in purpose and users of the two types of system" (Harris, Sleight and Webber 2005).

This topic was one of great interest as it generally led to two contrasting views in users that we interviewed. Users from a pure GIS background did not appear to classify the GDIS systems as GIS systems as such due to their limited functionality whereas users who originated from other disciplines found that GDIS's delivered every aspect of real estate analysis that they would require. Interestingly nearly every company had both a GIS system and a GDIS system, demonstrating the possible need for both types.

Sources

As stated earlier the key characteristic of a geographic dataset is that it contains both attribute information and information about location. Geographic datasets, such as municipality boundaries or, particularly in the UK, postcode boundary data can be obtained from data vendors such as the Ordnance Survey, the Post Office or independent data vendors. It is then possible to combine additional attribute datasets with a geographical aspect to their relevant geographic dataset. This can be done through a matching field in each dataset, for example municipality name, or through spatial location, such as proximity.

Most location based decision making in the Real Estate environment is characteristically a combination of subjective and objective analysis. There are a huge variety of data sets available to real estate professionals with which to make decisions on locations. These datasets include information on market transactions, forecasts, comparables, revenues, vacant/available properties, demographics and transport infrastructure.

There are certain datasets that are more prevalent within the real estate industry than others. Most of the companies we spoke to, indeed all of the ones in the UK, used socio-economic classifications, such as ACORN or MOSAIC, as well as using raw census and corresponding geodemographic data. There was also a high demand from the practitioners to be able to load their own, and customer data, into the GIS. One of the reasons given as to why a company acquired its own GIS capability was the confidentiality provided by doing GIS tasks in-house instead of outsourcing. Another widely used dataset is a transport network and infrastructure dataset with which the practitioners can use to run travel time models. Whereas drivetime simulators are fairly common, many companies will also purchase the ability to model public transport travel times if they are available and the cost justifiable.

In the UK, where there is a relatively long history of GIS usage, there are a wide range of data products offered by a variety of vendors. Many products are available where specific analysis tasks have already been modeled by data vendors who then offer the end product to GIS practitioners. For example one dataset purchased by many companies we spoke to was a retail footprint model where the catchments of retail centres have been calculated using a spatial interaction model. Whilst these catchments could be calculated by knowledgeable GIS practitioners within real estate companies, many companies find it simpler, quicker and most importantly cheaper to purchase these catchments and corresponding attribute data. Data providers told us that in their opinion that these more advanced analytical tasks are better suited to being calculated by their own specialized GIS analysts who have the requisite methods,

techniques and knowledge in place, and access to greater resources than is often found within a non-GIS specialized company. For example datasets such as forecasting shopping flows and changes in London caused by the changes to Stratford for the Olympics are calculated using sophisticated models from a vast range of data sources that are better suited to the capabilities of specialized personnel. However the purchase and use of the finished data products may add a great deal of value to the real estate companies' outputs.

The use and understanding of datasets is one area where errors can quickly be introduced by inexperienced personnel. Working with data from more than one country requires some awareness of datums and coordinate systems in order to use the correct data in the correct manner. Using data in the wrong coordinate system can have devastating effects on the accuracy of any geographical analysis. Another common problem area encountered with inexperienced users is the Modifiable Areal Unit Problem. This can cause errors that occur when users do not fully understand or take into account the effects of spatial scale or analyzing features consisting of contrasting geographical regions. As O'Sullivan and Unwin explain "The practical implications of MAUP are immense for almost all decision making processes involving GIS technology … The implication is that our choice of reference frame is itself a significant determinant of the statistical and other patterns we observe." (O'Sullivan and Unwin 2003). This was a problem GIS practitioners were aware of when other personnel in the company where using the systems to run their own analysis.

Any data created by a user should ideally have full metadata accompanying the data set describing who created the data, when it was created, what method was used, why it was created and what coordinate system. However even with data supplied from vendors or public service sites this is not always complete. As the RICS states "Metadata, or information about information, should be used to ensure that anyone using the data can do so with confidence".[4]

Any GIS usage and analysis is only going to be as good as the data that it is built upon. You can have developed the most complex and thorough analyses but if the data sources turn out to be invalid or not compatible the results will be rendered meaningless.

Storage

Generally the emphasis on data storage was less significant than other aspects of GIS amongst the companies we spoke to. Data was stored in a number of unconnected databases and inputs and outputs created by users were stored in localized files, folders and projects with no special location for Geographic data. Data was often stored within built in data organizational structures in systems equipped with this facility, primarily GDIS's, but this data was then difficult to access through other systems and software. Customer data and data from other departments were generally passed as spreadsheets or tables rather than the GIS system having direct access to the location where the information was stored. Ideally geographical data should be stored in structures such as geodatabases accompanied by up-to-date metadata but this solution is often not practical depending on factors such as the IT setup of the company. A connection to a centralized or departmental database that contains data linked to geographic locations can improve overall performance as well as adding to the efficiency and complexity of any analysis. However in many cases amongst the companies we spoke to this was not an option due to licensing constraints and increased data costs of making some data widely available.

Most Real Estate companies will have a number of different internal databases, generally used and maintained within different departments. These databases are used to record various aspects of

[4] http://www.rics.org/site/scripts/news_article.aspx?categoryID=339&newsID=1338

property information but also other sources of data which are vital to the particular departments operation. There are often inconsistencies not only between the databases but also within each database too which can hinder their effectiveness and make GIS processes more time consuming when linked to these sources.

Data Visualisation

It may seem obvious but the first real use of GIS for most companies in the real estate industry is as a very useful method to display data effectively. This may require little in the way of analytical capability but this should not belie its importance. As the old cliché says a picture tells a thousand words but in this case a simple map can present data in a manner that is far easier to comprehend than a series of tables and charts or as a descriptive passage. Hernandez writes "The aim of geovisualisation is to turn large heterogeneous data into information (interpreted data) and subsequently, into knowledge (understanding derived from data) … Geovisualisation techniques are geared to exploit visual-cognitive abilities; such as, patter recognition, ordering and interpretation of visual cues." (Hernandez 2007)

Point Maps

It is often necessary to map the distribution of particular feature types, such as buildings of interest or closest transport nodes to a location. This was one of the most requested tasks of GIS departments and personnel and one that makes up a significant proportion of day to day tasks. One of the complaints made by several of the companies we interviewed was that this was the extent of many colleagues idea of how GIS could help them. Rather than ask for any kind of in-depth analysis they just wanted to put 'points on map'. However these simple maps are very useful for pitches and reports as they can convey the spatial relationship of features even to people who are not that familiar with any kind of mapping output. Although some systems can come with templates set up there is still skill involved in being able to get the visualisation right, especially when there are numerous categories of information that need to be seen on one map.

With the advances made in the last five years or so by Google and Bing maps mean that a large section of the population are now familiar with seeing points of interest displayed via internet mapping services on websites and what they often require is a similar task, usually to demonstrate certain features to clients.

The next stage is to create similar point maps that show the difference in particular variables at these locations either by altering the colours used to depict the symbology, the respective size of the symbols or by using concepts such as bar or pie charts to represent the locations.

Thematic Maps

These are generally used to display data that refer to regions rather than single locations. They are very useful for visualising how data such as demographics vary from region to region and can be used as a simple way of identifying hotspots. These maps were a common output of many of the companies that we spoke to and users saw them as being ideal for the dissemination of data in reports and presentations. They have the added advantage that they are good at demonstrating background data whilst other data in the form of points or lines can be displayed above them.

A critical choice for the creator is to define the boundaries between the classes of a particular variable as this can drastically alter the pattern of results.

Surfaces

We found a less common way of representing data in the real estate industry is as a raster surface. One of the reasons this is used less is that, with many systems, it requires the purchase of extensions that are able to create a more complex spatial analysis. This method of visualisation can also be viewed as a quite complex form of spatial analysis and it requires a greater knowledge of GIS than any of the other visualisation techniques. There are different methods to interpolate a continuous surface from a dataset and choosing the right method and variable values to get a meaningful and accurate result and this adds a much greater level of complexity. However these surfaces are not only a very good way of visualising continuous data but by interpolating an existing dataset it is possible to model the probable values of areas for which there is currently a lack of data.

Techniques and applications

This section gives a brief overview of the most common techniques that the interviewees informed us they used to analyse spatial data as well as the kind of applications they put this analysis to use on.

Office Relocation

This is one of the most requested tasks asked of GIS personnel that we interviewed. The task is to assess the potential impact of office relocation on the morning peak rush hour travel-to-work for staff at varying office locations.

The analysis is carried out by geocoding all the addresses of the staff who work at the current office. Using a transport network model it is then possible to calculate how long it takes each individual to get from their home address to the current office location. Most companies will model the travel times using peak hour drivetimes although if they have the capability GIS analysts will also use public transport travel times. This is obviously more important if the office locations happen to be in a city centre, especially central London, but the use of a public transport model is very dependent on availability and cost.

The same analysis is then calculated from the employees home addresses to the other potential office locations and a change in average travel time calculated. This is normally classified by different groups based around level of staff hierarchy.

Companies are also using this as part of their sustainability and green studies if they can show that by moving offices average and overall travel times for their employees will be reduced and especially if more staff will use public transport than rely on travelling by car.

Catchment / Trade Area Creation

Much of Real Estate market analysis begins with the assessing and calculating the spatial delineation of the geographic trade area or catchment. There are generally four methods used to define catchment areas described to us by real estate GIS analysts; ring study, drive times, regional and gravity models.

The simplest model is to create rings around a site of specified distance. The distances used are usually subjective and, in the case of many of the GIS practitioners we spoke to, usually come from the client or agent. However these are seldom recommended to be used for any kind of robust analysis as they rely on an implicit assumption that customers are spatially uniform and that it does not take into account behavioural, geospatial, road network or physical conditions that promote or restrict usage in various

directions (Patel, Fik and Thrall 2007).

However because of their simplicity they are often used, mainly for more basic studies or for practitioners who have a lighter version of a GIS system that does not include more advanced spatial analysis functions. They are popular with other staff, particularly agents, who want a quick and easy method to describe list of figures for a location to show to clients and find that a figure of, for example, 5 miles around a site is acceptable for illustrative purposes. It is also useful as a selection criterion in web-based report delivery where it is difficult to build in more advanced functionality.

Regional selection is another straightforward way of defining a catchment that has both advantages and disadvantages. This is typically again a relatively subjective method but can draw on a person's expert understanding of an area, a factor which as we mentioned should not be discounted. Also quick analyses can be conducted to see which regions best suit a list of requirements and these regions then used to create the catchment. In reality they do suffer from many of the same disadvantages and shortfalls as ring catchments.

The most common form of catchment used in real estate that we have discovered has been the use of travel times. These offer improvements in the calculation of catchments and consequently improvements in analyses that rely upon data measurements of the trade area. They are by no means perfect though and do not take into account people's willingness to travel, multiple modes of transportation, consumer preferences, knowledge and experience, perceptions and spatial use patterns. However many decision makers think in terms of drive-time based catchment and errors introduced by drive-time based trade areas are thought by many analysts and decision makers to be tolerable and accountable(Patel, Fik and Thrall 2007).

A more complex way to model a catchment area is to use a spatial interaction model, based upon the concept of a gravity based model and still often referred to as such. Clarke et al write that "The integration of diverse data sources, together with substantial enhancements to the model structure, means that the term 'gravity model' does scant justice to the sophistication of the techniques now in use, although the name does still remain popular." There are many different methodological approaches that can be used for this kind of analysis but the basic concept involves taking a measure of a locations attractiveness, based on variables such as retail provision, turnover and size, and its accessibility combined with an inverse distance weighting approach. One of the main advantages of these models is that unlike the methods listed above they do not assume there is equal drawing power in all directions and they do not give the same weight to locations close to a site of interest as locations a lot further away. A few of the companies we spoke to had the ability to create these kind of models themselves. It was however one of the most desired components of the GIS practitioners' wish lists or as in several cases, they previously had the ability to create these models but had not renewed their licence for the application because of cost cutbacks.

Catchment profiling

The catchment created through one of the techniques listed above are commonly used to analyse and retrieve data about demographic issues such as population characteristics, family incomes, expenditure/buying preferences and social classes. These geodemographic datasets are understood as containing information about people and the places those people live in and are a fundamental resource for most real estate GIS tasks as they provide an understanding of the types of individuals who inhabit the area. Reporting of these statistics in maps, tables and charts is often the end product of this type of analysis.

A popular feature of geodemographic data is their classification into geodemographic neighbourhood groups, particularly CACI's ACORN and Experian's MOSIAC classification structures. These

classifications play a key role in the catchment profiling.

Catchment profiling is popular for use with residential development departments as they can analyse the likely target populations for the new site and match the residential and non-residential mix to the local population. It can also be combined with forecasts of demographic and housing change in the locality if such information is available. With office location decisions the clients are more interested in uncovering information on the local workforce and available labour pools. Information gathered from catchment profiling can be used as a starting point for many other types of analysis. They are a vital tool in much retail location decision making.

These demographic values, especially information on factors such as income or expenditure or lifestyle values, can be used as a basis for more in-depth economic analysis by calculating factors such as turnover estimates and market potential. GIS can then be used to model how changes in accessibility may then affect this market potential.

Site Assessment

This is another key area for use of GIS in real estate and one of the main aspects to it is the aforementioned technique of catchment profiling. Although this analysis technique is most associated with the retail side of the industry it can be just as useful in the residential, office, warehouse or health care sectors as well.

Understanding and knowing all the specifics about an existing or potential site are key to successful site location and planning. By evaluating sites and their potential it is possible to determine which sites have the best possibility of success.

One of the most common methods for assessing a site was by using a comparable method. By taking the figures generated in the analysis of a successful site, such as demographics, economic and accessibility factors, they could compare these with the figures generated for the site of study.

In retail the catchment area was sometimes used to examine the market penetration by comparing information collected from store cards and surveys to the socio-economic makeup of the catchments. GIS can also be used to calculate factors such as the sites accessibility, local facilities or environmental risk.

Competition Analysis

GIS is often used to investigate where competitors are located or where does the competition plan to locate in the future and how will that affect the client's site. This is not just useful in retail as being able to investigate the impact of competitors to your residential or office site will aid a company's decision making.

For those companies with the ability gravity models were very useful for determining competitor's influence, especially with trying to determine what the impact of a new competitor location will be.

The presence of competitors means that the real geographic catchment of a new store or development will be highly skewed in certain directions. This subject also contains the notion of store or company cannibalisation, where clients would want analysed the effect of opening a new site on their current locations.

This application is where spatial interaction models are most heavily used. On the retail side these kind of models generally work on the assumption that when choosing between centres which are equally accessible, consumers will show a preference for the more attractive one. When centres are equally attractive consumers will show a preference for the more accessible centre. It should be noted that these preferences are not deterministic and therefore more complex models have been developed to deal with

the stochastic nature of consumer behaviour (Birkin et al 1998).

Portfolio Analysis

GIS is also used to analyse property investment performance. The performance measures of property investment assets, such as total return, income and capital returns or rental growth, are monitored geographically to identify geographical patterns or time series trends.
One use of this is to justify rent reviews as agents can identify comparable sites to see if there is an evidence base for a rental increase. Another use is to add spatial data into investment decision making capabilities to optimise portfolio mix.

This topic was not one that was spoken about in much depth by the majority of the people we spoke to. The most common use of their GIS systems in dealing with portfolios was as a way to display the locations of portfolio events and to visualise changes in factors such as rent or price at these locations in relation to each other.

However this was an area where more complex analysis was outsourced to specialised GIS companies who could combine GIS outputs with statistical and econometric analysis and various spatial and non-spatial datasets to provide a far more in-depth analysis of the client portfolio and, in some cases, even advise them on their investment decisions.

Branch networks

These are based around location-allocation models and are concerned with the optimal location of facilities and services to best suit the population. They deal with what is known as the equity-efficiency problem that recognises that facilities need to be located to maximise their accessibility to individuals, yet at the same time that any network of facilities has to be efficient in relation to scarce resources (Birkin et al 1998).
Mature network analysis often mean that new site development is an unrealistic means of increasing sales because new sites will cannibalise existing sales. Therefore selective opening, closure and relocation of sites to optimise the network are required to maximise the efficiency of the facility network.
By using techniques such as spatial interaction models to model consumer flows between possible destinations, GIS can then be used to determine how resources should be allocated to various sites based on their strengths.

Market Research, Marketing and pricing policies.

Pricing policies are related to geography in a number of ways. Firstly retailers may recognise the differential spending power of different regions, caused by differential regional wages and incomes, and adopt flexible pricing policies which may offer lower prices, or cheaper products, to less affluent neighbourhoods. Secondly the different spending power within regions may or may not attract different retailers to locate there.

By using demographics and lifestyle data marketers can segment the population profile of the catchment and then use this to specifically target the geographical location of groups of interest for the advertising campaigns or for their market research.

Some of the companies we spoke to concentrated a large portion of their work analysing exit surveys carried out by their or their clients marketing departments. The results of these surveys were imputed into their GIS systems using respondents' locations and patterns analysed using the survey results alone or combined with, for example, demographic data.

Perceptions, problems and the future

In the majority of cases when we asked our interviewees what were the biggest problems that they faced there was one answer that seemed to dominate. This problem focused on the topic how GIS was perceived within the company. It was therefore no surprise to find that the interviewees who were concerned with this aspect also revealed that the area of the GIS that they were hoping to improve on in the coming year was the overall perception of GIS. The approaches to this solution mainly revolved around setting up presentations to individuals and departments. They did acknowledge that in most cases this approach had already been attempted often with limited success. Although it wasn't quantifiably stated there appeared to be an air of letting the knowledge grow organically through the company via successful projects and through client requests.

It was also acknowledged by some of our interviewees that they felt there was some level of bias against GIS, especially amongst some of the more senior personnel. This was considered to be down to a lack of knowledge and familiarity, as well as a distrust of new technologies, and this was really the biggest hindrance against improving the perception of GIS in the company. A significant number of other staff were reported to have an opinion of GIS as a way to put points on maps and that was the limit of their interest in the subject. They did not seem to understand the spatial analysis benefits or are not really interested. On the agency side the amount of money available in prospective fees also played a part in the amount of GIS analysis required, particularly with GIS departments that were classed as fee earners.

The bias that GIS faced was that of any new technology in that some of the senior staff appeared to be of the opinion that despite being aware of the benefits that GIS can offer why should they change the way things had always been done. It was hoped this problem would be overcome in time as GIS usage becomes more common and familiar and an accepted part of the works process.

One interesting development was that it was reported that there were a number of times company staff had come to the GIS department as the clients themselves had asked whether they had any GIS capabilities. On finding out what services the GIS personnel could offer the apparent standard response was one of interest and disbelief that they didn't know these services were on offer. It was felt this was a particularly surprising result with staff the GIS department knew they had presented to about their services.

The other factor which had an impact on the effectiveness of their GIS services was the cost. Not only are there very high start up costs but providing an up-to-date GIS service also incurs a high maintenance cost. These costs are due to the software licences and extensions and also high data costs which can either be charged monthly, quarterly or annually. There was a noticeable difference in the companies we spoke to between those where the current economic climate had had little impact on their service provision and those that had had to cut costs by not renewing some of their extension and data licences. On balance more companies had trimmed back their GIS capabilities, or were planning to when the contracts were up for renewal, than were speaking about expanding their systems and data sources. There was often an apparent view that the company's IT department were not as helpful or as supportive of GIS as the users would like.

When asked about their future plans the aim of most practitioners we spoke to was to improve on their services offered and to increase the knowledge of GIS throughout the company. The purchasing of new data sets, as a compliment or as an alternative to existing datasets, was also on the agenda for many of the companies and also increasingly the cooperation between departments.

On the development side the main focus was on creating new ways to disseminate the end

results of any GIS analysis. Only a few companies had really looked into this element and these companies corresponded strongly with the companies that both provided a more advanced service and had personnel who came from a strong GIS background. As well as providing a web based service so that other company staff or clients could access geographic data online, as well as some light GIS analysis, the idea of creating mash-ups as well was being investigated so that interactive maps containing relevant data could be delivered to clients, utilising technologies provided by Microsoft Bing or Google.

On a similar line automated reporting is also an area of potential interest. Some of the data and software providers will provide a web based mapping service that can run catchment reports but there is also a demand to be able to create their own bespoke reports using technology such as ARCServer and Crystal Reports. This method mainly used GIS as a system to store and manipulate spatial data, preferably in a spatial database. A GIS front end, often a customised GOGGLE or BING interface, would then be used to create user defined catchments that were then used to retrieve data located within the catchment. This was especially popular with companies who dealt with confidential datasets as data on individual people and buildings could be aggregated into coarser spatial areas and so conceal personal and private information.

One of the areas that concerned particularly the more technical users from pure GIS backgrounds was the increasing amount of low cost GIS provision available over the internet. This was balanced by optimism that although these systems had the potential to reduce some aspects of their role they could possibly expand other avenues. Conversely practitioners who used GIS as part of their skill set where optimistic about increasing GIS provision through the internet as they saw it would provide them with a greater options of tools to use in their work as well as increasing the familiarity of GIS and GIS concepts with clients.

In academic literature the most common use of GIS and spatial analysis is to incorporate spatial elements into a hedonic price model. This area of property valuation is one that the RICS see as being seriously impacted by GIS in the short to medium term. This will be through incorporation geographical data into Automated Valuation Models (AVMs) which use one or more algorithms, generally based around a hedonic model, to value properties[5]. At the moment there are few AVMs in use in the UK but that could change in the future. This scarcity of current commercial use was reflected in our interviews where there was little knowledge or interest displayed in this subject.

[5] http://www.rics.org/site/scripts/news_article.aspx?categoryID=339&newsID=1338

Bibliography

- Benoit, D. & Clarke, G. (1997). Assessing GIS for retail location planning. *Journal of Retailing and Consumer Services, 4*(4), 239-258.
- Birkin, M. & Clarke, G. & Clarke, M. & Wilson, A. (1996) *Intelligent GIS: Location decisions and strategic planning:* Cambridge: John Wiley.
- Birkin, M. & Clarke, G. & Clarke, M. (2002) *Retail Geography and Intelligent Network Planning.* Chicester: John Wiley
- Estaville, L. (2007). GIS and Colleges of Business: A Curricular Exploration. *Journal of Real Estate Literature, 15*(3), 443-448.
- Fryrear, R. & Prill, E. & Worzala, E. (2001). The Use of Geographic Information Systems by Corporate Real Estate Executives. *Journal of Real Estate Research 22*(1), 153-164.
- Harris, R. & Sleight, P. & Webber, R. (2005) *Geodemographics, GIS and Neighbourhood Targeting.* Chichester: John Wiley.
- Hernandez, T. & Bennison, D. (2000). The art and science of retail location decisions. *International Journal of Retail & Distribution Management, 28(*8*)*, 357-367.
- Hernandez, T. (2007). Enhancing retail location decision support: The development and application of geovisualization. *Journal of Retailing and Consumer Services, 14,* 249-257.
- Hernandez, T. & Thrall, G.(2007) Integrating GIS Technology within Portfolio Management. *Journal of Real Estate Portfolio Management, 13*(3), 289-292.
- O, Sullivan. & Unwin, D. (2003) *Geographic Information Analysis.* New York; John Wiley
- Patel, A. & Fik, T. & Thrall, G. (2007) Trade Area definition and Calculation.
- Thrall, G. (1999) Demographic Ring Study Reports with GIS Technology. *Journal of Real Estate Literature, 7*, 211-217.
- Webber, P. & Chapman, D. (2009) Investing in Geography: A GIS to support inward investment. *Computers, Environment and Urban Systems 33,* 1-14
- Weinstein, M. & Worzala, E. (2008) Graduate Real Estate Programs: An Analysis of the Past and Present and Trends for the Future. *Journal of Real Estate Literature 16*(3), 387-413
- Wyatt, P. & Ralphs, P. (2003) *GIS in Land and Property Management.* London; Spon Press.
- Zaddack, G. (1999) Real Estate Applications for GIS: A Review of Existing Conditions and Future Oppurtunities. *Real Estate Issues 23*(4), 13-19.