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The use of GIS in Town Planning

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Abstract

This paper tracks the various applications of Geographic Information Systems in town planning. It is proposed that these relate to four uses of information: holding, output, processing and analysis. Each of these uses, and the inherent applications of GIS, are discussed in turn. The paper goes on to present the findings of two major surveys of GIS use in local planning authorities, carried out by the Royal Town Planning Institute in 1995 and 2000. It is concluded from these surveys that the use of GIS is widening, with successively more authorities making use of GIS, more applications, and more computer "seats" within local authorities. However, these developments have themselves revealed new opportunities for GIS application, and few authorities consider the process to be complete. Finally, the outlook for GIS in town planning, in terms of data, technology and implications for management and professional development, is considered. The outlook in terms of data is considered to involve greater "sharing" of data sets to enable the building of integrated information systems; in terms of technology, to involve the development of 3-D capabilities, automated data entry and map interpretation; and in terms of management and professional development, to involve a commitment from practitioners as "champions; support from management; and dissemination of good practice.

1 Introduction

This paper relates to the use of Geographic Information Systems in town planning. Much of planning involves the collection, processing, analysis, presentation and use of information. Being able to engage with these functions, and having the necessary skills to do so, is fundamental to the town planning

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process. Planners need to have geographic information-related skills in order to carry out their jobs properly.

Increasingly, these skills are involving the use and application of information technology. This is particularly true in the context of local government, which is the principal place of employment of planners. As holders and users of large amounts of land-related information, local government planning authorities have benefited particularly from GIS implementation. The technology, which was developed in the late 1980s/early 1990s, is approaching maturity in the third millennium as the large majority of local planning authorities possess and make use of such systems.

There are many users of geographically referenced information in local government, and many of them are potential beneficiaries from GIS. They include all of the functions that control and record how we use our environments: planners, certainly, who are concerned with land use and its governance; but also environmental health officers, housing officials, land charges clerks and highways engineers. All of these functions require that records of the use of land or buildings are collected, referenced, kept, maintained, analysed and controlled and all can benefit from a system that allows this in an easy and organised fashion. GIS, with its versatility of applications and use, can provide such a system, and is increasingly doing so.

This paper draws on a number of key publications and surveys to outline the key issues and moves on to explain, in a town planning context, the nature of GIS technology, the policy framework, and some of the problems that have been encountered and overcome. It concludes by looking to the future.

2 GIS in Local Authority Planning

The important uses of geographic information in planning and local government, as identified by the Chorley Report, [1] include monitoring land use, forecasting change, service planning, resource and network management.

Add to this the ability to produce high-quality hard copy reports and maps, and the ease of information retrieval, and it is not surprising that GIS is considered a useful tool by local planning authorities. Ideally, most planning authorities would like to utilise fully-operational GIS to carry out, or at least ease the carrying out of, most of their functions. These may be divided into the **holding** of data; the **output** of data; the **processing** of data; and the **analysis** of data. It would be useful to consider each of these functions, and the possible ways in which a GIS could assist with their discharge, in turn.

2.1 Holding

Local planning authorities hold vast amounts of data. The planning system as we currently understand it has operated since 1947, and over that time, vast numbers of planning applications have been submitted and decided; structure plans and local plans have been produced; and reports have been written. A great many of these are, of course, out of date, but it is a bold planning authority that throws

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away any of its data! Legal cases relating to decisions made in the dim and distant past are rare, but they do occur. It is also true to say that the history of the use of land is very germane to the carrying out of the planning function. For example, although past planning decisions on a plot of land should not determine the decision of a current planning application on that same plot of land, they, and the reasons for them, would be of interest to the officer making the current recommendation.

So there is a well-recognised need in town planning, as in many other local authority functions, to maintain records; usually over long periods of time. It is not surprising, perhaps, that planning authorities have been eager to respond to the information holding capabilities of GIS. A GIS can hold enormous amounts of data digitally in tiny spaces; furthermore, this data should be available at the touch of a button, and of course, it does not deteriorate. It can also provide rather better representations of maps and drawings than alternative means of data storage such as microfiche. Clearly, there are implications as to whether a GIS should hold planning data "from this point forward", or an authority should input its historic data into the system, and a decision based on resources and the utility of increasingly historic data would need to be made. But even if the former course of action is taken, an authority can be confident that its stores of manual data are not going to be (as significantly) added to.

2.2 Output

Geographic Information Systems have undoubtedly improved the quality of map based data in planning departments. Both updating and access can be greatly simplified by GIS. Appropriately detailed, up-to-date maps can be produced quickly where maps would have been considered dispensable or too cumbersome to provide in the past, and by far the most common application of GIS in planning is the production of good quality hard copy maps. It may seem rather strange that a computerised mapping system is used to produce paper maps but it must be remembered that a lot of planning business is still paper based. Hard copy maps can be used in a number of contexts: from the very simple purpose of finding one's way to a development site to the plotting of a layout on an up-to-date Ordnance Survey base. Policy work demands the production of thematic maps and reference maps showing, for example, the coverage of conservation areas, agricultural land quality or population density. These outputs can find their way into reports, policy documents and statutory documents such as the local plan.

It may also seem a little strange to use the power of a GIS for such an apparently rudimentary application, but consider for a moment the process by which one of these examples of hard copy would be provided under the manual systems that the GIS has replaced. A paper map would need to be obtained and, possible, photocopied if the original was not to be used for annotation; a technician would need to transcribe site details onto the map using pens, letter and shading transfers and, possibly, colour wash; the finished product would

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need to be sealed to prevent the fading of inks or prints; and dye line printers would need to be used to provide multiple copies. Compare this with the accessing of a map file on screen, the on-screen digitising of a polygon and the printing of multiple copies on an inkjet or laser printer, and it is clearly apparent that the GIS has introduced a much easier, more efficient and less error-prone process.

So even on a basic level, the GIS is "earning its corn". Other examples of output may include the data from a GIS; the results of geographical analysis provided as database tables showing, for example, the numbers of tree preservation orders by parish, or all of the planning applications for industrial development in a town over the last three years. Such products are not exclusively the province of GIS, but they do rest on the sort of geographical referencing that is central to a GIS.

2.3 Processing

Many planning authorities will, however, be looking to GIS to do more than produce good quality maps. Much of the day-to-day job of town planning involves the processing of information: applications are received, registered and acknowledged, consultations carried out, responses received and processed, advertisements placed, decisions issued. A lot of this work is routine and is able to be carried out quite easily by a computer system. Planning application processing systems can hold relevant details and issue standard documents (such as acknowledgement letters). Planning authorities have implemented such systems for many years, but the advent of GIS gives new potential to the organisation of such information geographically and the interface of planning application processing with map-based interrogation and retrieval.

GIS can, and indeed probably should, be central to the handling of large and complex datasets, which may grow by many thousands of planning applications in a normal year. Potentially, a GIS can provide a seamless link between the plotting of a development site on a map to the retrieval, processing and output of all the information and correct formats for the carrying out of the planning function.

However, to do this, it needs data; comprehensive and reliable data that may extend beyond the pure planning function. Such data sets are regularly complex and large; and growing all the time. GIS implementation should therefore be accompanied by strategies for information gathering and management. One of the most cost-effective methods in fully computerised offices is the automatic logging of routine information processing, for instance from planning applications. Ultimately, a GIS should be a support for good decision making, and if emphasis is placed on the decision support role of GIS, there are implications for the approach to information management not just within a planning department, but throughout the local authority.

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2.4 Analysis

GIS is also a research tool, in that all sorts of geographical analysis can be carried out once data is so referenced. The capability for spatial analysis within GIS is a significant distinction to conventional database management systems. Data can be selected or manipulated according to its spatial reference, say to locate sites of a particular land use within a given distance from a road.

But more sophisticated analysis can also be carried out, a fully referenced GIS can allow the statistical analysis of maps to provide new policy information. For example, planners can carry out all sorts of analysis and relatively sophisticated modelling, based on such items as land use information, site area and environmental data. They can produce sieve maps overlaying such information as constraints (slope, drainage, land quality) to identify developable land; least-cost or least-distance route between two points (either for travel or installing infrastructure); and site development histories, with attendant house type and price details. As in all example GIS applications, the success of such a piece of analysis depends on the system having the correct data to begin with; however, there is evidence to suggest [2] that these sorts of policy applications are rather more common in planning departments than the management of large sets of planning application data referred to above. The reason for this is almost certainly because it is reasonably straightforward and quick to assemble the necessary datasets.

3 The Implementation of GIS in Local Authority Planning Departments

Here, then, are the potential benefits: and the rather more immediate costs; of GIS implementation. But how, in practice, are local planning authorities implementing Geographic Information systems? This question may be answered through reference to the Royal Town Planning Institute's surveys of GIS applications in town planning, which were carried out in 1995 [2] and 2000 [3].

These were undertaken to establish the state of GIS applications in British Planning Authorities. Questionnaires were despatched to all local planning authorities and the replies provided a snap shot in time. The report of the survey was published in 2001 [3]. Essentially, this was an update of a similar survey carried out five years previously [2], and it allowed comparison of situations over time.

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3.1 GIS availability

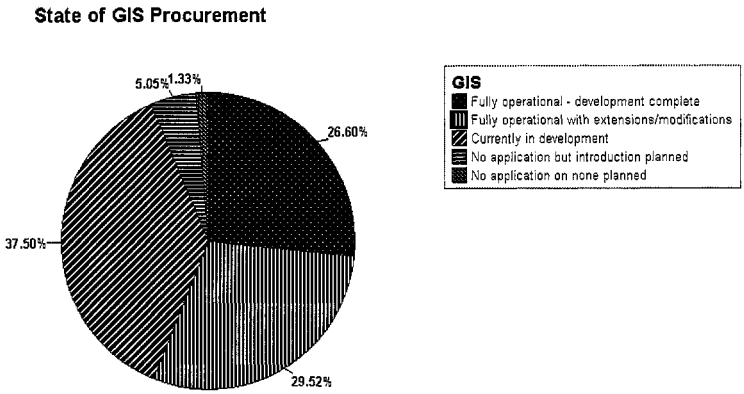

Figure 1: State of GIS Procurement
(Source: [3])

The survey showed that some 94% of authorities had either implemented, or were implementing, GIS. This compares with 64% of authorities in 1995 and indicates that GIS has consolidated its position as a mainstream technology within planning departments. Around 56% of councils considered that they had a fully operational GIS (compared to 30% in 1995). Different considerations of what constitutes "fully operational" may explain the rather modest growth here.

In 1995 there were 8.3% authorities who had no plans to introduce GIS; this figure is now reduced to just over 1%. It is suggested that this reduction may in part be attributed to the increased accessibility and affordability of PC based GIS.

3.2 GIS Hardware

What hardware platforms are councils using for the implementation of GIS?

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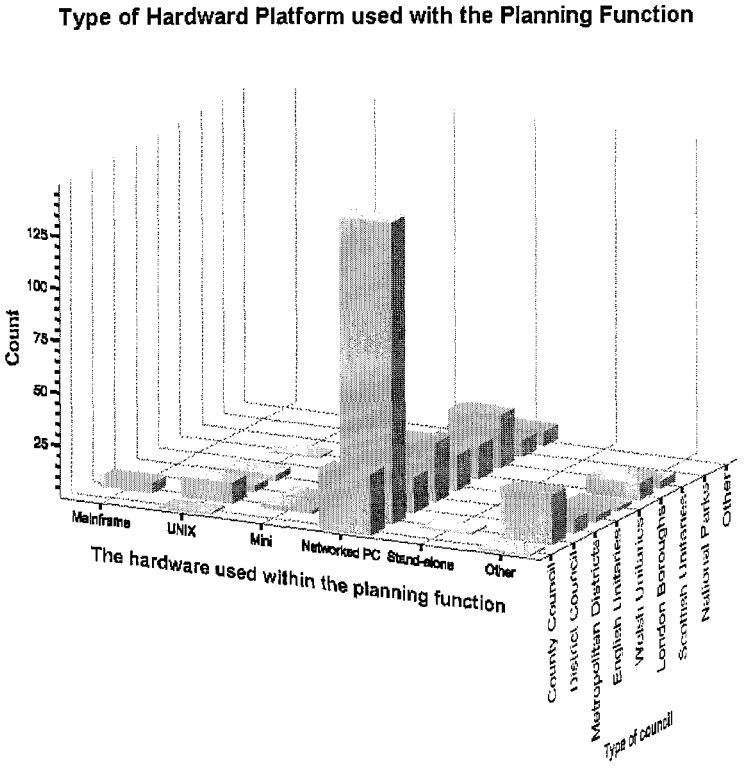

Figure 2: Type of Hardware platform used within the planning function (Source: [3])

Figure 2 and Table 1 show that networked personal computers are by far the most common platforms, and these have grown significantly since 1995.

Table 1: Hardware platforms for GIS

	1995	2000
PC network	50%	79%
UNIX	30%	5%
Stand alone PC	21%	0.3%

There has been a significant decline in the use of both the UNIX platform and stand-alone PCs; there has also been a general shift towards more seats. In 1995, some 70% of systems had five or fewer seats, and 26% only one. Comparison with 2000 data is not straightforward due to the use of different

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categories, but in this year, 54% of systems had ten or fewer seats and 40% between eleven and fifty seats.

3.3 Data and applications

The 2000 survey reports that the key data sets that have been captured are:

- Electoral boundaries
- Listed buildings
- Planning policies
- Scheduled ancient monuments
- Tree Preservation Orders

Some 56% of authorities have either completed, or are engaged in, the capture of Land and Property directories. But there is also a substantial minority (19%) of authorities who have no plans to capture a Land and Property directory.

3.4 Applications developed by Local Planning Authorities

The 1995 survey showed that the principal use being made of GIS was the production of good quality maps (reported by 34% of respondents) with social analysis (23%), planning constraints and thematic mapping (22%) slightly behind.

Map production is also the most significant application in the 2000 survey, but the proportion had risen significantly. Either linked to other applications or stand alone, 83% of authorities have this facility. Only 3% of authorities have no plans for to introduce this application.

The second most frequently cited applications are planning application systems where 68% have a system and another 26% are in development or planned. This is in marked contrast to the situation in 1995, when only 7% of authorities named this as a current application and 9% had plans to introduce it.

Development plan policies and proposals maps are similarly well developed, with 40% of authorities having a fully operational system and a further 54% having an application in development or planned. Similar figures for 1995 were 7% and 10% respectively.

3.5 Conclusion

The trends identified over the years since 1995 point to growth everywhere: in numbers of authorities making use of GIS, in numbers of GIS "seats" within local authorities, and in types of GIS application. It is also relevant to note that the process is not complete; undoubtedly further applications are becoming manifest as authorities acquire GIS skills and recognise the opportunities that are offered by improving technology.

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Opportunities also bring costs, however, and for many authorities these relate to data capture to improve the coverage of existing systems and to realise new applications. Decisions as to the appropriate ways of conducting this have been, and will need to be, made, and there is probably a need for further research here to identify examples of "best practice".

4 The Future Trends in GIS

This overview of the use of GIS in planning, largely in a local authority planning context, has shown the potential of such technology to improve many aspects of spatial data handling. There can be little doubt that the advance of GIS systems has been substantial over the past two decades and will continue in view of falling costs, increasing computing capacity and higher software specifications.

The prospects for the future depend much on improvements of data transfer and on reduced costs and more powerful computer systems.

4.1 Data transfer

Over the early years of the third millennium, efforts to collect spatially referenced data and to make existing data sets available are expected to bring important improvements. Networking is becoming increasingly important and is likely to spur a new drive towards integrated information systems, both within and between organisations. Whereas corporate information systems in the 1970s were not entirely successful because of inflexible, centralised structures, the networked systems of today have the potential to combine local control of operations with universal access to shared data sets. The standardisation of referencing and file transfer formats is increasingly important in view of the technological possibilities of computer communications.

4.2 Technological outlook

Technological developments are likely to focus on improvement and maturation of currently used techniques. Hardware is becoming more locally controlled, and improved use of networking for distributed data transfer as well as distributed processing is set to improve system performance at a faster rate than it increases the costs.

GIS software enhancements are likely to include 3D-capabilities, automated data entry and map-interpretation. This includes feature recognition and error checking. Packages that can build vectors from raster data (and vice versa) have been common for a number of years. Digital maps are cheaply available through the local authority/Ordnance Survey Service Level Agreement.

An integral feature of GIS is that it can only deal with 'hard data', that is areas can only be defined by a exact boundaries. In some forms of spatial analysis, these may not be known or not exist at all. Developments in the field of 'fuzzy logic' and 'fuzzy data', that is, questions that are difficult to answer with a

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definite yes or no will have a range of practical applications in the context of GIS.

As GIS technology has been maturing over the years, more of its advantages have become evident while the difficulties are being dealt with. There can be little doubt that this trend will continue into the future and GIS will hold sway as the rule rather than the exception as an information system for local authority planning departments.

4.3 Management and professional outlook

If GIS is to continue to be utilised effectively then, as the 2000 GIS and IT survey concludes [3], it requires a commitment from individual practitioners to develop and "champion" applications, with the support of senior management, and to disseminate good practice. Planners need to continually ask what GIS can do for them; but it is just as important in the long-term development of the science and its planning interface to ask what they can do for GIS.

With acknowledgements to Stuart O'Callaghan and Alan Markham for their work on the 2000 RTPI GIS Survey

References

[1] Department of the Environment Handling *Geographic Information: the Report of the Committee of Enquiry chaired by Lord Chorley HMSO* 1987
[2] Royal Town Planning Institute *1995 GIS Survey: National Statistical Report* RTPI 1998
[3] Royal Town Planning Institute *IT in Local Planning Authorities 2000* RTPI 2001