THE APPLICATION OF GIS IN CBD PARKING MANAGEMENT

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Abstract: Similar with the situations of many cities in the world, the management of parking demand and supply has been an on going problem. The City of Adelaide has a mixture of business and residential sites and consequently parking in the City is essential in servicing different needs. There are approximately 6000 parking zones serving for almost 20,000 vehicles a day throughout the city consisting of different time limits and restrictions. There are also requests for changes with the parking system from time to time to accommodate various situations (average of 700 zones need to be re-classified each year). In managing such a vast system, GIS Arc Info management system has been developed to suit the particular situation, and it has demonstrated a superior value in the process. The objective of the paper is to provide a brief introduction on the application of GIS in managing parking facilities in the Central Business District (CBD) of Adelaide in South Australia. It discusses the development of the system, advantages of the management database and some interesting features.

1. INTRODUCTION

With the increasing scale and details in transport planning and management, the requirement for creating database and data presentation, in particular spatial based information, has reached a higher level than ever before. The well known, Geographic Information Systems (GIS) based method has provided an excellent platform in planning, managing, quantifying, displaying and analysing geographical transport related information. GIS is the most promising and universally accepted new technologies in the field of decision analysis and data management. It is an innovative means of organising database by geographic area and presenting the information in spatial forms. The use of GIS makes site/area-specified data more accessible and information can be displayed in an easily understood format. In the last few years, there have been many applications of GIS in assisting traffic engineers and transport planners in dealing with complicated transport problems. It has played an important role in planning and decision making process. PC Arc Info and Arc View are members in GIS program family. They can be used to display spatial information, query particular attributes or features and to create new data set based on existing resources of data. One of the applications is to use GIS in managing parking facilities in the CBD of Adelaide.

2. PARKING SUPPLY AND DEMAND IN ADELAIDE

Adelaide - as the dynamic economic, cultural, education, retail and leisure centre, has a population around 1000,000. The City of Adelaide is considered to be one of the best designed cities in the world and was originally designed within a square mile (1600 metres square) with all streets perpendicular to each other. Figure 1 shows the format of the CBD area of Adelaide. The City consists of a suburb named North Adelaide, which is separated from the main city area by natural parklands. The main city square is also completely surrounded by Park Lands, a large oval complex and sports ground a golf course, a horse racecourse, a Festival Theatre, a Museum, an Art complex, Universities, Hospitals, Botanic Gardens and many other facilities. A world class swimming centre is also located at North Adelaide (Adelaide City Council, 1934).

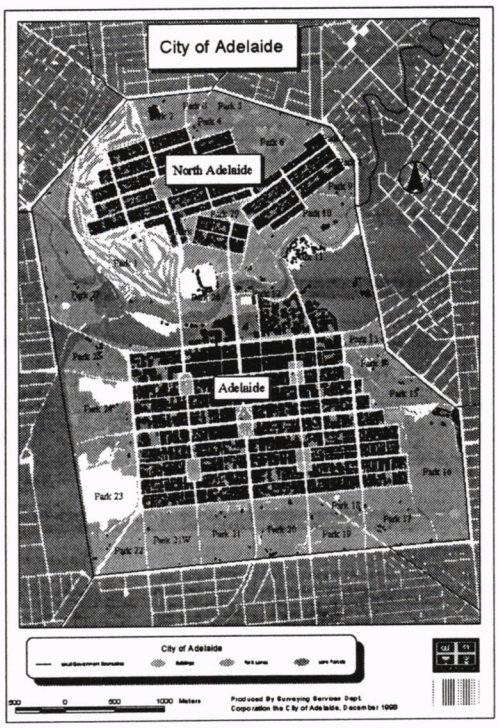

Figure 1 – City of Adelaide

Public transport uses the City of Adelaide as a terminus with all train services and bus services finishing and starting in the city. Public transport also consists of an O'Bahn bus line servicing the city and north eastern suburbs. Suburbia runs north of the city for approximately 30 kilometres and some 40 kilometres south, 10 kilometres west to the coast and 20 kilometres east to the foothills.

Similar with the situations of many other cities in the world, the management of parking demand and supply has been an on going problem. The City of Adelaide has a mixture of business and residential sites and consequently parking in the City is essential in servicing different needs. Some main streets of the city of Adelaide are used as a corridor for

commuters to access the outer city and other suburbs. Approximately 225,000 vehicles pass through the borders of the City of Adelaide each week-day with many commuters stopping to do business and/or shopping in Adelaide. There are approximately 6000 parking zones appointed throughout the city consisting of different time limits and restrictions. These parking zones consist of either a **Parking zone** (time limits), **Restricted Parking zones** (eg. Loading zones) and **Prohibited zones** (No standing zones). On street parking in the city and North Adelaide accommodates approximately 20,000 vehicles and off-street parking in parking stations accommodates a further estimated 16,000 vehicles. Parking in the city needs to accommodate short, medium and long term parking for deliveries, shopping, business needs and workers.

3. THE DEVELOPMENT OF THE PARKING CONTROL REGISTER

Parking management is part of the duties of a Local Government. Local Government consists of a Corporate body who controls the installation, update and maintenance of minor roads. Other duties include running of public institutions such as libraries, car parking stations, swimming centres, approval for redevelopment and the control of vehicle parking. The Corporate body is controlled by a democratically elected Council, known as Adelaide City Council. The Corporation consisting of engineers, planners and other professional people submit recommendations to Council for approval for any major changes or developments of any type within the CBD.

3.1 The Traditional Parking Management Approach

Traditionally, parking management within the CBD is a day to day business. Recommendations - reports and drawings were produced and submitted to the Council for approval. Included in these recommendations for approval by Council is the subject of any on street parking changes such as parking time limits, the appointment of bus zones, loading zones for deliveries to businesses or the appointment of taxi zones. Parking change recommendations are usually supported by investigations such as canvassing and assessing the best parking facilities for all concerned.

The Council has policies such as zoning different parts of the City into residential or commercial areas in conjunction with their planning strategies. For example, if a certain area is zoned residential, then business developments cannot be approved in this area. Therefore, parking zones such as Loading zones would not be approved in this vicinity. Parking within residential areas would usually consist of unrestricted parking, or some time limit parking, residential parking or visitor parking (City of Adelaide, 1992).

For Council members to assess parking recommendations, the Corporation needs to submit reports and drawings to clarify the matter before these changes can be approved. Similar with many large cities, the on street parking is a big issue as it can either assist or restrict vehicles access to businesses or residents. Government, business communities and residents living in the area are often having different views with a similar matter. To achieve a satisfactory result, before Council approves any parking changes, staff members of the Council need to inspect the existing and surrounding areas about on street parking to ensure that these changes are best suited in comparison to other parking conditions. Parking requirements continually change and Council meet once a fortnight to evaluate

these changes. These plans had to be continually changed by hand, tearing off and applying colour adhesive to update the plans. Technically speaking, the traditional process in managing parking within CBD is still workable. However, the process depends heavily on a lot of documentation works – such as producing drawings, preparing reports and site inspections. It is time consuming and not suitable for future working environment. To improve the efficiency in parking management, there is a need to upgrade the traditional method to a modern computerised approach and apply GIS technology in viewing, producing drawings (for before and after changes) and preparing reports.

3.2 The Need to Develop a Parking Control Register

With the constantly updating of land use in the City of Adelaide, the purpose and requirement of parking are changing all the time. The requests for changes with the parking system from time to time to accommodate various situations. On average, there are 700 zones need to be re-classified each year. In managing such a vast system, A GIS Arc Info management systems need to be developed to suit the particular (Adelaide City, 1996).

Apart from to record these changes for enforcement and legalities purposes, upgrading the management system is also a requirement by State Law under the Local Government Act. It requires that all Councils in South Australia "must establish and maintain a register of parking controls imposed within the area of the council". For these reasons, a reliable database must be used to present previous appointed parking zones (up to 2 years), current parking and proposed parking changes (Adelaide City Council, 1991).

3.3 The GIS Based Parking Control Register

In 1981, the Traffic Engineering section of the Corporation decided that the best way to present recommendations to the Council when considering parking changes was to have a colour coded drawing and reporting system to present the details of parking. In this way, overall surrounding parking and environment can be viewed/displayed, and any unique parking to the area would be recognised immediately.

With the use of GIS, council staff have the means to integrate all corporate data onto a spatially referenced database with the underlying spatial framework being the Digital Cadastral Database (DCDB). Not only can spatially referenced data be analysed, overlayed and viewed together but new spatial relationships using proximity and containment functions enable entities such as assets and parking zones to be grouped spatially. Each asset or in the case of a parking register, each zone must be uniquely numbered. Any type of information concerning this type of zone can be linked to this identification number (City of Adelaide, 1992).

As shown in Figure 2, the main cadastral property boundaries are used as the base map to present the surrounding parking details. Different layers can be used to present information for different purposes. This provides an efficient way to locate streets and a particular parking zone under consideration. Some other constraints such as location of fire hydrants (as vehicles are not permitted to park in front of fire hydrants), footpaths, driveway

entrances and Park Land and road boundaries are also part of the features that can be viewed from a GIS based map.

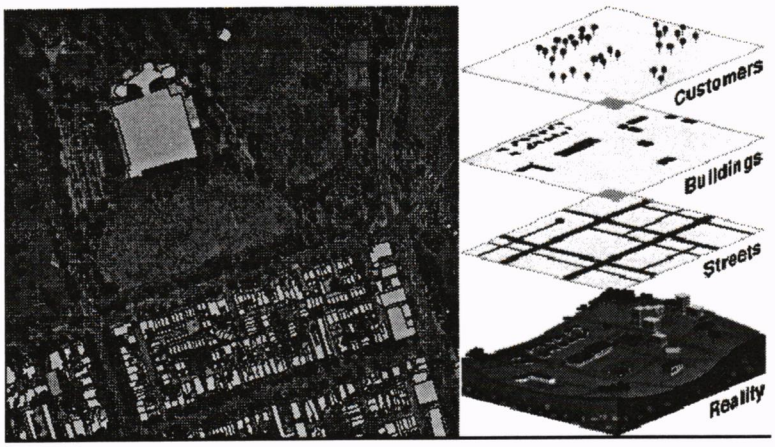

Figure 2 – GIS Display

3.4 The Structure of the Parking Control Register

Like many other packages, the Parking Control Register is a menu driven program – users can follow the menu to edit old parking zones and create new ones. Once a job being done, colour drawings and text reports can be produced. Figure 3 presents a window of the program. Users select the layers and location types to locate a parking zone (left part of the window) and then define the parking zone in the centre part of the window. The parking zone attributes are contained in the right side of the window.

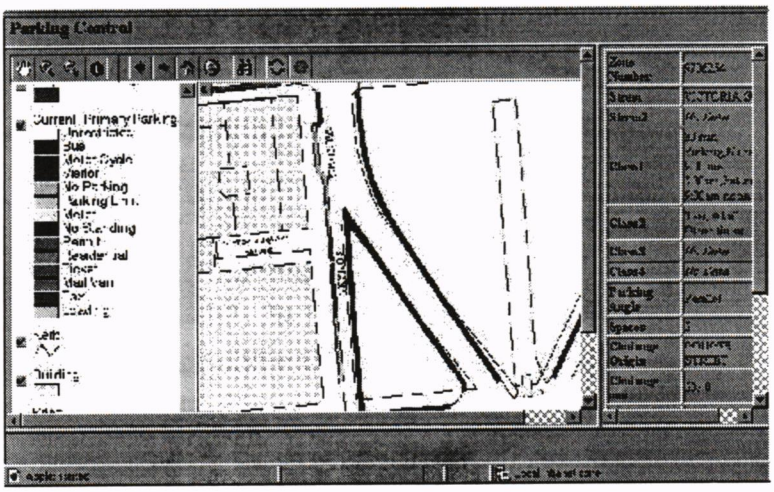

Figure 3 – Working Window of Parking Control Register

The Parking Control Register's update module utilises an event driven approach. The main menu and the edit and layer menu are all active. Other menus such as a utility and option

menu can also be invoked. Users can click on a parking zone and determine its properties. It also can be used by various sections such as customer services. It has enabled customer services to handle queries over the phone rather than pass on to other parts of the organisation.

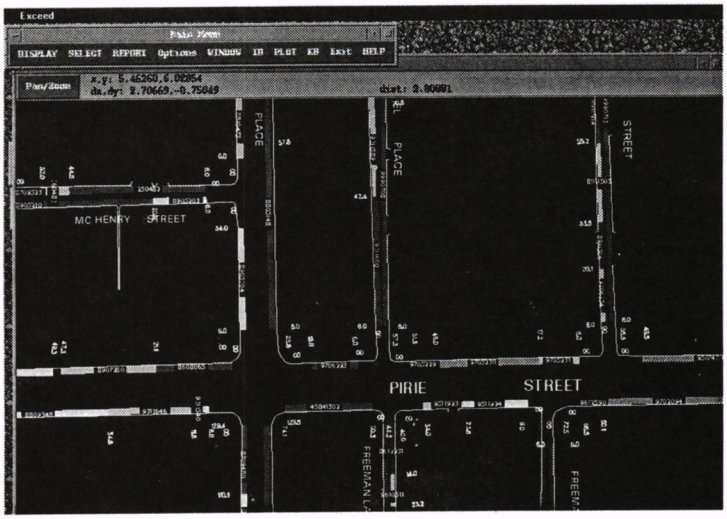

Figure 4 – Location Details of Parking Control Register

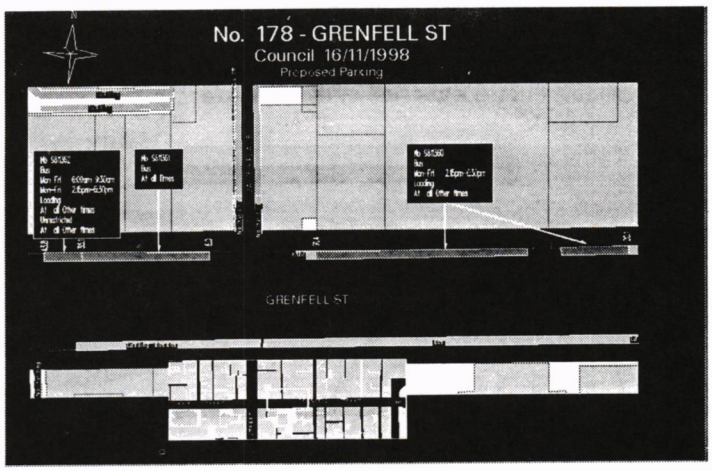

Figure 5 – Parking Zone Details from Parking Control Register

To create a new proposed parking zone, the user needs to copy a section of the database or Map Library (puts transactional lock on that section to avoid lost updates). If current data can be used to create a proposed database then transfer spatial data to the proposed layer, otherwise the zone needs to be created using utilities. Figures 4 and 5 are examples from the Parking Control Register. The following procedures are necessary at this stage:

- Edit zones until satisfactory

- Build proposed zones
- Add attribute data to the proposed zones, ie. Information regarding operation of parking control areas
- Replace section to database.
- Utilise report module to generate report for the Council for approval

If there are existing data on the areas, the process could be simpler. The user needs to:

- Archive current zones
- Import proposed zone from proposed layer.
- Replace section to database

The spatial data are kept in a proprietary database. Attribute data are kept in an Info-database, which is a semi relational database management system. The data structure has the following form as shown in Figure 6.

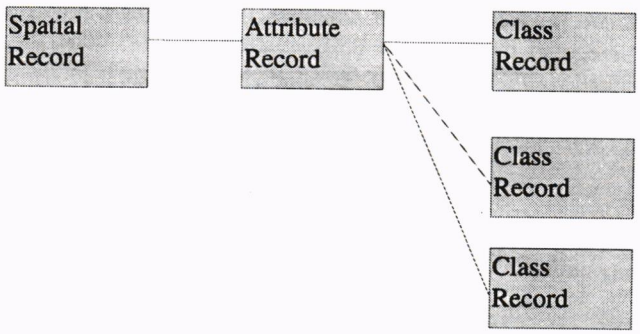

Figure 6 – Database Structure in Parking Control Register

In the Parking Control Register, there is only a one to one relationship between a spatial entity and any attribute data. As we can see from Figure 6, there is a one to many relationships between the attribute data and parking class record. To cater for this separate subsidiary data, tables are maintained and linked to a main table.

3.5 Data Required by Parking Control Register

In 1994, the Parking Control Register was identified as the best available management system used for the City of Adelaide for database. To operate the program, the following data are needed:

- The DCDB was acquired from State Government in a spatial data format. This database is used because it has geographic control components as it is tied into the

Australian Map Grid (AMG) which can be converted to Latitude and Longitude throughout the world.

- The existing old plans had been accurately surveyed and tied into these cadastral boundaries so were digitised onto the data base system.

- Information that was digitised included all kerb-lines, fire hydrants, chainages of where parking zones stop and start, traffic signal lights, street names, pedestrian crossings and road intersection information.

- The different types of parking zones were represented as a polygon, usually in the form of a rectangle. This polygon contained a label to which information can be attached.

- Additional Park Land information was contained by using aerial photography and using additional control points with field surveys done to lock in on the AMG.

- All information concerning these established parking zones was then fed into the label system of Arc Info with each label having a unique numbering system. This numbering system was already operational, so existing numbers could be used to identify each parking zone.

- The zone numbering system works on the current year, current month and the number of zones changed for each year. For example, if the Council body has its meeting in December, 1998, and if this is the 250th change we have done this year, the zone number appointed would be 9812250. This system cannot have a repeat number.

The Parking Control Register was programmed to receive the following information:

- Existing zone number
- Previous zone number
- Date approved by Council
- Street name
- Date installed on street
- Type of parking (Loading zone, 30 Minute parking etc.)
- Times of operation (e.g. 9.00am - 5.30pm, Monday to Friday.)
- Location of start of chainage (e.g. Reference 00 Building line North Street)
- First and second chainage of zone.
- Type of parking (e.g. Angle parking, parallel parking)
- Any other information or description such as type of Permit

To assist with input, much of the requied information was abbreviated. For example, standard signs for parking could be 9.00am - 5.30pm, Monday to Friday and 9.00am - Noon Saturdays abbreviated to time **2**. So by inputting the number **2** under the heading 'times of operation', all this information was input automatically. Similarly, L-Z was abbreviated for Loading zone and so on.

4. THE APPLICATION OF THE PARKING CONTROL REGISTER

Once the existing parking was established, an "Archive" layer and a "Proposed" layer can be established to show both old and new parking changes. All the above information can be individually or group displayed.

In addition to this, other programs were written to extract information from any part of the database at any scale required to produce necessary drawings and reports. Figure 7 show the drawing (before and after change) and a report produced by the Parking Control Register (City of Adelaide, 1997/8).

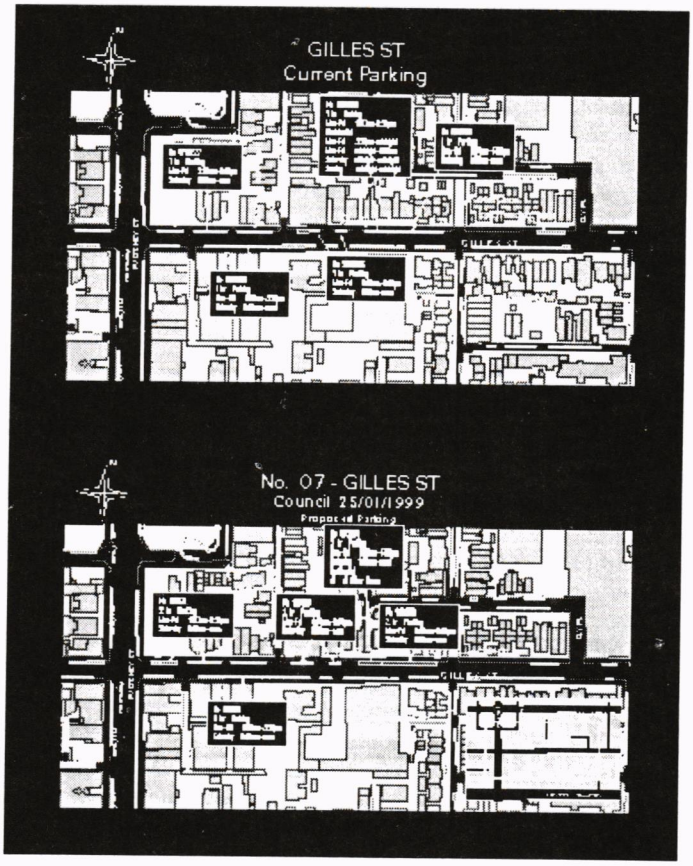

Figure 7 – Drawings from Parking Control Register

From Figure 7, it can be seen that the parking zone is presented in a format with before and after change drawings. The top section of Figure 7 shows the current parking arrangement and the bottom section displays a proposed plan. On both the plans, the detailed location references are identical and the geographical features can be referred to each other. This would provide a clear picture on the changes made with the particular zone/location. Together with the well prepared drawings and reports, the evaluation of the proposals by the Council would be efficient and clear.

Once a parking database is completed, it is a valuable tool for locating and pinpointing all parking zones and information relating to these zones in a short space of time. The program can also automatically extract base sheets produced in colour representing all on street information at a scale of 1:1000. These plans are constantly used when discussing parking matters with concerned parties.

In addition to this, other programs have been developed to automatically extract information from the database showing both "Existing" and "Proposed" parking changes for Council viewing and recommendation. These plans have been set up to include all relevant features such as street names, chainages, operating times etc. so a comparison can be viewed to see what parking currently exists compared to the proposed parking changes. These plans can be produced in a matter of minutes. A full report accompanies these proposed changes showing all other relevant parking.

Once the parking changes have been approved by Council, the drawings and reports are sent to field staff to install on street parking changes. On completion of the update on street, paperwork is sent back to the database input person with dates and times of installation. This information is recorded on the database. With an average turnover of 12 parking changes on street each fortnight, these parking changes take a short time to prepare and update.

5. CONCLUSION

The paper introduced a parking management tool – Parking Control Register. Once the system being established, the database requires an average of 10 hours a week to maintain. The colour coded base plans save considerable time when discussing parking changes in regard to the on street parking. Recommendations on parking changes can often be decided without field checking and it can easily process approximately 400 requests from traders and residents for parking changes each year - considerable time could be saved by using the register.

Although the Parking Control Register has been in use for a few years, it is still in a constant updating process. To take the advantages of computer software and hardware development, a major rewrite is currently under way to the "Update" module to develop a modern user interface. In line with the corporation's policy of preferring "shrink wrapped solutions", ArcView - an easy to use, powerful and flexible PC based desktop package is the preferred solution for enquires. It is intended that the inquiry interface will be modified to generate hard copy output only. This takes advantage of ArcInfo's superior plot generation capability. Another dimension of development is also attempting to enable the Parking Control Register at network level. Utilising ArcView and an Internet Map Server, the Corporation publishes interactive maps of the Parking Control Register on the

Corporation's Intranet. Any staff member can now access data regarding a parking control zone. It has been of benefit to the Customer Service centre - they now can answer some calls regarding parking instead of relaying them to other departments.

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