Local Government Spatial Information Management

Module 7
Guidelines for Selecting Spatial Information Systems Software and Hardware

Building capacity for integrated spatial information management solutions

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A joint initiative of the Australian Local Government Association and ANZLIC—the Spatial Information Council
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MOD U LE 7
Guidelines for selecting spatial information system software and hardware

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Guide for managers

Context
Councils are experiencing increased demands on their budgets to support information technology software and hardware, including the need to establish and maintain good databases of spatial information in digital format. Access to reliable and up-to-date information reduces uncertainty in planning and management by helping to identify, model and analyse situations and issues. Strategies to overcome such issues may then be prepared and implemented, with the impacts monitored as part of an overall system. The value of the information and the effectiveness of the decision-making and planning processes are very closely related to the quality and completeness of the information and the manner in which it is made available. In this respect, data access, management, integration, analysis and communication are key components of effective spatial information management.

For the purpose of this Toolkit, spatial information systems include geographic information systems (GIS), image-processing applications for raster data (e.g. satellite images and aerial photographs) and spatially enabled databases.

Module 7: Guidelines for selecting spatial information software and hardware provides general material to assist councils in selecting appropriate software and hardware, with an emphasis on spatial applications.

Actions
Managers need to make judgments and decisions when selecting new spatial information systems software and hardware, upgrading existing systems or evaluating whether to change to systems provided by different vendors. This guideline provides information to assist in making such decisions.

When choosing spatial information systems software, managers need to ensure that the selected software covers the range of functionality and applications required by the council. It is important to understand the context, and not be influenced by the loudest voice. If in doubt, get additional help.

It is also important to remember that spatial information system software and hardware are parts of an integrated information management solution, and therefore need to be considered in relation to other components (e.g. other software, procedures, standards and protocols) designed to provide ready access to data and information, and support leading practice procedures. Consequently, councils are encouraged to purchase software products that are fully compliant with OpenGIS® specifications, enabling them to interoperate with other council information systems.

Leading practice guidelines and standards are available to assist in the design and evaluation of spatial information systems. Checklists and templates are included in this guideline to assist in selecting new systems, upgrading existing systems or changing systems providers.
Acknowledgments

This module draws heavily on material from Harmon and Anderson [2003]18. Material in this module has also been sourced from Spatial Knowledge Engineering (SKE, Inc. www.skeinc.com); Peter Thorpe Consulting http://www.planweb.co.uk/tip1.htm); and the Point of Beginning Magazine website (http://www.pobonline.com). These sources are duly acknowledged.

Guide to symbols

The following symbols are used throughout the Toolkit to draw attention to important issues and information.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>✴️ <strong>NOTE!</strong></td>
<td>Information of which readers should take particular note</td>
</tr>
<tr>
<td>⭐️ <strong>LEADING PRACTICE</strong></td>
<td>Leading practice information</td>
</tr>
<tr>
<td>🔥 <strong>TIP!</strong></td>
<td>Tips for readers, based on experience and aimed at saving time and other resources</td>
</tr>
<tr>
<td>⚠️ <strong>CAUTION!</strong></td>
<td>Caution—readers should take particular care, or the issue may be complex</td>
</tr>
<tr>
<td>🏅 <strong>HIGHER CAPABILITY</strong></td>
<td>Capability raising—shows a signpost to a higher capability level</td>
</tr>
<tr>
<td><strong>Bold Text</strong></td>
<td>Bold Text—highlights an important issue</td>
</tr>
<tr>
<td>✉️ <strong>Boxed Text</strong></td>
<td>Boxed Text—highlights issues specifically related to ANZLIC or ALGA</td>
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</tbody>
</table>

7.1 Introduction

In any organisation, including councils, it is important that software and hardware are selected and upgraded based on the range of functionality and/or applications needed by the organisation, rather than the imperatives of an individual or a small group.

In recent years there has been a proliferation of spatial information systems software, accompanied by an ever-increasing capacity and range of functionality, making selection decisions more complex.

In any selection process, it is important to remember that a spatial information system is more than a collection of software and hardware. Rather, the system is an integrated information management solution that includes data, personnel, procedures, standards

and other elements. Software and hardware need to be considered in relation to the other components. This will enable implementation of a system that provides ready access to data and information, and will support leading practice procedures (see Figure 7.1 and Module 1: Spatial information management in local government). In fact, the other components may be weighted heavily among the criteria used in selecting a solution.

**FIGURE 7.1** Schematic illustration of an integrated information management solution

This focus on usability in current information management systems is expressed succinctly in the text box below.

**TODAY:** Intuitive interfaces, intranet and web-served data in neutral formats allow data and spatial data services to be readily accessed across the organisation, resulting in reduced barriers and enhanced decision-making processes.

**YESTERDAY:** The task of dealing with spatial data within an organisation or group was often the domain of experts who worked with complicated high-end technology that dictated business processes, instead of facilitating and supporting the organisation’s information needs.
When developing an integrated information management solution, it is important to recognise that there will be a range of different user groups. The user groups will include general, technical and analytical users, with different needs, expectations and expertise. One spatial information management system can serve all these groups, as shown in Figure 7.2.

Spatial information is now widely accessible, due to the use of web-based online mapping viewers with simple-to-use toolsets. Councils can readily share information internally and externally, presenting information to the public through the internet. Significant functionality is available without the need to load complex software, and can include a suite of tools to query, layer control, identify, zoom, pan and print the spatial data. The range of software available can be used by a variety of different users for various applications.

Similarly, developments in hardware, networks and internet technologies mean that it is now feasible to have spatial information system applications delivering real-time data and web services that can operate on a wide range of hardware systems. These include large mainframe computers and workstations (less common), desktop computers (very common), notebooks, hand-held devices (e.g. PDAs, integrated mapping/GPS units) and even mobile phones and car navigation systems.
Decisions on new systems or upgrading existing systems should always be based on the needs of the organisation or group. When selecting spatial information system software, councils should focus on:

→ functionality and applications identified as part of a needs assessment (a requirements analysis)
→ the hardware needed to run the software
→ operating systems, based on the software products and hardware, and the standards that have been developed as part of the council’s data policy.

Ensure that the council’s spatial information system procurement process is driven by documented and justified business needs, under a funded and endorsed plan for system procurement and implementation. As a guide, use the selection checklist (Section 7.4), criteria (Section 7.5.7) and tips (Section 7.5.8).

### 7.2 Guidelines for acquisition

Individual councils may already have specific procedures and policies for acquiring software, hardware and communications technologies, in addition to their usual procurement process. Useful information can also be drawn from government departments. For example, see the *Acquisition of ICT Guideline* published by the Office of Information and Communications Technology in the NSW Department of Commerce, available at [http://www.oit.nsw.gov.au/docs/ICTAcquisition.pdf](http://www.oit.nsw.gov.au/docs/ICTAcquisition.pdf).

### 7.3 Elements to consider when selecting software and hardware

When making a purchase decision, it is worth keeping in mind a number of elements, including the following:

→ ensure that the product has a proven record in the marketplace
→ avoid outdated products that are no longer supported, and/or have not adopted recent open standards
→ avoid unproven products [the ‘bleeding-edge’ technologies]
→ ensure that good support mechanisms are available, including manuals, training material, online help and technical support from vendors
→ ensure that staff with appropriate skills are readily available to ensure smooth implementation, as developing or employing specialist staff with spatial information systems skills is expensive in terms of both cost and functionality
→ ensure that the product has the appropriate functionality to suit existing and planned needs for the council, including being sufficiently rugged for field based use as necessary (e.g. mobile devices).

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19 Now the Government Chief Information Office.
Conduct formal, documented system audits, including user reviews and alignment of spatial information systems to the support of core business, when examining system development or replacement.

The outcome of this analysis should be a structured business case justification incorporating such elements as Total Cost of Ownership models.

### 7.3.1 Evaluating software and hardware

**TIP!** The key to selection is to fully understand user or organisational requirements and capability and to choose a product that matches.

The main criteria for consideration when evaluating software include functionality, performance, scalability, licensing and standards.

**Functionality**

*Functionality* is the ability of the product to perform required tasks, in a simple and straightforward manner. Two key elements of functionality are usability and adaptability.

There have been significant recent advances in functionality, such as the development of easy-to-use graphical user interfaces (GUIs). In early versions of spatial information systems software, most activities were command driven, requiring users to type commands into the system to execute tasks. Users needed to be familiar with a suite of command functions. This partly explained the frequent isolation of GIS technical staff within organisations.

Most software packages now incorporate a standard Windows-type GUI, with menus and toolbars. Functionality is enhanced, with consequently reduced need for user training and improved user access to spatial data.

The introduction of Windows-based or internet browser-based interfaces coincided with increases both in the tools available on many systems and in system functionality. As a result, the learning curve for users of most professional-level spatial information systems is still quite steep. It is this factor, along with the demand by casual users for access to spatial data on their desktops, that has seen the development of many web map viewers with deliberately limited functionality. Those viewers, which are often low cost or even free of charge, generally have functionality limited to more common needs, such as simple queries and pan, zoom and layer control.

**TIP!** If spatial information system software is to be used by novices or those unfamiliar with computer technology, it is important that the software has a simple and easy to use interface.

Aside from the usability aspect, functionality also includes the ability of the software to be customised using industry-standard programming languages. Many systems have adopted the Visual Basic programming language as a development language.
The degree to which spatial information systems can be customised varies from product to product. Systems might be designed as:

→ stand-alone applications designed to meet a specific need (often called ‘custom’ applications) and developed using specific programming tools
→ large, professional-level spatial information system applications with internal programming functions
→ entry-level applications designed for simple viewers.

Entry-level applications cannot be customised and are effectively ‘locked’. They are designed to do a simple task and do it well.

**TIP!** The key to selecting software is to fully understand user needs and choose a product that matches those needs. To assist this process, a list should be developed detailing the functionality required for each user group that will be accessing and using spatial data from the system. That information can then be used to produce a matrix, which can be used to compare user requirements with available products for each functionality issue.

Once user requirements are clear, each council will use its normal procurement policies and procedures, guided by expert technical advice from sources such as the guideline noted in Section 7.2.

Where those policies allow, it is recommended that software vendors demonstrate their products’ ability to perform the tasks or functions required by each user group identified in the needs assessment. Alternatively, or additionally, the council could seek information from other groups currently using the software to meet similar needs. Section 7.5.7 provides a draft list of criteria to consider when selecting spatial information system software.

**Performance and hardware requirements**

The *performance* of software applications is governed by their design and engineering at the programming stage, and the speed and configuration of the hardware and networks they are running on. Good software applications make full use of the available hardware resources, such as dual processors and high-end graphics cards.

Most spatial information system software offers more than simple viewing capabilities, such as added functionality to perform overlay, analysis and modelling tasks. This makes the software very complex, requiring large amounts of computer resources to operate efficiently. Performance of the software application can be significantly affected if an appropriate level of system resources is not available, so care is required to ensure that the operating capability and capacity of the central processing unit (CPU), speed, memory, graphics display card and disk type are optimised. The system will only operate as efficiently as the weakest link in this framework.

Most software vendors, particularly larger companies, provide minimum and recommended specifications for hardware and often publish them on their websites. Performance information is also available on vendor websites for individual components, such as graphic cards.

It should be noted that minimum specifications often refer to the absolute minimum requirements to run the system and therefore may not yield good performance.
Given that hardware technology changes rapidly, care must be taken that the specifications listed are not out of date. Most software vendors will supply up-to-date specification recommendations on request.

**Scalability**

*Scalability* is the ability to increase the functionality and/or capacity of the spatial information system applications by expanding, migrating, upgrading or ‘adding on’ more or improved functions to the base implementation, in an ordered and structured manner.

Key aspects of scalability include the following:

- Scalability should match the needs and skill levels of the council and align with its business objectives.
- The system should have the ability to incorporate additional functionality that may be required in the future.
- The system should have the ability to communicate seamlessly with other programs via connections or interfaces.

Most software vendors are constantly developing and changing their products to provide increased functionality in a competitive market. Spatial information system software is no exception. New releases, updates and patches are continually being released.

Many of the major spatial information systems and image-processing software companies provide a suite of software as part of an overall family. It is possible to purchase a base version of the software, which can then be augmented by the purchase of additional modules, often called ‘extensions’ or ‘add-ons’, to provide increased functionality. The ability of software vendors to offer a functionally scalable product enables users to streamline their software purchases and installations to match their business needs.

Most large integrated information management solutions have a number of software products that communicate and share data. To support scalability, some software vendors have implemented special software licensing systems in which licences can ‘float’ within a network to enable individual users to access increased functionality on a temporary ‘as needed’ basis. These are called ‘floating’ or ‘concurrent’ licences.

Scalability also includes the capacity to increase the number of users of the base version of the system.

**Licensing**

Most software programs available on the market are sold subject to licensing agreements that detail the terms and conditions of use. There is commonly a one-off licence fee included as part of the purchase price. Suppliers of the more popular products also offer maintenance programs as part of the licensing agreement, entitling users to free or reduced-cost upgrades and new versions as they become available.

In earlier releases of most programs, the standard licensing agreement licensed the software to a particular machine. These were known as ‘single-seat’, ‘stand-alone’ or ‘per-CPU’ licences. More recently, the increasing scalability and functionality of software has resulted in more complex licensing agreements, such as the floating or concurrent licences noted above. Such licences commonly cover the base version and, in some cases, extension or add-on components that can operate simultaneously on the computer system.
To achieve this functionality, some major spatial information systems and image-processing software companies use a separate licence manager program to administer the use of separate software applications through an organisation’s network. This allows larger organisations with many infrequent users to use fewer licences than they would if they were required to install a stand-alone licence on each computer.

**TIP!** It is recommended that the council discuss licensing requirements with vendors to ensure that software purchases are appropriately licensed for both immediate and planned future needs.

**Standards**

As discussed in Module 4: Spatial data priorities, standards and compliance, integrated information management solutions depend on the use of standards for aspects including metadata descriptions, file-naming and directory structure conventions, and data storage formats.

Standards are also important in software. For example, the proposed spatial information system should be compatible with the operating system and standards used in the council (e.g. UNIX, Windows NT/95/98/2000/XP/Vista, MacOS, Linux).

Further, the software should be able to recognise data formats used in other computer systems. Many spatial information system and image-processing applications have unique file formats. This used to mean that the data exchange and transfer protocols were necessarily precise and application-specific. More recently, most major packages—while still having their own unique native formats for raster, vector and data attribute information—have the ability to import, export, read and write data in many other formats.

This is not to say that data formats are no longer important: they are, especially given increasing interoperability. More detailed discussion on interoperability (the ability of different computers and systems to communicate, and to share or access data) and open data standards is in Module 4.

In local government, information management systems may include those used for:

- rating management
- document management
- financial management
- development and other application processing
- asset management
- environmental management and monitoring.

In this respect, it is important to be aware that standards groups in Australia are currently very active in the development of standards in collaboration with their counterparts overseas. The Open Geospatial Consortium (OGC) is one such group [see http://www.opengeospatial.org/]. The OGC is an international industry consortium, currently comprising 339 companies, government agencies and universities, participating in a consensus process to develop publicly available geoprocessing specifications.

According to the OGC, open interfaces and protocols defined by OGC specifications support interoperable solutions that ‘geo-enable’ the web, wireless and location-based services and mainstream IT, and empower technology developers to make complex
spatial information and services accessible and useful with all kinds of applications. Most of the major spatial information system and image-processing suppliers are members of the OGC, thereby ensuring that their software complies with industry standards.

The work of the OGC has also played a part in the development of international geographic information standards by the International Organization for Standardization (ISO), published in the ISO 19000 series. Many software companies are now including ISO standards in their products. Councils are encouraged to purchase commercial-off-the-shelf software that is fully OpenGIS® compliant and meets the relevant ISO standards, to enable interoperability with other council information systems at minimal cost.


### 7.3.2 Steps in choosing software and hardware

#### Evaluation team

The first task when choosing software for a council is to establish a tender or bid evaluation team that represents a cross-section of technical, general and casual users in the council. The team should include motivated staff who are able to make decisions on behalf of the work area they are representing.

#### Development of a specification document

The second step involves preparation of a detailed specification document, covering matters such as functionality, scalability, licensing requirements, performance, delivery timeframe, maintenance and support requirements, and standards, as described in Section 7.3.1. Consideration also needs to be given to:

- capacity building, to ensure that adequate skills are available to implement the system
- the range of products and services the system will be required to deliver or undertake.

**TIP!** The council should consult widely when preparing the specification document. Valuable information can be gained from:

- other councils, particularly those of similar size or with similar functional requirements
- relevant state or territory agencies
- industry groups
- consultants
- multiple vendors.

Note that vendors obviously have a vested interest in their products, and in some cases this situation also applies to consultants. If engaging consultants, ensure that they are objective and free of any vested interest. For additional information on choosing and managing consultants, refer to Module 8: Raising capability for use of spatial information.
Development of a procurement approach

Each council will have its own policies and procedures for the procurement of goods and services. Procurement and tendering requirements should be discussed with the council’s purchasing staff and/or senior management in the process of developing a procurement approach. There are often clearly defined council-specific legal and probity issues that must be addressed.

**CAUTION!** The exact method of the tendering and selection of software and hardware will be determined by the council’s procurement policies and procedures. The council’s purchasing section should be consulted before embarking on a software or hardware purchasing process. It is a good idea to define the procurement process, before the details of the system requirements are defined in the specification.


Factors that influence the procurement approach may include value thresholds. For example, procurement of goods and services over a certain limit may require a certain number of written quotations (often called a Request for Quotation, or RFQ). Higher thresholds may trigger open tendering, with advertisements placed in newspapers or online (often called a Request for Tender, or RFT).

Alternatively, a Request for Proposal (RFP) may be prepared. This approach is often adopted in situations in which a number of software programs might potentially fulfill the requirements detailed in the specification. Companies are asked to submit a document outlining their proposed approach, experience, fees and supply timeframe. In some cases, vendors are provided with actual council spatial data and asked to provide working solutions to predefined issues and problems. This tests the proposed systems.

**TIP!** Note that there may be opportunities for collaborative purchasing arrangements with other councils through local government associations or other arrangements.

Development of an assessment matrix

A matrix can be developed to assess software packages against the specification. This will provide a clear overview of the options. An example of a set of criteria used for selecting spatial information system software is in Section 7.5.7.

In designing the assessment matrix, leave room for evaluating intangibles (for example, see the methods used for the CB-90 process in Section 6.4.2 in Module 6). Non-cost factors relating to functionality may include:

- availability of skilled staff in other nearby councils or state/territory agencies
- skill and availability of an in-house GIS group
- skill of the service provider.
Evaluation

The procurement policies and procedures of the council will dictate the approach used in the evaluation of the system supply options. The council may go through an intensive formal process or use a simpler approach. For example, the council may decide to proceed directly with a purchase, based on the assessment matrix and recommendations from consultants or others. Alternatively, the council process may require the recommendation of a selected option, and subsequent endorsement or approval of that recommendation by one or more committees.

In cases where more than one company may sell the same software, it is possible to ask them to bid on the cost of supplying the specified software. It is important to note that installation, training requirements and ongoing technical support need to be considered.

Some key questions to ask when evaluating vendor or company quotes and submissions include the following:

- Do they have a demonstrated understanding of the applications and needs of local government, and of this council in particular?
- Are they able to clearly articulate what they are going to do, by when, with what and to what standard?
- Do they have proven experience in providing similar services to councils or similar organisations?
- Are they able to meet the proposed timeframes?
- What allowance have they made for contingencies, in terms of time, cost and availability of any necessary skilled staff?
- Have they recommended a solution that matches the council's budget?

Benchmarking

Benchmarking involves testing the ability of a proposed software system to perform a number of specified tasks and then comparing the results with those from the testing of other software systems. In such cases, data and information are often provided to suppliers and they are given a set amount of time to undertake the tasks.

Final decision

The process used to reach a final decision will be in accord with the usual procurement policies and procedures of the council, perhaps influenced by the complexity of software system decisions. In some cases, a two-phased process is used, in which evaluation team members assess the competing bids independently and then meet to reach a collective decision. A second option is to assess the competing bids as a group and to reach a consensus. Either way, the evaluation team should be certain that:

- The chosen system meets the specifications
- The purchase fits within the council's short- and long-term budgets for the system
- The selection was made in accordance with the council's procurement policies and procedures.
## Checklist for selecting spatial information system software

General tips and tricks for selecting and implementing spatial information systems are included in Section 7.5.8. Below is a checklist of issues that need to be addressed when selecting spatial information software.

| **Does the council need a spatial information system or a mapping package?** If so, what scale or type—e.g. simple desktop viewer, professional workstation, custom application? |
| **Cost.** Hardware and software requirements (including ongoing maintenance). |
| **Type of operating system that will be used** [e.g. Linux, Unix, Windows, Mac]. |
| **Format requirements.** Ability to handle raster (pixel data), vector (point, line, polygon data) or both formats. |
| **Support.** Is the council going to be able to get help if there are problems? How will it get that help, and how much will it cost? |
| **Complexity/personnel resources (including staff and training).** For a beginner, it will be important to have a user-friendly spatial information system (i.e. one with an easy-to-understand GUI). Ensure that budget funds are available for initial training and continued capacity-building activities for both technical and non-technical users of the spatial information system. |
| **Company, agency or organisation requirements (general and specific).** Develop a needs assessment. Can specific benchmark requirements be met? Does the software fulfill a variety of needs? Does the system have the functions needed? |
| **Reliability of system and vendor.** Will they be around for the next ten years to service equipment and provide technical support? |
| **Scalability, maintenance and upgrading.** Does the technology have an update or production development program? Does it offer a migration path or suite of options? Will the council need to buy add-ons, and are they available? |
| **Support material.** Is there a pool of people locally or within the council that uses the proposed spatial information system? If so, will it be possible to get help from more experienced users? Capacity building is one of the most important aspects in the successful implementation of a spatial information system. |
| **Maintenance and licensing.** What maintenance and licensing options are available? |
| **Interface with other software used and interoperability.** Will the proposed software interface well with other software the council is using? For example, between computer-aided drafting, mapping, image-processing and database applications, web systems, web services, mobile mapping systems, etc. |
| **Open system support.** Does the software support or accord with the Open Geospatial Consortium specifications, the World Wide Web Consortium standards and the Australian Spatial Data Infrastructure standards (as reflected in the National Interoperability Framework initiative)? |
7.5 Additional support

Considerable resource materials exist that can support the process of selecting GIS software. For example, many spatial information industry newsgroups and magazines often review particular software products, in some cases providing cross-functionality comparisons. It is important to undertake an objective process that is guided by organisational need and not rely on vendor brochures.

The following list provides links to some available sources, but is not meant to be exhaustive. Note: the inclusion of individual organisations does not in any way promote a particular product.

7.5.1 GIS procurement


7.5.2 Choosing a GIS


7.5.3 Product reviews


7.5.4 Software surveys


Note: the 2006 software survey results and many other resources are available from Point of Beginning at http://www.pobonline.com/.

7.5.5 Free software viewers and data conversion tools

A number of free viewers and software applications are available over the internet. Free applications and reviews of functionality and file formats are available from:
→ Grime: http://www.grime.net/gistools/

7.5.6 Support on system upgrading

### 7.5.7 Criteria for selecting spatial information system software

The following criteria are based on those on the Point of Beginning website; they provide a template for assessing GIS functionality requirements and software products. For additional information on software features, refer to http://www.pobonline.com.

#### SOFTWARE FEATURES

<table>
<thead>
<tr>
<th>Program name</th>
<th>GIS X</th>
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<tbody>
<tr>
<td>Manufacturer/distributor</td>
<td>Company X</td>
</tr>
<tr>
<td>Cost per seat</td>
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</tr>
<tr>
<td>Date of first release</td>
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</tbody>
</table>

#### SOFTWARE FEATURES

**Operating system/network support**
- Network client/server support
- Server operating system
- Client operating system
- Internet server enabled

**GIS data administration**
- Multi-user edit locking
- Versioning
- Metadata maintenance

**Database management**
- Proprietary DBMS
- Relational database management system
- RDBMS spatial data warehouse
- OODBMS spatial data warehouse

**Native Graphic Data Structure and Format**
- Vector spaghetti
- Vector topological
- Parametric
- 3-D
- TIN
- Grid
- Raster image
### Interoperability and open standards compliance
- Read WMS data
- Publish WMS data
- Read WFS data
- Publish WFS data
- Interface with other organisational systems [AM/FM/SCADA/Enterprise systems]

### GIS data import/export utilities
- Direct import formats
- Direct export formats

### GIS data entry and editing
- Board digitising
- Coordinate geometry/precision entry
- Electronic survey data import

### Software Features
- Heads-up digitising
- Vectorisation/rasterisation
- Map rectification
- Graphic error check/correction
- Field data entry

### Map design and composition
- Interactive map composition
- Annotation from attributes
- Global symbol change
- Thematic mapping

### Geographic query and analysis functions
- Attribute query and selection
- Map measurements
- Address matching
- Buffer generation
- Point/line-in-polygon analysis
- Polygon overlay
- Network analysis
- Raster document query and access
- Direct access to other GIS format
Terrain data processing and analysis
- Digital elevation model (DEM) generation
- Contour map generation
- 3-D display/profile generation
- Map draping
- Slope/aspect analysis

**Raster image capabilities**
- Geometric rectification
- Orthoimage generation
- Image enhancement
- Spectral classification

Application development language
- Proprietary application development language
- Industry standard programming environment

Summary of GIS software features

<table>
<thead>
<tr>
<th>SOFTWARE FEATURE CATEGORY</th>
<th>EXPLANATION</th>
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<tbody>
<tr>
<td>Geographic data management</td>
<td>Database administration tools for managing data access by users, locking of data during edit and maintenance of metadata.</td>
</tr>
<tr>
<td>Tabular attribute data management</td>
<td>Software environment and capabilities for storing and managing database attributes linked to map features in the GIS database. May involve use of a vendor-proprietary system for attribute storage or a commercial relational database management package.</td>
</tr>
<tr>
<td>GIS data import/export utilities</td>
<td>Utility programs bundled with the GIS package for translation of GIS or CAD data to or from another format, including common industry-standard formats such as SHP, DXF, SIF, DLG, SDTS, GRID, ASCII.</td>
</tr>
<tr>
<td>GIS data entry and editing</td>
<td>A range of interactive and batch processing functions for entry of map data through such means as board digitising, coordinate geometry entry (COGO), scanning and heads-up digitising, along with capabilities for editing GIS data, performing error checking and resolution, map rectification and transformation of coordinate systems and map projections.</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Map design and composition</td>
<td>Interactive capabilities for the design of map plots and displays, automatic creation of thematic maps and legends, and modifying map symbology and annotation for custom map displays.</td>
</tr>
<tr>
<td>Basic geographic query and analysis functions</td>
<td>Basic tools for performing attribute or map-based queries and displays, basic distance and area measurements, query and access to scanned documents, buffer generation, polygon overlay operations and other query and analysis functions.</td>
</tr>
<tr>
<td>Network analysis</td>
<td>Spatial analysis operations based on linear networks (e.g. road or pipeline systems), including operations such as the shortest path tracing and region allocation. Network analysis capabilities in GIS packages often allow users to design network models based on attributes of network segments.</td>
</tr>
<tr>
<td>Terrain and 3-D data processing and analysis</td>
<td>Capabilities for storing three-dimensional data normally in a grid or triangular integrated network (TIN) format with functions for 3-D analysis such as contour mapping, 3-D display, draping of map features over a 3-D display, slope and aspect analysis.</td>
</tr>
<tr>
<td>Raster image processing capabilities</td>
<td>Capabilities for the manipulation and processing of raster images (e.g. digital aerial photos or orthophotography, satellite images), including functions for the import and rectification of raw imagery, digital image enhancement and automated classification of multi-spectral imagery.</td>
</tr>
<tr>
<td>Application development languages</td>
<td>Programming environment for customising applications accessing software functions provided by the package, including proprietary languages included with the GIS software package or industry-standard tools (e.g. C++, Visual Basic, Delphi) that may be used for application development.</td>
</tr>
</tbody>
</table>
7.5.8 Tips and tricks for selecting and implementing a spatial information system

The following list is a summary of the ‘tips and tricks’ presented by Peter Thorpe (Peter Thorpe Consulting) at the United Kingdom Royal Town Planning Institute’s [Planning and Environmental Training] GIS Selection and Implementation Conference at the Cavendish Centre, London on 19 April 1996 [Source: http://www.planweb.co.uk/tip1.htm].

**SELECTING**

1. First develop a vision for how the GIS will support the business priorities, then fill in the details of the requirements.
2. Focus on the key requirements, not on the GIS technology.
3. Decide the overall shape of the GIS procurement at the outset—Map management? Full GIS? Integrated systems such as Development Control? Land and Property Gazetteer? Links to databases such as Census? Links to existing council systems such as Land Charges?
4. Identify the first ‘showcase’ project so as to ensure high visibility and maximum chance of successful implementation.
5. Get commitment from elected members, chief officers and senior managers.
6. Refine the requirements through supplier demonstrations and visits to councils that are active in GIS—but don’t get deflected from the priority needs.
7. Review the relevant Australian and international standards and put in place ‘home grown’ standards for the geographic data ['streets', 'properties', 'addresses'].
8. Consider the council’s GIS functional specification—but treat it with healthy suspicion and don’t use it indiscriminately!
9. Structure the Invitation-to-Tender to ease direct comparison between suppliers—if possible in a way, that can be quantified.
10. Call the tune in assessing suppliers and ensure that presentations, demonstrations and benchmarks are carried out to rules that the council defines.

CONTINUES OVER THE PAGE
IMPLEMENTING

1. Set ‘benefit targets’ in advance as the challenge for implementation.
2. Hand pick the Project Leader [skills in GIS, people management and trouble-shooting equally important].
3. Dedicate adequate resources (human and financial) within the Project Team.
4. Keep alive a detailed Implementation Plan and use it rigorously as the basis on which to monitor progress and take corrective actions.
5. Don’t skimp on training, which is a fundamental investment without which the project is unlikely to succeed.
6. Treat geographic data as a major corporate asset and put in place procedures to ensure standardised definitions, responsible ownership and quality.
7. Maintain the support of chief officers and members in order to underpin ongoing success.
8. Exploit the opportunities for new ways of working that GIS can offer the council.
9. Promote the successes and achievements accruing from the implementation of GIS, in order to sustain and justify continued commitment.
10. Keep it all under review because things never stand still [vision, strategy, implementation plan, benefits, future direction]!

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Acronyms

ACRES  Australian Centre for Remote Sensing
ADAC   Asset Design and As Constructed
AGD    Australian Geodetic Datum
ALGA   Australian Local Government Association
ANZLIC ANZLIC—the Spatial Information Council for Australia and New Zealand
ASDD   Australian Spatial Data Directory
ASDI   Australian Spatial Data Infrastructure
AS/NZS Australian Standard/New Zealand Standard
CAD    computer assisted design, computer-aided drafting
CPU    central processing unit
DSDB   detail survey database
GDA94  Geocentric Datum of Australia 1994
GIS    geographic information systems
GML    Geography Markup Language, Generalised Markup Language
GPS    global positioning system
GSDI   Global Spatial Data Infrastructure
GUI    graphical user interface
HTTP   Hypertext Transfer Protocol
ICT    information and communications technology
INCIS  Integrated National Crime Information System (New Zealand)
ISO    International Organization for Standardization
IT     information technology
MGA    Map Grid of Australia
OGC    Open Geospatial Consortium
OGC-A  Open Geospatial Consortium—Australasia
PRINCE Projects IN Controlled Environments
RCSC   Regional Collaboration Steering Committee (Queensland)
RFP    Request for Proposal
RIP    raster image processor
ROC    regional organisation of councils
SDE    spatial database engine
SDI    spatial data infrastructure
SEQ    south east Queensland
SIDP   Spatial Interoperability Demonstrator Project
SLIP  Shared Land Information Platform (Western Australia)
SOAP  Simple Object Access Protocol
URL   Uniform Resource Locator (website address)
VR0C  voluntary regional organisation of councils
WALIS Western Australian Land Information System
W3C  World Wide Web Consortium
XML   Extensible Markup Language

**NOTE**: A list of several online spatial information system, GIS, cartographic, data and IT glossaries and dictionaries is provided at http://www.gis.com/whatisgis/glossaries.html. An additional online glossary for definitions of many current IT-related words is available at http://whatis.techtarget.com/.