MODULE 7

MODULE 7: Guidelines for Selecting Spatial Information System Software and Hardware

Building capacity to implement natural resources information management systems.

www.nlwra.gov.au

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Guide for managers

Context

One of the prerequisites for natural resources management (NRM) involves the establishment and maintenance of a good database of information in digital format. Access to reliable and up-to-date information reduces the uncertainty in planning and management by helping identify and analyse situations and issues. Strategies to overcome them 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/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, standards, and communication are key components.

Under current arrangements, funding for NRM projects is increasingly being channelled from government agencies to regional groups, such as catchment management authorities and resource information centres. In many situations regional groups are faced with the need to purchase software. Given that most groups are experiencing increased demands on budgets to support information technology hardware and software it is important that products are chosen that fulfil actual requirements. Selections should always be based on the needs of the organisation or group. The following is a simple 'best practice' guideline:

- Software and hardware should be selected giving consideration to functionality and applications that have been identified based on a needs assessment
- Hardware should be based on software requirements.
- Operating systems should be based on the software products and hardware, and the standards that have been developed as part of the organisation's data policy and standards activities.

It is acknowledged that each state and territory jurisdiction may have its own initiatives related to data collection and information management including governance guidelines and protocols related to the implementation of NRM projects within their jurisdictions. In some cases this may involve recommendations for spatial information system (SIS) software and hardware.

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 photography) and spatially-enabled databases.

Module 7: Guidelines for selecting spatial information systems and hardware provides general material to assist regional groups in the selection of software and hardware with an emphasis on spatial applications.

Actions

Managers need to make judgements and decisions when selecting new SIS software and hardware, upgrading existing systems or evaluating whether to change system providers. This guideline attempts to provide the parameters to assist in the decision-making process.

When dealing with the issue of SIS software, managers need to ensure that it is selected based on the range of functionality and applications needed by an organisation—it is important to understand context, and not be influenced by the loudest voice. If in doubt, get additional support.

It also important to remember that hardware and software are part of an integrated information management solution, and therefore need to be considered in relation to other components, (e.g. procedures—standards and protocols, etc), designed to provide ready access to data and information, and support best practice procedures. As such, NRM regional groups are encouraged to purchase software products that are fully compliant with OpenGIS® specifications, enabling them to interoperate with other information systems.

Best 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 SIS components, upgrading existing systems or changing system providers.

Acknowledgements

This module draws heavily on material from the publication by Harmon and Anderson (2003) 'The Design and Implementation of Geographic Information Systems'.

Material in this module has also been sourced from Spatial Knowledge Engineering, (SKE, Inc www.skeinc.com), Peter Thorpe, of 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 as a guide to users, and draw attention to important issues and information.

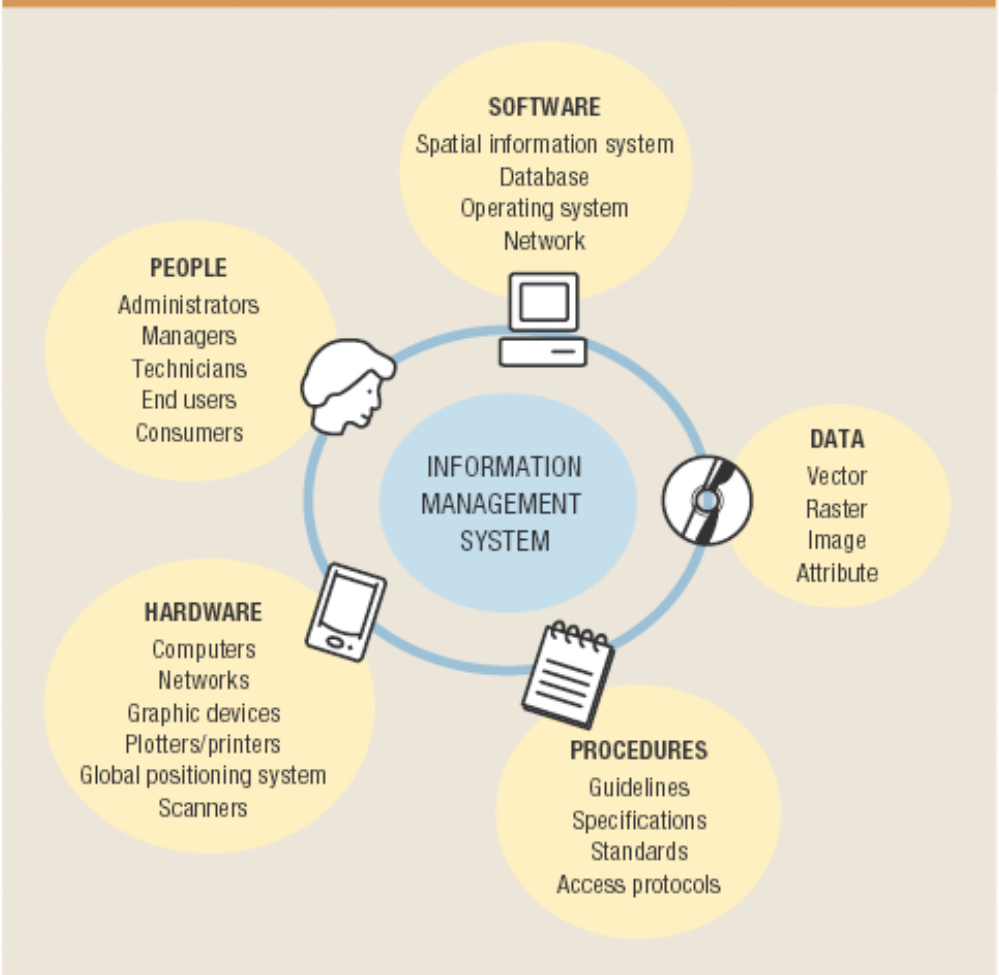
	Information which readers should take particular note of
	Best practice information
	Tips for readers—based on experience and aimed at saving time and resources
	Caution—readers are advised that particular care should be taken or that the subject issue may be complex
	Additional information
	Capability raising—used to show a signpost to a higher capability level
Bold Text	Used to highlight a particular issue
Boxed Text	Highlighting of issues specifically related to ANZLIC or the Audit

7.1 Introduction

It is important that software and hardware is selected and upgraded based on the range of actual functionality and/or applications needed by an organisation. In recent years there has been a proliferation of SIS software and various related hardware items (computers, plotters, GPS receivers, hand-held devices and digital cameras) that support spatial information systems, and an almost exponential increase in the range of functionality or tools available.

It is also important to remember that hardware and software are part of an integrated information management solution, and therefore they need to be considered in relation to other components (e.g. procedures—standards and protocols, etc), designed to provide ready access to data and information, and support 'best practice' procedures. (see Figure 7–1 and *Module 1: Information management and the sustainable management of natural resources).*

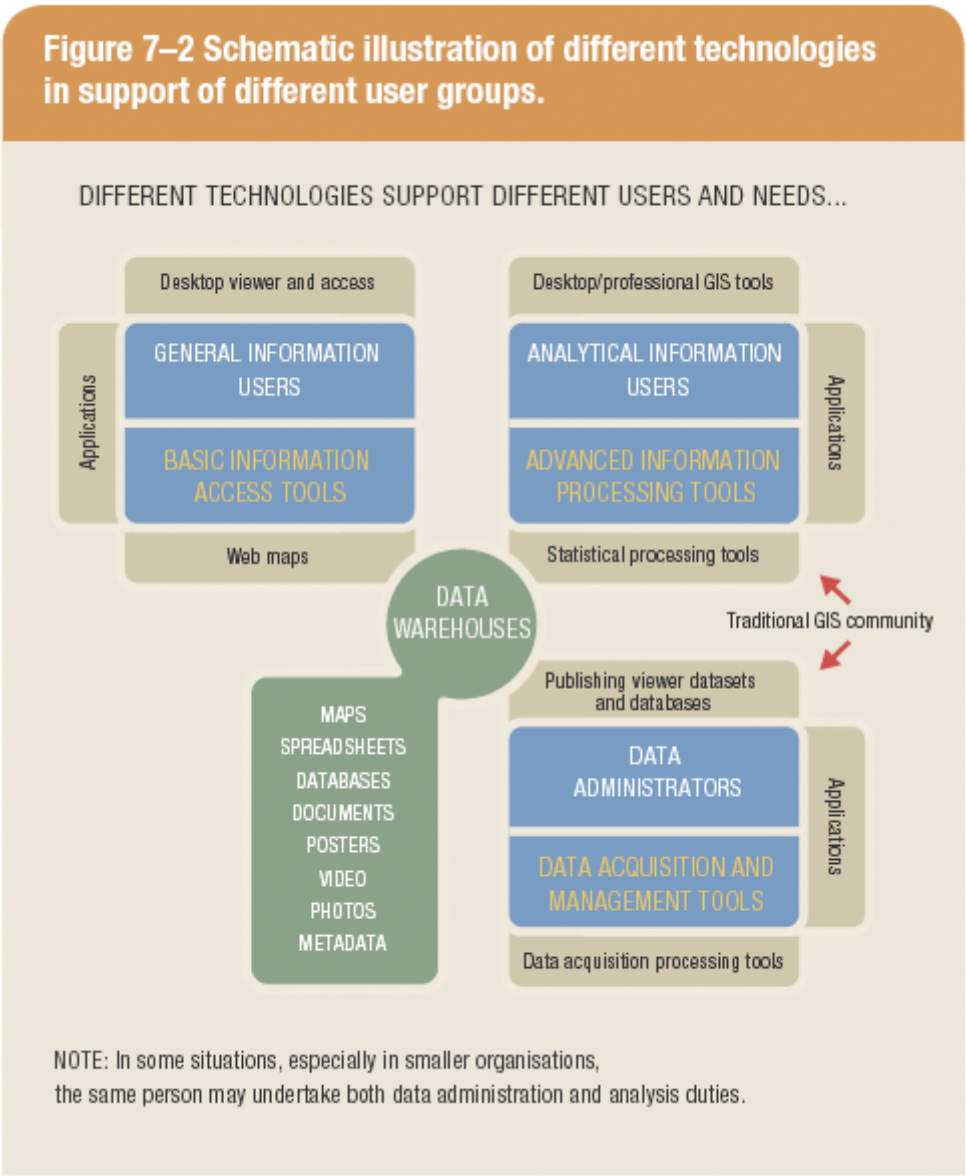
Figure 7–1 Framework for an integrated information management solution.



Traditionally, the tasks of dealing with spatial data within an organisation or group has been the domain of 'experts' who worked with 'high-end complicated technology' to dictate the business processes, instead of facilitating and supporting the organisation's information needs.

In the context of developing an integrated information management solution it is important to recognise that there is a range of different user groups involved including general, technical and analytical. In addition, with the advent of simple low-cost or free-viewing software and web-based applications, there is now a suite of tools available for casual users to access, query and print spatial data (Figure 7–2).

Figure 7–2 Schematic illustration of different technologies in support of different user groups.



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Spatial information system procurement is driven by documented and justified individual or departmental business needs under the umbrella of a funded and endorsed plan for system procurement and implementation. As a guide, use the selection checklist (Section 7.3) and criteria (Attachments 7–1 and 7–2).

Similarly, developments in hardware technology mean that it is now feasible to have SIS applications operating on the full range of hardware systems such as large mainframe computers and workstations through to desktop computers, notebooks and hand-held devices, (known as personal digital assistants or PDAs) and even mobile phones.

As such, there is an increasing range of software and hardware available that can be used by different user groups.

Selections should always be based on the needs of the organisation or group. The following is a simple 'best practice' guideline:

- Software and hardware should be selected giving consideration to functionality and applications that have been identified based on a needs assessment.
- Hardware should be based on software requirements.
- Operating systems should be based on the software products and hardware, and the standards that have been developed as part of the organisation's data policy and standards activities.

7.2 Elements to consider when selecting software and hardware

When making a decision to purchase hardware and software it is worth keeping in mind a number of key elements, including:

- whether the product has a proven record in the marketplace—avoid outdated and unproven products
- whether good support mechanisms are available—these include manuals, training material, online help and technical backup support from vendors.
- whether staff with appropriate skills is readily available to enable smooth implementation. Employing specialist staff with spatial information skills is an expensive activity. It is recommended that a software and hardware product is chosen for which people with the skill sets are obtainable in the marketplace. The issue of staff turnover and general capacity building need careful consideration
- whether the product has appropriate functionality to suit existing and planned needs for your organisation.

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In preparing for any system development or replacement, undertake formal, documented system audits including user reviews and alignment of spatial information systems to the support of core business. The outcome of this analysis should be a structured business case justification incorporating elements such as total cost of ownership models.

7.2.1 Evaluating Software and hardware

The key to selecting software and hardware is to fully appreciate user or organisational requirements and choose a product that fulfils these criteria.

The main criteria to be evaluated when selecting software involve functionality, performance, scalability, licensing and standards.

Functionality

How well does the functionality of the software and hardware fit the requirements to solve the problem?

Rule of thumb—

- Don't buy more than you need.
- Educate, review and then upgrade.

Functionality is the ability of the product to perform required tasks in a simple and straightforward manner. A number of issues are involved in determining functionality, e.g. an easy to use graphic user interface (GUI). In earlier versions of SIS software, most activities were command driven where the user typed commands into the SIS to execute tasks. This required users to be familiar with a whole suite of command functions to undertake even simple tasks. The command-line era, in part, explains the situation in which SIS technical staff operated in a domain of their own within an organisation (as referred to in Section 7.1).

With advances in technology and improvements in software development, today most software packages incorporate a standard Windows-type interface with menu and toolbars. This reduces the learning curve for users and thereby enables access to spatial data on desktops. It should be noted that in reality the introduction of a Windows-based or internet browser-based interface coincided with an increase in the functionality and tools available on many systems. As a result, the learning curve for users of most professional level spatial information systems is still quite steep. It is this factor, and the demand by the general community for access to spatial data on their desktops, that has seen the development of many free or low-cost applications, often referred to as viewers. These viewers generally have limited functionality.

If SIS 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.

A second functionality factor involves the ability of the software to be customised using industry standard programming languages. The degree to which SIS software can be customised varies from product to product. Such applications include:

- stand-alone applications designed to meet a specific need—often referred to as custom applications and developed using specific programming tools
- large professional level SIS software packages with internal programming functions
- entry level applications designed for simple viewing operations. These packages are often 'locked' and have no ability to be customised. They are designed to undertake a simple task and do it well.

The key, when selecting software and hardware, is to fully understand user requirements and choose a product which matches those needs. To assist this process it is recommended that a list is developed detailing the functionality required for each user group that will be accessing and using the spatial data. This information can then be used to produce a matrix which compares user requirements against available products for each functionality issue. Having completed this task it is recommended that, where possible, software or hardware vendors are invited to provide a demonstration of their product's ability to perform the tasks or functionality required for each user group identified in the needs assessment. An alternative is to seek the support of other groups who currently use the software or hardware and have them undertake a demonstration (and make a recommendation). Attachment 7–1 provides a draft list of criteria to consider when selecting SIS software and hardware.

Performance and hardware requirements

The *performance* of software applications is governed by the way it was designed and engineered at the programming stage, and the speed and configuration of the hardware it is running on. Good software applications are optimised to fully utilise the hardware resources available, e.g. dual CPU processors, large amounts of RAM, and high-end graphics card, etc. Most SIS offer more than simple viewing capabilities (such as added functionality to perform certain overlay, merging and analysis tasks) which makes them very complex. Such software requires large amounts of computer resources to operate efficiently. Performance of the software application can be significantly affected if the appropriate level of system resources is not available, and therefore care is required to ensure that the frame conditions comprising CPU speed, memory, graphics display card, and disk type are optimised. The system will only operate as efficiently as the weakest link within this framework.

Most software vendors, and in particular the larger companies, provide minimum and recommended specifications. Information is also available for individual components such as the graphic card performance for a particular piece of software. Minimum specifications can often refer

to the absolute minimum requirements to run the system and therefore may not yield good performance. Given that hardware technology is rapidly changing, care must be taken to ensure the specifications listed by the software vendor are not out-of-date. If requested, most software vendors will supply up-to-date specification recommendations, and most of these are also available online.

Scalability

Scalability relates to the ability to expand, migrate/upgrade or 'add-on' increased functionality to a base product in an ordered and structured manner.

- Scalability has to match the skill levels of the organisation or NRM regional body.
- Does the system have the ability to incorporate additional functionality that may be required in the future?
- Does the system have the ability to communicate seamlessly with other programs via connections or interfaces?

Due to competitive market forces and the need to provide increased functionality, almost all software vendors are constantly changing their products. In this respect SIS software and hardware is no exception as updates and patches are continually being released. The contemporary approach to software development for a number of the major SIS and image processing software companies is to provide a suite of software as part of an overall family. Under this scenario, it is possible to purchase a base version of the software and add on additional modules, often called 'extensions' or 'add-ons', to provide increased functionality. It is also important to consider the ability of a system to expand.

Key questions are:

- Does the system have the ability to incorporate additional functionality that may be required in the future?
- Does the system have the ability to communicate seamlessly with other programs via connections or interfaces?

Most large integrated information management solutions have a number of software products which communicate and share data between each other. The ability of software vendors to offer a scalable product enables users to streamline their software purchases and installations to match their own business needs.

To support scalability some software vendors have implemented a special software licensing system in which licences can float within a network to enable users to access increased functionality when required.

Licensing

Most software programs available on the market have a *licensing* agreement, i.e. the terms and conditions the user agrees to during the installation process. In addition, 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 by which users pay an annual maintenance fee entitling them to free upgrades or new versions as they become available. These are additional on-going expenses that need to be included in operational budgets.

In earlier releases of most programs, the standard licensing agreement meant that software was licensed to a particular machine—known as a single-seat, stand-alone or per-CPU licence. The advent of increasing scalability and functionality of software has resulted in more complex licensing agreements. As previously mentioned, it is now possible to obtain floating or concurrent licences for some SIS software. These licences cover the overall program, and in some cases, the extension or add-on components that may operate on any given computer. To achieve this functionality some of the major SIS and image processing companies have adopted a system that involves installing a separate licence manager program to administer the use of separate software applications within an integrated system. This allows larger organisations with many infrequent users to utilise fewer licences than if they were required to install stand-alone licences on each user's machine.

It is recommended discussing licensing requirements with vendors to ensure software purchases are appropriately licensed for both immediate and planned future needs.

Standards

The development of an integrated information management solution is dependent on the development of standards for areas such as metadata descriptions, file naming, directory structure conventions and data storage formats. In the context of software programs, standards are also important. For example, is the SIS compatible with the operating system standards used in your organisation or NRM regional body (e.g. Mac, Linux, UNIX, Windows NT/95/98/2000/XP/Vista)?

A further aspect in which standards are important involves the ability of the software to recognise data formats used in other computer systems. Many SIS and image processing applications have unique file formats. This used to mean that the data exchange and transfer protocols were extremely important. In recent times most major packages (while still having their own unique native formats for raster, vector and data attribute information) now have the ability to import and export, and read and write data in many other formats. This is not to say that data formats are no longer important: they are, especially in the area of increasing interoperability (or the ability of different computers and systems to talk to each other and share or access each other's data). Within an NRM regional body, these may include systems for:

- document management
- financial management
- approval processing
- identification and monitoring of significant assets
- environmental management, resource condition assessment and monitoring
- reporting of on-ground works, etc.

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 OpenGIS® Consortium (OGC) is one such group (see www.opengis.org). It is an international industry consortium and currently comprises in excess of 250 companies, government agencies and universities which participate in a consensus process to develop publicly available geoprocessing specifications. According to the OGC, open interfaces and protocols defined by OpenGIS® 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 SIS and image processing suppliers are members of the OGC, thereby ensuring their software complies with industry standards.

The work of the OGC has also played a part in the recent development of international geographic information standards by the International Organisation for Standardisation (ISO). These ISO standards are published as the ISO 19100 series. Many software companies are now including these standards in their products and, given the global status of the ISO process, this is likely to become an important requirement for local governments. Consequently, NRM regional bodies are encouraged to purchase commercial off-the-shelf software that is fully OpenGIS® compliant to enable interoperability with other regional bodies and local/state/national government information systems at minimal cost.

The ISO geographic information standards can be obtained through Standards Australia (http://www.standards.org.au/ and http://www.standards.com.au). Further information on the development and application of the standards in Australia is available from ANZLIC (http://www.anzlic.org.au/publications.html).

7.2.2 Steps in choosing software and hardware

Evaluation team

A primary task when choosing software for an organisation is to establish a team comprising a mix of technical, general and causal users. Such a team should include motivated staff with the ability 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 the items of functionality, scalability, licensing requirements, performance and standards as described previously. Consideration also needs to be given to capacity building to ensure adequate skills are available to implement the system, and the range of products and services the system will undertake.

It is often a good idea to consult with other NRM regional bodies of similar size or functional requirement for comparison. Liaison with state/territory bodies, industry groups, the engagement of consultants and consultation with vendors are other options to consider. It should be remembered however, that vendors obviously have a vested interest in their products, and in some cases this situation also applies to private companies and individual consultants. If engaging a private consultant care should be taken to ensure they are objective and free of any vested interest.

For additional information on choosing a consultant refer to *Module 8: Enhancing capability for using spatial information.*

Develop a procurement approach

Each organisation or NRM regional body will have its own approach to the procurement of goods and services. Factors that influence the procurement approach include value thresholds. For example, procurement of goods and services over a certain limit requires a certain number of written quotations (often called an RFQ or Request for Quotation). Higher thresholds may require open tendering with advertisements placed in newspapers or online (often called an RFT or Request for Tender).

Alternatively, it is possible to prepare what is termed a Request for Proposal (RFP). This approach is often adopted by larger organisations in situations where a number of software programs may potentially fulfil the requirements detailed in the specification. Under this scenario companies are asked to submit a document outlining their proposed approach, experience, fees and timeframe. In some cases, vendors are provided with actual NRM regional body spatial data and asked to provide working solutions to pre-defined issues and problems. Through this mechanism the use of systems in 'real life' can be tested.

It is strongly recommended discussing procurement and tendering requirements with your organisation's purchasing staff and/or senior management in the process of developing a procurement approach. There are often clearly defined legal and probity issues that must be followed.

Development of an assessment matrix

The development of a matrix to enable software packages to be assessed against user requirements or functionality is recommended to provide the evaluation team with a clear overview

of the options. An example of a features functionality matrix used in GIS industry surveys is included at Attachment 7–1.

Evaluation

A number of options exist for evaluation depending on the chosen procurement approach. For example, based on the results of the assessment matrix and recommendations from consultants or others, your organisation or NRM regional body may be happy to proceed directly with a purchase. In cases where more than one company is selling the same software it is possible to ask for them to bid on the cost of supplying the software. It is important to note that installation, training requirements and ongoing technical support need to be considered.

Key questions for evaluating vendors' or companies' submissions include:

- Do they have a demonstrated understanding of the applications and needs of your organisation?
- Are they able to articulate what they are going to do in a clear and precise fashion?
- Do they have proven experience in providing similar services to other NRM regional bodies or similar organisations?
- Are they able to meet timeframes?
- Have they recommended a solution that matches your budget availability?

Benchmarking

Benchmarking involves testing the software system's ability to perform a number of tasks or handle a number of issues. 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

A number of options exist to reach a final decision. In some cases a two-phased process is used where each member of the team is given an opportunity to evaluate the outcomes of the tasks above. A meeting is then held and the final decision determined. A second option is to reach consensus as a group thus eliminating an extra step in the process.

Either way the evaluation team should feel comfortable with the selection process and assured that the final selection fulfils the requirements.

Rule of thumb

- It is a good idea to define the selection process before the detail becomes known.
- Leave room for evaluating intangibles—some non-cost factors generally relating to functionality include:
  - availability of skilled staff in nearby NRM regions, local government or state/territory agencies
  - skill and availability of an in-house SIS group
  - skill of the service provider.
- Be conscious of where your next technician may come from—skilled SIS professionals can be expensive and often in short supply.

The exact method of the tendering and selection of software and hardware will be determined by your organisation or NRM regional body's purchasing and procurement policies. It is recommended that you talk to your purchasing section (if they exist) before embarking on a software and hardware purchasing initiative.

7.3 Checklist for selecting spatial information system software

General tips and tricks for selecting and implementing spatial information systems are included at Attachment 7–2. The following is a checklist of issues that need to be addressed when selecting SIS software:

☐	**Do you need a spatial information system or a mapping package?** If so, what scale or type—simple desktop viewer, professional workstation, custom application?
☐	**Cost:** Hardware and software requirements (including ongoing maintenance)
☐	**Type of operating system:** Linux, Unix, Windows, Mac
☐	**Format requirements:** Ability to handle raster (pixel data), vector (point, line, polygon data) or both formats
☐	**Support:** Are you going to be able to get help if you have problems?
☐	**Complexity/personnel resources (including staff and training):** For a beginner, it will be important to have a user-friendly SIS, i.e. one with an easy to understand graphic user interface (GUI). Ensure that budget funds are available for initial training and continued capacity building activities for both SIS technical and casual users
☐	**Company, agency or organisation requirements (general and specific):** Develop a needs assessment. Can specific benchmark requirements be met? Does the software fulfil 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 you need to buy add-ons and are they available?
☐	**Support material:** Is there a pool of people locally or within your organisation that uses your preferred SIS? 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 an SIS
☐	**Maintenance and licensing:** What maintenance and licensing options are available?
☐	**Interface with other software used and interoperability:** For example, between computer aided drafting (CAD), mapping, image processing, database and web systems
☐	**Open system support:** Does the software support OpenGIS® Consortium specifications and the World Wide Web Consortium within the Australian Spatial Data Infrastructure (as mandated within the national Interoperability Framework Initiative)?

Additional support

Considerable resource materials exist that can support the process of selecting GIS/SIS software. For example, many of the spatial industry news groups and magazines often have information reviewing particular software products, and in some cases providing cross-functionality comparisons.

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

Choosing a GIS

GIS Strategies and Issues—a complete framework, including needs analysis, funding and choosing hardware and software, from the Louisiana Geographic Information Council: http://lagic.lsu.edu/gisprimer/strategies.asp

How to Choose a GIS (GIS Monitor website):
http://www.gismonitor.com/articles/features/how_to_choose.php

Ultimate Map/GIS Directory (GIS Monitor website—links to available mapping and GIS products):
http://www.gismonitor.com/products/index.php

Support on system upgrading

A challenge facing many organisations is whether or not to update existing SIS installations and what the best approach is. Several considerations are important and require evaluation to ensure successful updating which provides for the continued effectiveness and efficiency of spatial systems to meet future geo-spatial needs and changes.

Upgrades can originate from existing systems which have been installed for quite some time or upon those systems that have been in place for shorter periods of time.

Upgrade Your GIS: Best Practices for Successful Implementation:

http://www.gisvisionmag.com/vision.php?article=200111%2Ffeature.html

Product reviews

General product reviews (GeoCommunityTM website): http://software.geocomm.com/reviews/

Product comparison (GeoCommunityTM web site):
http://www.spatialnews.geocomm.com/reviews/mifav.html

Software surveys

The results of a variety of annual product surveys between 1999 and 2007, including *GIS Software Survey* and *GPS Receiver and Software Survey*, are available from the Point of Beginning (POB) website: http://www.pobonline.com.

Free software viewers and data conversion tools

A number of free viewers and software applications are available online. Free applications and reviews about functionality and file formats are available from the following websites:

Grime website: http://www.grime.net/gistools/

GeoCommunityTM website: http://spatialnews.geocomm.com/features/viewers2002/

Attachment 7–1

Criteria for selecting spatial information system software

The following criteria, sourced from the Point of Beginning website, is a template from which GIS functionality requirements and software products can be assessed. For additional information on software features refer to http://www.pobonline.com

Program name	**GIS *X***
Manufacturer/distributor	Company *X*
Manufacturer's phone number	
Cost per seat	
Date of first release	
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	
Native Graphic Data Structure and Format	
- Vector — spaghetti	
- Vector — topologic	
- Parametric	
- 3-D	
- TIN	
- Grid	

- Raster image	
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	
- 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	
SOFTWARE FEATURE CATEGORY	***EXPLANATION***
Geographic data management	Database administration tools for managing data access by users, locking of data during edit and maintenance of metadata.
Tabular attribute data management	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.
GIS data import/export utilities	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.
GIS data entry and editing	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.
Map design and composition	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.
Basic geographic query and analysis functions	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.
Network analysis	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.
Terrain and 3-D data processing and analysis	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.
Raster image processing capabilities	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.
Application development languages	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, Python, Delphi) that may be used for application development.

Attachment 7–2

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 UK 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 your **vision** for how GIS will support your business priorities, **then** fill in the details of your requirements.
2. Focus on your **key** requirements, **not** on the GIS technology.
3. Decide the overall shape of your 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 your requirements through supplier demonstrations and visits to local authorities which are active in GIS - **but don't get deflected from your own priority needs**.
7. Review the British Standard BS7666 ('Spatial Datasets for Geographic Referencing') and put in place **'home grown'** standards for your geographic data ('streets', 'properties', 'addresses').
8. Consider the Local Government Management Board's GIS Functional Specification - **but treat it with healthy suspicion and don't use it indiscriminately!**
9. Structure your Invitation-to-Tender to ease direct comparison between suppliers - if possible in a way, which can be **quantified**.
10. Call the tune in assessing suppliers and ensure that presentations, demonstrations and benchmarks are carried out to rules that **you** define.

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. Administer 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 which GIS can offer the local authority.
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)!