17 Managing GIS

OVERVIEW

- This chapter addresses the essential ‘front end’: the procurement and operational management of GIS
- This chapter describes how to choose, implement, and manage operational GIS.
- It involves four key stages: the analysis of needs, their formal specification, the evaluation of alternatives, and the implementation of the chosen system.
- Implementing GIS requires consideration of issues such as planning, support, communication, resource management, and funding.
- Successful on-going management of an operational GIS has five key dimensions: support for customers, operations, data management, application development, and project management.

LEARNING OBJECTIVES

- **Return on investment concepts.**
- **How to go about choosing a GIS to meet your needs.**
- **Key GIS implementation issues.**
- **How to manage an operational GIS effectively with limited resources and ambitious goals.**
- **Why GIS projects fail—some pitfalls to avoid and some useful tips about how to succeed.**
- **The roles of staff members in a GIS project.**
- **Where to go for more detailed advice.**

KEY WORDS AND CONCEPTS

Return on investment (ROI), prototyping, stages of choosing, implementing and managing a GIS

OUTLINE

17.1 Introduction
17.2 The case for GIS: ROI
17.3 The process of developing a sustainable GIS
17.4 Sustaining a GIS – the people and their competences
17.5 Conclusions

17.1 Introduction

- This chapter is concerned with the practical aspects of managing an operational GIS.
- Describes high-level management concepts
- The authors argue that success comes from combining strategy and implementation
- Success involves constant sharing of experience and knowledge with other people, keeping good records, and making numerous judgments where the answer is not preordained.

17.2 The Case for GIS: ROI

- Outlines the strategic questions that senior executives are likely to ask before implementing a GIS
- To be successful:
    - GIS strategies must be aligned with business strategies,
    - GIS processes must reflect business processes.
- GIS that exists in a vacuum and is disconnected from an organization's business processes may be more of a business concern than no GIS at all.
- ROI uses a combination of qualitative and quantitative measures to assess the utility that an organization will obtain from an investment.
- Figure 17.1 outlines the ROI methodology comprising of 10 steps
- Table 17.1 describes some examples of the main types of tangible and intangible benefits that have been used in the past to justify GIS projects for government and utility organizations.

17.3 The Process of Developing a Sustainable GIS

- This section provides a short, but very useful summary of the formal stages and steps in the development of a GIS
- GIS projects comprise four major lifecycle phases: business planning; system acquisition; system implementation; and operation and maintenance.

17.3.1 Choosing a GIS

- Choosing a GIS involves four stages: analysis of requirements; specification of requirements; evaluation of alternatives; and implementation of the system.
- Figure 17.4 shows these stages and the 14 steps
- This section briefly describes each of these steps in sufficient detail to understand what they entail
- Stage 1: Analysis of requirements
    - Step 1: Definition of objectives
    - Step 2: User requirements analysis
    - Step 3: Preliminary design
    - Step 4: Cost-benefit analysis
    - Step 5: Pilot study
- Stage 2: Specification of requirements
    - Step 6: Final design
    - Step 7: Request for proposals
- Stage 3: Evaluation of alternatives
    - Step 8: Short-listing
    - Step 9: Benchmarking
    - Step 10: Cost-effectiveness evaluation
- Stage 4: Implementation of system
    - Step 11: Implementation plan
    - Step 12: Contract
    - Step 13: Acceptance testing
    - Step 14: Implementation

17.3.1.1 Discussion of the classical acquisition model

- While widely employed, this model has some significant shortcomings including:
    - It is expensive and time-consuming
    - Proposals can become technologically obsolete
    - Short-listing requires multiple vendors
    - Evaluation process often focuses under attention on price

    - This type of procurement can be highly adversarial
    - Many organizations have little idea about what they really need
- A less complex and formal selection method is *prototyping*
- Here a vendor or two are selected early on and funded to build a prototype in close collaboration with the user organization
- Works best for those procurements where there is some uncertainty about the most appropriate technical solution

17.3.2 Implementing a GIS

- Plan effectively
- Obtain support
- Communicate with users
- Anticipate and avoid obstacles
- Avoid false economies
- Ensure database quality and security
- Accommodate GIS within the organization
- Avoid unreasonable timeframes and expectations
- Funding
- Prevent meltdown
- Table 17.3 lists many tools and techniques available for use in implementation projects including SWOT analysis, data flow diagrams, project management tools and object model diagrams

17.3.3 Managing a sustainable, operational GIS

- Success in operational management of GIS requires customer support, effective operations, data management, and application development and support.

17.2.3.1 Customer support

- Key tasks include including technical support and problem logging plus meeting requests for data, maps, training, and other products.

17.2.3.2 Operations support

- Operations support includes system administration, maintenance, security, backups, technology acquisitions, and many other support functions.

17.2.3.3 Data management support

- Large, multi-user geographic databases use database management system (DBMS) software to allocate resources, control access, and ensure long-term usability.

A database administrator (DBA) is responsible for ensuring that all data meet all of the standards of accuracy, integrity, and compatibility required by the organization.

17.2.3.4 Application development and support

- Sources of application development work include improvements/enhancements to existing applications, as well as new users and new project areas starting to adopt GIS.

17.4 Sustaining a GIS—The People and Their Competences

17.4.1 GIS staff and the teams involved

- In addition to management, day-to-day GIS work involves three key groups of people: the GIS team itself, headed by a GIS manager; the GIS users; and external consultants.
- Figure 17.9 shows the GIS staff roles in a medium to large GIS project

17.4.2 Project managers

The role of the project manager is to establish user requirements, to participate in system design, and to ensure that projects are completed on time, within budget, and according to an agreed quality plan.

17.4.3 Coping with uncertainty

- The chapter ends with a strong note of caution about the importance of understanding uncertainty
- Organizations must determine how much uncertainty they can tolerate before information is deemed useless.
- Managing error requires use of quality assurance techniques to identify them and assess their magnitude.

17.5 Conclusions

ESSAY QUESTIONS

1. ‘Does my company really need a GIS’? Outline the arguments you would present to the Chairman of the Board of a utilities (gas, electricity or water) supply company by way of answer to this question.
2. List and describe a series of reasons why GIS implementations can ‘fail’. Why are ‘success’ and failure often hard to determine in GIS and similar projects?

3. What do you understand by the term ‘cost benefit analysis’? Identify and describe the major elements of such an analysis as applied to a possible GIS implementation.
4. How would you evaluate the impact of a corporate GIS implementation on an organization?
5. GIS can be introduced into an organization either ‘top down’ or ‘bottom up’. Compare and contrast these approaches, commenting on their strengths and weaknesses.
6. What are the general management strategies that can be adopted to minimize the risk associated with a large scale GIS acquisition and roll out into a company?
7. The classical system acquisition model is widely used in the GI industry and has proved its worth many times. What are its shortcomings?
8. Many studies of GIS introductions isolate the importance of a ‘champion’ in the enterprise. What are the advantages and disadvantages of being a ‘GIS champion’?
9. What are the key needs of a ‘sustainable’ GIS?
10. Analyses of the labor force in the GI industry show that by far the largest proportion have a background in academic geography and related disciplines. Is this a good or a bad thing for GIS project management?

MULTIPLE CHOICE QUESTIONS (MCQ)

The materials in this Chapter do not lend themselves into creating MCQ or related examinations questions.

ACTIVITIES

Perhaps for three reasons, formal project management is often dismissed by GIS instructors. First, it is sometimes seen as ‘not GIS’, or someone else’s responsibility, with the result that, if it is covered at all, it is treated in a cursory manner. Second, many instructors seem to think that it is in some sense ‘trivial’, not worthy of attention relative to all that exciting GI theory. Third, when formal techniques are addressed, the opinion often expressed is that they are ‘common sense’.

We empathically reject all of these arguments, and the text devotes three extended chapters to examination of a number of related human issues in GIS. Although there is a reluctance to discuss it, what evidence we have in the literature of ‘failure’ in GIS shows that it is almost always not associated with the technology but with various complex failures of management. Formal project management will not in itself guarantee project success, but it will lessen the chance of ‘failure’, and is almost always worth the additional effort and cost. It is a discipline

in its own right, with an associated body of both theory and practice that is relevant to GIS. The 'common sense' argument ignores the fact that, once it has been pointed out, a great deal of well found scientific theory can be dismissed in the same terms.

There are numerous institutions dedicated to furthering the art and science of project management, for example:

www.pmi.org
www.apm.org.uk
www.pmforum.org

1. Implementation is critical to the spread of any technological innovation such as GIS, but what are the conditions that favor it? How do organizations interact with technology? Campbell and Masser (1995, pages 25-50) suggest three main approaches:
   - Technological determinism
   - Managerial rationalism
   - Social interactionalism

Working in three teams, study their Tables 3.1, 3.2 and 3.4 and then outline the implications for GIS implementations of each approach. A possible approach makes use of a so-called **PEST** analysis (Political, Economical, Social, and Technical) of the environment.

2. A key skill in developing any project is the determination and articulation of the objectives. The standard acronym used is that these should be **SMART** (Specific, Measurable, Achievable, Relevant, Timely). An effective in-class pyramid exercise is to define a specific possible GIS implementation and then ask each member of the class to list just four **SMART** objectives for the system. Next, students join into groups of two and negotiate their 'best' four from the eight available. Then meet as groups of four and repeat the exercise, 'pyramiding' in this way until you have, perhaps 12-16 agreed objectives identified. These can then be discussed and moderated by the entire class. Examples and criteria for making objectives SMART can be found, for example, at www.learnmarketing.net/smartobjectives.htm

    a. Stage 1: Requirements analysis. This exercise, and those that follow, is suitable for an extended class activity, associated perhaps with a formal course on GIS management. Using any favored formal approach to project management, and for a selected applications area, simulate by role play the

management of the implementation, starting with the requirements analysis. In each step identify the roles that are involved, assign these to individuals or groups, and provide the necessary time and related resources for them to complete the tasks. The opportunity should be taken to introduce the actors to relevant materials from a selected formal approach (such as **PRINCE 2**) and to appropriate aids (such as Microsoft Project ™, **GANTT** charts and associated critical pathways). In this stage deal with:

- Objectives definition
- User requirements analysis
- Preliminary design
- Cost-benefits analysis
- Pilot study

b. Stage 2: Formal specification of requirements (see also Activity 2.9). The objective here is to create a formal request for proposals (RFI) for the project that can be sent out as part of an invitation to tender to system vendors. Changing the teams and individuals around, address the next two steps in the management model suggested in the Chapter:
   - Final design
   - Request for proposals

c. Stage 3: Evaluation of alternatives. Either generate initial expressions of interest from possible suppliers, or ask student teams to prepare vendor responses (see Activity 2.8) capable of formal evaluation using a weighted scoring system and undertake the next two steps
   - Short-listing
   - Benchmarking
   - Cost-effectiveness evaluation

d. Stage 4: Implementation of system. Not every part of this is possible, but adopt the same approach to the final four steps:
   - Implementation plan
   - Contract
   - Acceptance testing
   - Implementation

3. Almost all writers on IT implementations agree that the ‘people ware’ is the most important and potentially costly element of the system. It follows that developing appropriate role and job descriptions is an extremely important part of any implementation. Either alone, or working in teams, use a template with headings such as ‘job name’, ‘conditions and salary’, ‘required educational level and qualifications’, ‘;experience’, ‘necessary skills’, and ‘person profile’, develop job descriptions for the following roles in a GIS:
    - manager
    - administrator
    - applications programmer
    - data base analyst
    - geographic information analyst
    - data entry technician
    - group secretary and assistant

4. In the UK and elsewhere, the standard approach to project management is called PRINCE 2, and possession of its basic qualification is a sine qua non for any IT manager. PRINCE ™, which stands for **Pr**ojects **in C**ontrolled **E**nvironments, is a project management method covering the organization, management and control of projects. It was first developed by the Central Computer and Telecommunications Agency (CCTA), now part of the Office of Government Commerce (OGC), in 1989 as a UK Government standard for IT project management. The website at www.ogc.gov.uk/prince describes the formal process and usefully provides no less than 28 blank templates for appropriate documentation. Nowadays, no IT literate business would actually use the printed medium to create or store these documents, but would instead maintain them via a shared and networked computer facility. Design an appropriate system to do this for a large number of projects, using either a simple basic hierarchical folder structure or standard relational database such as Microsoft Access™.

   Another excellent, if commercial, resource for information about PRINCE 2 methods is at http://www.crazycolour.com/p2/. Note that this lists no less than 45 formal steps in a full application!

5. Visit www.ogc.gov.uk/prince2/downloads/template_case.htm and examine the listed case studies of major IT implementations. In each case, identify the critical management decisions and actions.

11. Evaluating and using project management tools. Starting at the website www.pcworld.com/downloads, examine a selection of the available tools for project management that go by names such as Project, Business Plan Master, Plan Builder, Proficient Project Manager and so on. Make a formal evaluation of each, using a check list you devise in advance.

12. Imagine you are the GIS manager in a large retailing corporation. Currently your unit provides services solely for the market research team, but you would like your unit to grow. Prepare a presentation intended for your Board of Directors to persuade them to make a substantial investment in developing the current system into an enterprise wide GIS.

FURTHER READING

Campbell, H. and I. Masser (1995) GIS and organizations: how effective are GIS in practice? Taylor & Francis: London

In addition to a detailed analysis of GIS diffusion into UK local government, this text has some very useful materials setting the process into its general context.

Harmon J.E. and Anderson S. J. 2003 The Design and Implementation of Geographic Information Systems. Hoboken, NJ: Wiley (e-book).

Heywood I., Cornelius S. and Carver S. 2002 An Introduction to Geographical Information Systems (2nd edn). Harlow: Prentice-Hall.

Tomlinson R. 2003 Thinking about GIS: Geographic Information System Planning for Managers. Redlands, CA: ESRI Press.

By definition, Roger Tomlinson has more experience in GIS management than anyone else. This book distills all he has learnt over a long and distinguished career about how to manage a GIS project. As a 'how to do it' guide, it is required reading.

Thomas C. and Ospina M. 2004 Measuring Up: The Business Case for GIS. Redlands, CA: ESRI Press.

RELATED READING

Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (eds) 2005 Geographical Information Systems: Principles, Techniques, Management and Applications (abridged edition). Hoboken, NJ: Wiley.

42. Measuring the benefits and costs of GIS, N J Obermeyer, pp. 601-610
43. Managing an operational GIS, L J Sugarbaker, pp. 611-620

Maguire D.J., Goodchild M.F. and Rhind D.W. (eds) 1991 Geographical Information Systems: Principles and applications. Harlow, UK: Longman (text available online at www.wiley.co.uk/gis/volumes.html).

31. GIS specification, evaluation and implementation, A L Clarke, pp. 477-88
33. Managing an operational GIS: the UK National On-Line Manpower Information System (NOMIS), M J Blakemore, pp. 503-13
44. Counting the people: the role of GIS, D W Rhind, pp. 127-37

ONLINE RESOURCES

NCGIA Core Curriculum in GIScience, 2000 (www.ncgia.ucsb.edu/giscc)

3.1. Making it work (136), *Hugh Calkins and others*

NCGIA Core Curriculum in GIS, 1990 (www.ncgia.ucsb.edu/pubs/core.html)

60. System planning overview
61. Functional requirements analysis
62. System evaluation
63. Benchmarking
64. Pilot project
65. Costs and benefits