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Compiled with assistance from Ken Dueker, Portland State University

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UNIT 67 - IMPLEMENTATION ISSUES

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[A. INTRODUCTION](#)

- most organizations acquiring GIS technology are relatively sophisticated
 - some level of investment already exists in electronic data processing (EDP)
 - they have experience with database management and mapping systems and some

combination of mainframes, minis and micros

- GIS technology will be moving into an environment with its own institutional structures
 - departments, areas of responsibility
 - as an integrating technology, GIS is more likely to require organizational changes than other innovations
 - the need for changes - cooperation, breaking down of barriers etc. - may have been used as arguments for GIS
 - existing structures are already changing - centralized computing services with large staffs are disappearing because new distributed workstation hardware requires less support
- organizational change is often difficult to achieve and can lead to failure of the GIS project
 - organizational and institutional issues are more often reasons for failure of GIS projects than technical issues

B. STAGE THEORIES OF COMPUTING GROWTH

- several models have been proposed for the growth of computing within organizations
 - growth is divided into a number of stages

Nolan model of computing growth

- the Nolan (1973) model has 4 stages:

Stage 1: Initiation

- computer acquisition
- use for low profile tasks within a major user department
- early problems appear

Stage 2: Contagion

- efforts to increase use of computing
- desire to use inactive resources completely
- supportive top management
- fast rise in costs

Stage 3: Control

- efforts to control computing expenditures
 - policy and management board created
- efforts to centralize computing and control
- formal systems development policies are introduced
- rate of increase in cost slows
 - charge-back policies introduced

Stage 4: Integration

- refinement of controls
 - greater maturity in management of computing
 - computing is seen as an organization-wide resource
- application development continues in a controlled way
- costs rise slowly and smoothly
 - charge-back policy might be modified or abandoned
- how does this model fit GIS experience?
 - two versions - incremental and radical

Incremental model

- GIS is a limited expansion of existing EDP facilities, no major organizational changes required
 - GIS will be managed by EDP department as a service
 - probably run on EDP's mainframe
 - this model fits AM/FM and LIS applications best - adding geographical access to existing administrative database
- GIS acquisition will likely be initiated by one or two departments, other departments encouraged to support by management
 - thus it begins at stage 2 of Nolan's model
 - if acquisition is successful, use and costs will grow rapidly, leading to control in stage 3

Radical model

- GIS is independent of existing EDP facilities, e.g. uses micros instead of EDP mainframe, may be promoted by staff with little or no history of EDP use
 - EDP department may resist acquisition, or attempt to persuade management to adopt an incremental-type strategy instead
 - may be strong pressure to make GIS hardware compatible with main EDP facility to minimize training/maintenance costs
- this model more likely in GIS applications with strong analytical component, e.g. resource management, planning
- model assumes that GIS will not require large supporting infrastructure - unlike central EDP facility with staff of operators, programmers, analysts, consultants
- unlike the incremental model, this begins at step 1 of Nolan's model
 - few systems have progressed beyond stage 2 - process of contagion is still under way in most organizations - GIS is still new
 - stage 2 is slow in GIS because of the need to educate/train users in new approach - GIS does not replace existing manual procedures in many applications (unlike many EDP applications, e.g. payroll)
 - support by management may evaporate before the contagion period is over - never get to stages 3 and 4

- we have little experience of well-controlled (stage 3), well integrated (stage 4) systems at this point in time

C. RESISTANCE TO CHANGE

- all organizations are conservative
- resistance to change has always been a problem in technological innovation
 - e.g. early years of the industrial revolution
- change requires leadership
 - stage 1 requires a "missionary" within an existing department
 - stage 2 requires commitment of top management, similar commitment of individuals within departments
 - despite the economic, operational, political advantages of GIS, the technology is new and outside many senior managers' experience
- leaders take great personal risk
 - ample evidence of past failure of GIS projects
 - initial "missionary" is an obvious scapegoat for failure
 - Rhind (1988), Chrisman (1988) document the role of various leaders in the early technical development of GIS - similar roles within organizations will likely never be documented
- GIS innovation is a sufficiently radical change within an organization to be called a "paradigm shift"
 - a paradigm is a set of rules or concepts that provide a framework for conducting an organization's business
 - the role of paradigms in science is discussed by Kuhn (1970)
 - use of GIS to support various scientific disciplines (biology, archaeology, health science) may require a paradigm shift

D. IMPLEMENTATION PROBLEMS

- Foley (1988) reviews the problems commonly encountered in GIS implementation, and common reasons for failure
 - reasons are predominantly non-technical

Overemphasis on technology

- planning teams are made up of technical staff, emphasize technical issues in planning and ignore managerial issues
- planning teams are forced to deal with short-term issues, have no time to address longer-term management issues

Rigid work patterns

- it is difficult for the planning team to foresee necessary changes in work patterns

- a formerly stable workforce will be disrupted
 - some jobs will disappear
 - jobs will be redefined, e.g. drafting staff reassigned to digitizing
- some staff may find their new jobs too demanding
 - former keyboard operators may now need to do query operations
 - drafting staff now need computing skills
- people comfortable in their roles will not seek change
 - people must be persuaded of the benefits of change through education, training programs
- productivity will suffer unless the staff can be persuaded that the new job is more challenging, better paid etc.

Organizational inflexibility

- planning team must foresee necessary changes in reporting structure, organization's "wiring diagram"
- departments which are expected to interact and exchange data must be willing to do so

Decision-making procedures

- many GIS projects are initiated by an advisory group drawn from different departments
 - this structure is adequate for early phases of acquisition but must be replaced with an organization with well-defined decision-making responsibility for the project to be successful
 - it is usually painful to give a single department authority (funds must often be reassigned to that department), but the rate of success has been higher where this has been done
 - e.g. many states have assigned responsibility for GIS operation to a department of natural resources, with mandated consultation with other user departments through committees
- project may be derailed if any important or influential individuals are left out of the planning process

Assignment of responsibilities

- assignment is a subtle mixture of technical, political and organizational issues
 - typically, assignment will be made on technical grounds, then modified to meet pressing political, organizational issues

System support staffing

- a multi-user GIS requires at minimum:
 - a system manager responsible for day-to-day operation, staffing, financing,

- meeting user requirements
 - a database manager responsible for database design, planning data input, security, database integrity
- planning team may not recognize necessity of these positions
- in addition, the system will require
 - staff for data input, report production
 - applications programming staff for initial development, although these may be supplied by the vendor
- management may be tempted to fill these positions from existing staff without adequate attention to qualifications
- personnel departments will be unfamiliar with nature of positions, qualifications required and salaries

Integration of information requirements

- management may see integration as a technical data issue, not recognize the organizational responses which may be needed to make integration work at an institutional level

E. STRATEGIES TO FACILITATE SUCCESS

Management involvement

- management must take a more active role than just providing money and other resources
- must become actively involved by supporting:
 - implementation of multi-disciplinary GIS teams
 - development of organizational strategies for crossing internal political boundaries
 - interagency agreements to assist in data sharing and acquisition
- must be aware that most GIS applications development is a long-term commitment

Training and education

- staff and management must be kept current in the technology and applications

Continued promotion

- the project staff must continue to promote the benefits of the GIS after it has been adopted to ensure continued financial and political support
- projects should be of high quality and value
- a high profile project will gain public support
 - an example is the Newport Beach, CA tracking of the 1990 oil spill (see Johansen,

1990)

Responsiveness

- the project must be seen to be responsive to users needs

Implementation and follow-up plans

- carefully developed implementation plans and plans for checking on progress are necessary to ensure controlled management and continued support
- follow-up plans must include assessment of progress, include:
 - check points for assessing project progress
 - audits of productivity, costs and benefits

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EXAM AND DISCUSSION QUESTIONS

1. Summarize the Nolan model of staged development of a computing environment, and discuss its validity for a GIS project.

2. Hay (Hay, A.M., 1989. "Commentary," Environment and Planning A 21:709) argues that GIS is a technical shift rather than a paradigm shift. Do you agree with his arguments?
3. The Nolan model does not appear to allow for project failure, which has been a consistent problem in the history of GIS. How could the model be elaborated to include the possibility of failure?
4. "Effective leadership in technological innovation requires both tenacious vision and the capacity to survive a long time". Discuss this comment in the context of GIS.

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