MEASURING THE INFLUENCES ON LAND RECORDS MODERNIZATION IN WISCONSIN COUNTIES

by

KRISTINE M. KUHLMAN

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ABSTRACT

Recent increases in local governments responsibilities have made managing land records more challenging than ever. Compliance with mandates and the increasing number of permits are a few of the activities that have put pressure on current land management systems. Struggling to meet the demands placed on them, land records professionals are looking for alternative ways to more efficiently and effectively manage land information. Use of automated land information systems (LIS) is one way users of land records can cope with the deficiencies in current land management systems.

Automated land information systems are not traditionally used to manage land records. Paper maps, files, and records are the way many organizations keep track of land information. Cutting and pasting from paper maps, drawing boundaries with markers, and coloring in areas of interest have been the norm for aggregating land information. These methods may get the job done, but replicating or completing further analyses with the same information is challenging. Computer technology has the capacity to perform land related spatial analyses in a digital environment. Use of multiple types of digital land information in an LIS can accomplish the same task as cutting and pasting. The resulting digital information products are often more accurate, aesthetically pleasing, and effective in conveying spatially complex analyses.

Introducing an innovative new technology brings in new fears, new tasks, and new skills. Not all professionals are comfortable with change. Resistance from in the workplace may be felt because of the fear of the unknown. Professionals might feel their job may be eliminated, or they may fear they might not be able to meet the new demands or adequately perform new skills. This uncertainty must be overcome if new technology is to be implemented.

The use of LIS's to manage land records is innovative for many land records professionals. The Wisconsin Land Information Program (WLIP) was formed to aid land records professionals in modernizing land records. WLIP was legislatively created to facilitate the use of compatible, but independent automated systems throughout the Wisconsin. WLIP provides the technical and administrative frameworks along with a funding mechanism to support local level modernization activities. WLIP's foundational elements were used to evaluate the extent land records have been modernized.

The coupling of Rogers (1983) and Kraemer et al. (1989) process and content models for diffusion formed the theoretical foundation for this research. Rogers' model defined the diffusion process with five stages -- knowledge, persuasion, decision, implementation, and confirmation -- with communication channels influencing each step of the process. The Kraemer et al. model was based on specific elements of diffusion with environmental variables and action leading to a specific outcome. In this case, that outcome was the implementation of automated land information systems.

Six independent environmental variables were examined to determine the influence they may be exerting on the modernization process in each county. Three of the six variables were internal environmental variables which represented characteristics that counties had control over. These included professional communication networks, formal and informal communication channels, and experience with information technology. The remaining variables were elements that counties could not directly control. These external environmental variables included economic capacity, land market pressures, and projected benefit. This research examined the relationship that these variables had with the level of modernization implementation in each county. Dependent variables such as modernization implementation were measured by a multi-purpose land information system (MPLIS), data automation, and information technology index.

Multiple linear regressions were the primary tool used to examine the influence environmental variables had on the level of implementation. The number of institutional arrangements (communication channels) was the only variable that was statistically significant for all three indices of implementation. The amount of retained fees (projected benefit), the number of Wisconsin Land Information Association members (professional communication networks), and growth rate (land market pressures) had minimal predictive powers. Per capita tax base (economic capacity) and the history of modernization activities (experience with information technology) were not related to the level of modernization implementation.

Most counties were focusing on implementing the basic elements of a MPLIS. Few counties were working towards automating data for application driven projects. Counties addressing information technology were taking an all or nothing approach. Based on the three indices of implementation, Douglas and Outagamie counties were the leaders in modernization activities.

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LOA	List of Acronyms
ARS	(WLIP 1992) Annual Report Survey
ASLI	A Study of Land Information
CULDATA	Comprehensive, Unified Land Data System
DNR	Department of Natural Resources
FGCC	Federal Geodetic Control Committee
GIS	Geographic Information Systems
HUD	Housing and Urban Development
LIB	Land Information Board
LIO	Land Information Office
LIOs	Land Information Officers
LIS	Land Information Systems
MPLIS	Multi-purpose Land Information System
NRC	National Research Council
PLSS	Public Land Survey System
SEWRPC	Southeastern Wisconsin Regional Planning Commission
URBIS	Urban Information Systems
WLIA	Wisconsin Land Information Association
WLIN	Wisconsin Land Information Newsletter
WLRC	Wisconsin Land Records Committee

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It should be borne in mind that there is nothing more difficult to handle, more doubtful of success, and more dangerous to carry through than initiating (a new system). The innovator makes enemies of all those who prospered under the old order, and only lukewarm support is forthcoming from those who would prosper under the new. Their support is lukewarm partly from fear of their adversaries who have the existing laws on their side, and partly because people are generally incredulous never really trusting new things unless they have tested them by experience. In consequence, whenever those who oppose the changes can do so, they attack vigorously, and the defense made by the others is only lukewarm. So both the innovator and her friends come to grief. But to discuss this subject thoroughly we must distinguish between innovators who stand alone and those who depend on others, that is between those who to achieve their purposes can force the issue and those who must use persuasion. In the second case, they always come to grief, having achieved nothing; when, however, they depend on their own resources and can force the issue, then are they seldom endangered.

-- adaptation of Machiavelli's *The Prince*

CHAPTER 1 - INTRODUCTION

Imagine trying to combine the information from three different linen or paper maps of varying scales to create an accurate and reliable composite map. The process of completing such a task is tedious and time consuming. Often, the resulting product does not yield effective results for answering land related questions that rely on spatial analyses. Sorting through the seemingly endless sets of files at the Register of Deeds office is another way land records can be used to acquire information about land. Many land records professionals find the traditional methods for managing land records obsolete and laborious. Paper maps containing land information are now being put into computer-compatible format so that multiple layers of information may be combined to perform more efficient and effective land-related analyses in a digital environment. This new method for managing land records is called modernization. Modernization implies changing the status quo. Managing land records by automating land information is a relatively new concept for land records professions.

The Wisconsin Land Information Program (WLIP) was created to provide a framework to facilitate the implementation of automated land information systems as a means to effectively manage land records in Wisconsin. WLIP is the product of two pieces of legislation that offer administrative and financial support for the establishment of decentralized confederations of land information systems in Wisconsin. Creating land information systems that can be utilized by a number of public and private agencies throughout the state involves changing the organizational and technological structure already established. Modernization requires the technical know-how to operate computerized systems and the organizational support to set the process in motion.

Over the past fifteen years, many local governments have grown interested in using computer technology to manage land records. Many different modernization strategies have been employed by a variety of agencies. Generally, efforts have been *ad hoc,* occurring on a project by project basis as funds become available. However, these undirected approaches may not be the most efficient way toward modernization. On the other hand, regimented strategies may not be appropriate for every kind of land records user. One of WLIP's objectives is to change the way land records professionals manage land records by encouraging the use and generation of digital land information that can be used for multiple purposes rather than single purpose endeavors. WLIP provides a framework to implement the basic elements germane to multi-purpose land information systems, but gives individual agencies discretion as to how best implement modernization within their realm.

By virtue of their increased investment in modernization activities, some counties have made more of a commitment to the modernization process than others. This may be due to the county's history with modernization, the economic status of the county, or any number of other factors (HUD, 1976; Onsrud and Pinto, 1993). However, no means exist to measure modernization activities. This thesis examines six variables that potentially influence the modernization process and develops indices to reflect the status of modernization activities in a county. Measuring the extent of modernization is a difficult task because the process is multi-faceted and cannot be easily observed. Therefore, the author constructed indices using the basic elements supported by the literature and WLIP's framework for modernization -- multi-purpose land information system (MPLIS) , data automation, and information technology index. The analyses were done to evaluate what relationship exists between the proposed factors related to modernization and the actual status of modernization in each county.

RESEARCH OVERVIEW

The focus of this research is on the diffusion of an innovation -- automated land information systems (LIS) -- to modernize land records in Wisconsin. Three main concepts are addressed throughout this document: innovation, diffusion, and modernization. An innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption (Rogers, 1993). Diffusion refers to the process of communicating an innovation to and among a population of potential users (Onsrud and Pinto, 1991). Land records modernization is "the capture of technology to invigorate and update land information, land records, and land information systems" (WLIP, 1992c).

Modernization is a process that involves a continuous feedback loop. Environmental conditions continuously affect the diffusion of automated land information. Introducing new ideas to solve old problems may bring to surface latent institutional barriers such as overcoming institutional inertia, departmental rivalry, attitudes towards data security, and commitment to long-term investment when the status quo is challenged (Burrough and Jones, 1993). The goal of this research is to provide a picture of how variables that are hypothesized to promote automated LIS diffusion actually relate to the level of innovation diffusion at the county level, where the Wisconsin Land Information Program (WLIP) acts to support the conceptual framework needed for modernization. Counties with environmental conditions supporting diffusion are expected to be farther along the path towards modernizing land records.

Theoretical Relevance

The Wisconsin Land Information Program (WLIP) exists to support the diffusion of a particular type of innovation: modernization of land records via automated LIS. Throughout this thesis automated LISs are considered a form of innovation, because an automated LIS is potentially a more effective and efficient means to manage land records than current systems. This research focuses on WLIP's (1992d) plan to implement modernization activities, and their definitions will be used as the basis for understanding land records, land information and land information systems (Appendix 1).

Land records are "the **medium** (emphasis added) in which land information is stored" (WLIP, 1992c). Land information refers to "any physical, legal, or economic **information** (emphasis added) concerning land, water, ground water, subsurface resource, or air" (WLIP, 1992c). A land information system is "the **means** (emphasis added) by which land information is organized and managed in an orderly fashion" (WLIP, 1992c). Land information describes attributes and the location of land. Information may exist in hard copy formats such as paper maps, or it may exist in digital format, such as magnetic tape. Records holding information may then be used to build land information systems (Figure 1.1). Understanding the previous terms will aid in comprehending the process of land records modernization. The modernization process includes the effective handling of land records, which involves improving means of collecting, storing, using, and disseminating information related to land (ASLI, 1990). These definitions explain the end result of modernization, but do not adequately explain how this process is implemented.

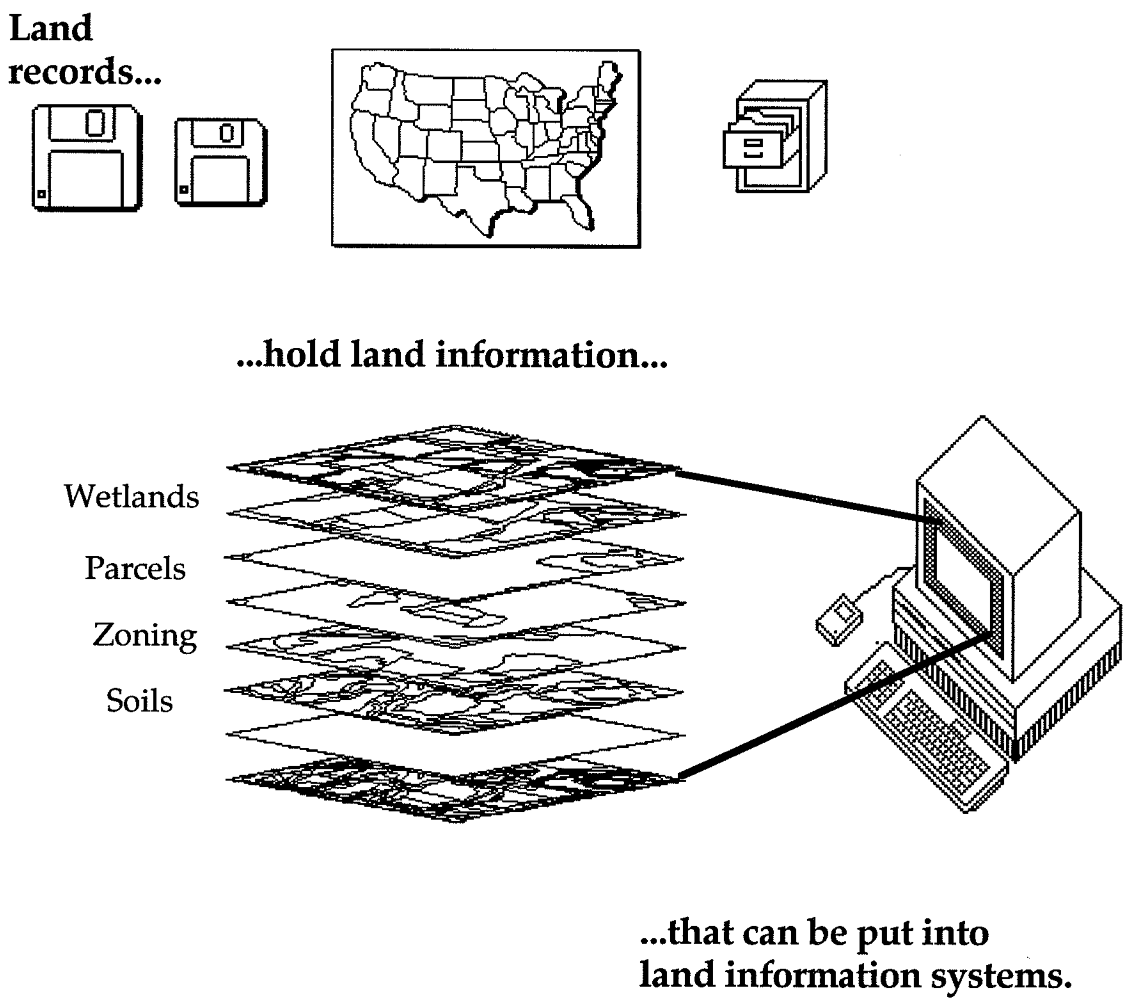

Figure 1.1 Components of a Land Information System.

Wisconsin's state-wide efforts to modernize land records provide a unique opportunity to empirically examine how the diffusion of innovation, such as the modernizing of land records, occurs. Charting the progress of modernization on an annual basis will aid in documenting and measuring the rate of diffusion implementation within the state. This work will provide a framework for tracking modernization over time. In addition, the opportunity exists to examine long-term investment in modernization activities to determine if resources have been spent wisely. This research coupled with a confidential survey (Ventura et al., 1993), will support further research to determine if WLIP has had a causal effect on increased modernization activities within the counties.

BACKGROUND

Maintaining land records has been a function of the United States government since its inception. Managing land records has become an increasingly complex task since this country was founded. Obtaining information necessary to comply with land related mandates has caused many problems in their efficient and effective use because of the increased number of parcels and number of building permits issued, to name a few indicators. In the last 15 years, much attention has been given to the design, construction, and maintenance of a framework to modernize land records (Perry and Kraemer, 1979; Niemann, 1984; Fletcher et al., 1992). One innovation involved in changing the status of and rectifying problems associated with land records is using automated land information systems (LIS) in local governments to modernize land records.

Modernizing land records is based on building more effective means to extract data from new and existing files for analyses by using geographic and land information systems to manipulate information about areas of land. One of the goals of modernization is to change the medium of the information from hard copy to digital format. The change in format is driven by the idea that data tied to a common reference system may be more readily analyzed. Having natural and cultural land information in a digital format makes possible more complex and more diverse analyses. In a digital environment it is possible to integrate or overlay different data sets -- e.g., soils, parcels, and wetlands -- so that information from many sources may be pooled (Figure 1.2). Hard copy material does not readily provide the means to extract this information into a composite map.

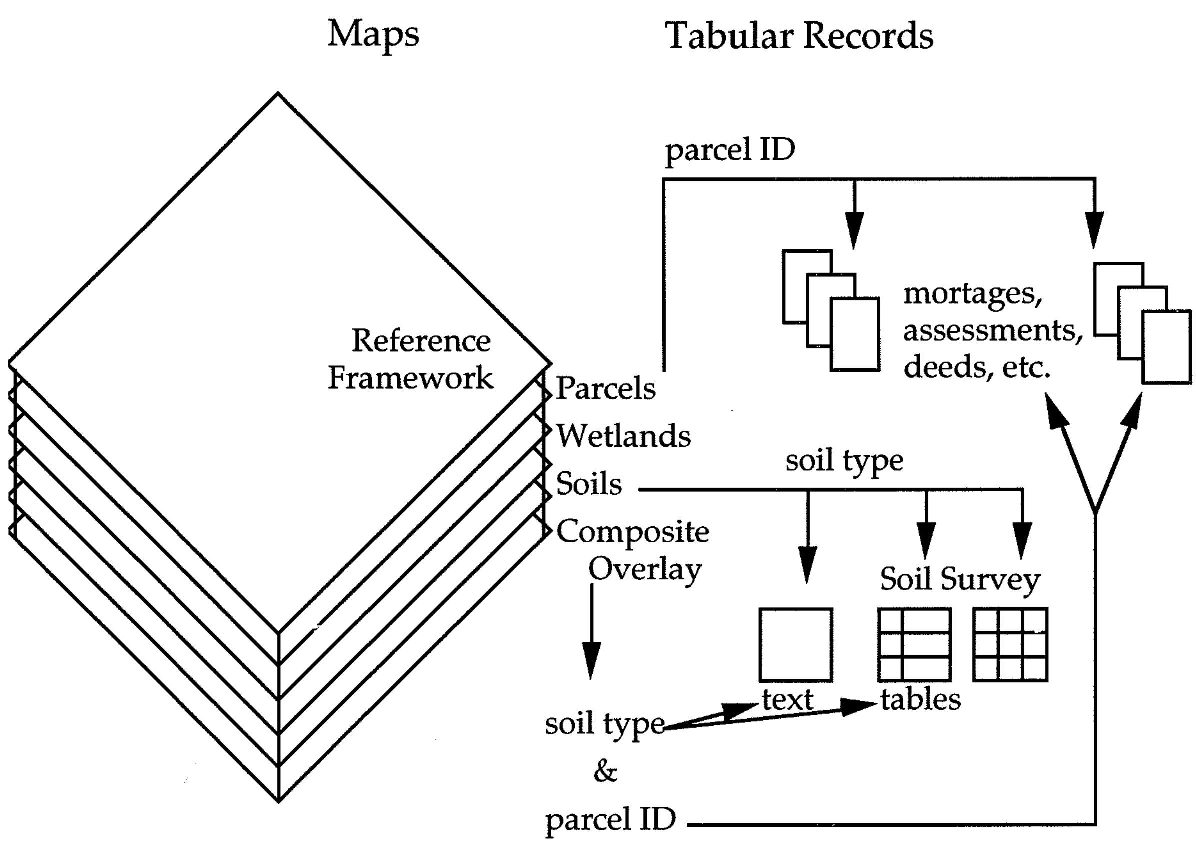

Figure 1.2 Concept for a multi-purpose land information system.
(from Vonderohe et al., 1991)

Moving from hard copy to digital environment is considered innovative, for it is not historically perceived by the land records community as the norm for managing land records. Innovation is difficult to diffuse because of the large degree of uncertainty surrounding new ideas or methods. The process of diffusion is not as fast as many individuals would like it to be; therefore, research has focused on identifying variables promoting and inhibiting the rate of innovation diffusion among users (HUD, 1976; Onsrud and Pinto, 1993).

Many members of the land records community have worked to promote the adoption of LIS. As momentum builds, the five stages associated with diffusing innovation are realized in most jurisdictions: knowledge, persuasion, decision, implementation, and confirmation (Rogers, 1983). This linear progression is based on setting up communication channels so that new ideas can be shared within the user community (Rogers, 1993; Goodman, 1993). As the process continues, users eventually find that they have incorporated LIS into their routines, and it has become mainstream (Onsrud and Pinto, 1993).

History of Land Records

Land records are used at many levels of government. However, this investigation will focus on the county as a hub for modernization activities, because much investment and activity occurs at this level to create and maintain land records (Larsen, 1978; Fletcher et al., 1992). Many land use decisions are made at this level, as those who are ultimately affected will benefit from being involved in the decision-making process. County governments are also the major providers of direct services and aid in managing land resources (Sullivan et al., 1985; Fletcher et al., 1992).

Counties are especially suited for modernizing land records, because sharing information can be most efficient in a limited geographic area by using local institutional arrangements. County governments are natural entities to facilitate the horizontal and vertical integration of information, because their vision is not obscured by the vast needs of the entire state or limited to the specific needs of a particular local unit of government. Thus, counties serve as a natural vehicle to bridge the gap between these two extremes (Fletcher et al., 1992).

Some Wisconsin counties were active in modernization activities before the inception of WLIP. Many people in a variety of organizations have influenced the modernization process. In Wisconsin, momentum grew with the formation of the Wisconsin Land Records Committee (WLRC). Their efforts led to the formation of an *ad hoc* consortium, later becoming the Wisconsin Land Information Association (WLIA) who, ultimately generated enough political support to obtain legislation adoption of the Wisconsin Land Information Program (WLIP, 1992a).

Impediments to Modernization

Land records must be organized to overcome the multitude of problems related to accessing and assimilating land information. As land records are collected, stored, and used by various agencies, the resulting data is collected at varying levels of precision and accuracy. Data cannot always be used to their fullest potential because many standards are not accepted across agency boundaries. Data may not exist or may require resources to access that are in excess of primary data collection. As a result of these inefficiencies, time, space, money and energy are wasted by competing agencies.

Lack of standards between and within agencies compound these problems. The inability to integrate different types of data from different sources contributes to the repeated collection and storage of data as agencies attempt to modernize their records (Clapp et al., 1988). Building consensus, and thus standards, to make technology more compatible with existing structures grows as the technology matures. GIS is still in its adolescence, and many standards are still evolving (Wortman, 1993). As the diffusion process continues, the ease in adopting technology should continue as more solutions to problems are found.

Technical impediments to modernization can be more easily overcome than social impediments. Technical decisions involve determining what software and hardware is most suited for an organization. This decision can be easily made with user needs assessments, and subsequently has far less of an impact on the adoption decision. Cost of hardware and software is a factor in making the adopting decision, but if organizational support is lacking, the means to implement technology is irrelevant. It is for these reasons that the factors that may promote the adoption and implementation of innovation in this research are primarily social.

Modernization involves change, learning new skills, adopting new ways of doing old tasks, and doing jobs one may not particularly enjoy. However, once new skills are mastered, they become commonplace. Users may find the new ways of doing tasks may become more efficient and effective for their needs, and jobs that were not particularly enjoyable become more tolerable as their confidence and skills increase. Employees often resist new practices in favor of the status quo. Staff may also dislike the status quo, but like the new idea even less. This institutional inertia is one of the major hurdles to overcome in the process of adopting innovation.

Portner (1982) found that land records professionals generally work to achieve their own goals; they do not act in the collective good when collecting land information. Generally, their efforts are single purpose and short-term in perspective. Strong leadership is needed to overcome this barrier. Due to the many users of land information, a focal point is needed to coordinate efforts, set priorities, and determine resource requirements (NRC, 1980).

Strategies to overcome counter-productive collective behavior include improving communication, providing incentives, and issuing mandates (Hardin, 1968). Concentrating on improving communication may be an effective strategy to diffuse innovation throughout the state to overcome institutional inertia. Creating communication channels would also fall into Rogers' (1993) scheme of reaching a "critical mass" to diffuse innovation, which will be discussed in greater detail in following chapters. The impact communication networks have had on the modernization process is also a part of the research question being asked.

Offering economic incentives is another method to support new projects that often require fiscal and technical support. Generally, resources are not allocated where the work load has increased. For example, the federal government has tended to shift the responsibility of fulfilling requirements of implicit mandates to those at the local level without providing fiscal support (Ventura and Giampetroni, 1992). This incongruency makes the jobs of those who must satisfy mandates challenging.

Using appropriate tools to effectively fulfill mandate requirements is another challenge. The new technology that makes compliance with mandates potentially more feasible, unfortunately, has substantial start-up costs. This is due to applying cost-benefit equations that are not really appropriate for GIS products (Wunderlich and Moyer, 1984). For example, what price is placed on better, more efficiently retrieved information or more equitable decisions? Providing economic support for new technology would focus more attention on the less tangible benefits and down-play the initial expenditures needed to implement new systems.

Land records professionals encounter a number of problems as they implement technological change. Applying problem-solving strategies to the land records arena means developing a mandate that provides economic incentives and improves communication between land records professionals to overcome impediments leading to modernization. Although technological factors are worthy of consideration, the key to the adoption and diffusion of innovation is still primarily social, for creating mandates is a social phenomenon.

Improving Land Records

As a result of existing problems, much attention has been given to developing means to improve the status of land records (Cook and Kennedy, 1966; NRC, 1980; McLaughlin, 1988; Huxhold, 1984). The Wisconsin Land Records Committee (WLRC) was formed to investigate the issues related to managing land records. The Wisconsin Land Records Committee (FRWLRC, 1987) constructed a list of recommendations to modernize land records.

The WLRC spent two years investigating the components necessary for modernizing land records to create a multipurpose land information system. Their recommendations include supporting legal, economic, institutional, educational, and technical frameworks to form a program to modernize land records. Once met, these recommendations will support a variety of land information systems (FRWLRC, 1987). WLRC called for a legal mandate to support the myriad activities related to land records modernization. The Wisconsin Land Information Program (WLIP) is the legislative result of their recommendations and will be discussed in the next chapter.

Diffusion of Innovation in Wisconsin

The Wisconsin Land Information Program is a formal attempt to make data available, integrated, and accessible while maintaining confidentiality (WLIP, 1992d). WLIP also provides leadership to reduce duplication of land information, and provides financial support for land records modernization (WLIP, 1992e). Because much activity and investment occurs at the county level, efforts to modernize are focused where the need exists.

WLIP supports the modernization of land records by providing economic support coupled with an implementation plan for modernization. Improvements are expected by counties participating in the program, and some have already been realized (Niemann, 1993).

At this point, the WLIP has allocated substantial resources toward modernization activities. The WLIP's 1992 Annual Report Survey has provided initial documentation to record the extent that this innovation has spread throughout the state. Recording the status of modernization activities occurring within each county may aid in determining the type and rate of innovation adoption. This is significant, as the Program contained a sunset clause that would have ended it on 1 July 1996. These determinations complete the statutory requirement for an evaluation, and could aid in showing that the Program acted "carefully, thoughtfully and with dispatch" (WLIP, 1992c).

CONCEPT AND FRAMEWORK FOR THESIS

The general structure of this research is first, to identify internal and external environmental variables that might support diffusion of innovation. The second component is to develop indices of innovation implementation to measure the level of modernization implementation within each county. The model used to describe diffusion is based on a systems interactions model (Chapter 3). This model considers external and internal environments as primarily influencing policy and outcomes. The final component of this research is to examine the relationship between the variables and the extent of modernization implementation so counties in Wisconsin may be effectively characterized.

To examine the adoption and subsequent implementation of innovation, this research used both content and process models to illustrate the modernization process. Content models focus on isolating the essential variables leading to the acceptance of the innovation; process models focus on the key phases in the diffusion of innovation (Onsrud and Pinto, 1993; Kraemer et al., 1989; Rogers, 1983). While a process model applies generalizations to a specific case, a content model effectively uses detail to expand and explain internal processes related to the case study.

In Roger's (1983) process model, prior conditions influence the extent of diffusion (Figure 1.3). Many factors are associated with promoting the diffusion of geographic information technology. However, this thesis focuses on six variables that might affect a county's likelihood for adopting automated LISs in Wisconsin. Roger's model provides the context for these analyses. After identifying key factors related to the adoption of innovation, Schultz et al. (1987)

recommend using a process model to examine key phases of innovation. Onsrud and Pinto (1993) suggest that initiation (adoption) and implementation are the two main phases that exist for the diffusion of innovation. However, Rogers (1983) breaks down the diffusion into five stages. For the purposes of this research, it is assumed that counties participating in the Wisconsin Land Information Program have made an affirmative decision to adopt. What remains to be seen is to what extent has automated LIS been implemented in each county.

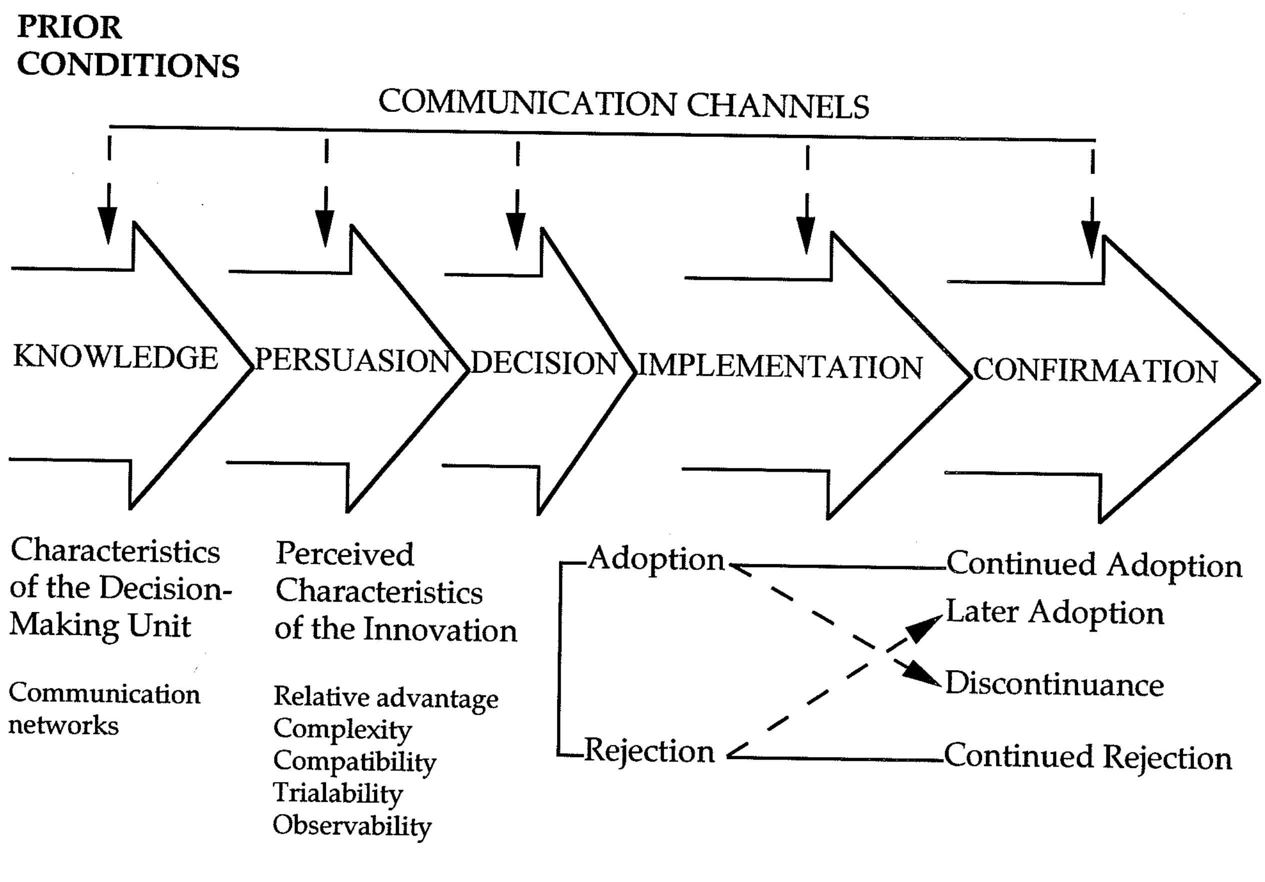

Figure 1.3 Stages in the Innovation-Decision Process
(Rogers, 1983. p.165)

Kraemer et al. (1989) use three components to model diffusion: environment, action, and outcome (Figure 1.4). Elements of this research can be inserted into the Kraemer et al. model because this model adds to our understanding of the Wisconsin situation. The environment is indicative of prior conditions that affect the diffusion of automated land information systems. This research considers different elements of the environment that may affect diffusion. Action is some measure or policy resulting from need perceived in the environment. WLIP represents the action land records professionals took to improve the way they manage land records. The outcome is a product of their efforts -- establishing automated land information systems. This research address the relationship between conditions in the environment and the level of diffusion.

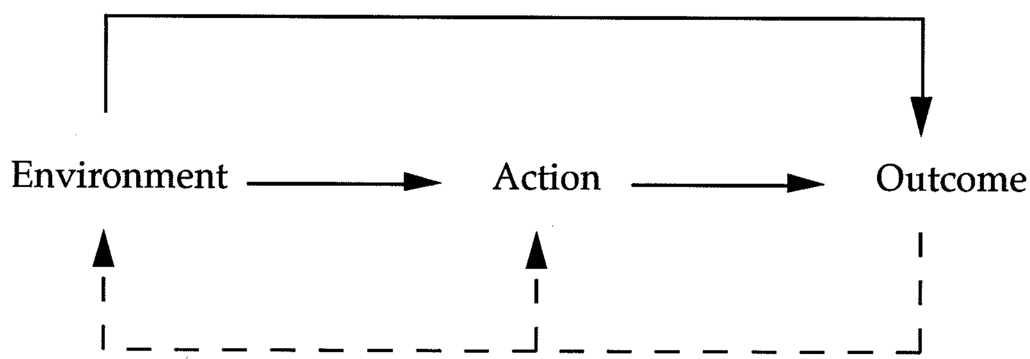

Figure 1.4 Variables in a General Model for Change
(Kraemer et al., 1989. p.7)

To gauge the progression of modernization activities in Wisconsin, technical indices were developed to reflect the outcome -- implementation of automated land information systems. These indices are designed to measure the extent of modern, multi-purpose land information systems and are based on the recommendations from WLRC (1987) and requirements of WLIP (1992d).

Three technical indices were developed in this research to measure the basic components of land information systems, information technology elements, and extent of automation of land records. These indices will be discussed in greater detail in following chapters.

By combining both content and process models, this research will examine the relationship between environmental variables promoting the adoption and subsequent implementation of innovation.

Hypotheses

Internal environmental variables are elements in the environment that affect the adoption decision, such as communication networks and institutional arrangements. Decision makers must consider organizational conditions, and many others, when deciding to adopt an innovation. The adoption decision involves knowledge of pertinent information and persuasion that the innovation will be useful to the organization, thus making communication and access to information vital in the diffusion process. Therefore, the first set of variables that may promote adoption of innovation are organizational in nature.

According to Rogers (1993), organizational factors primarily affect diffusion. Individuals tend to evaluate innovations and base their decisions on experiences from other adopters. Therefore, institutional arrangements must exist to form communication networks. In addition to forming informal or formal institutional arrangements, participation in professional organizations also facilitates communication. These two categories, along with the history of modernization activities, will be the basis for evaluating organizational conditions within each county.

The following hypotheses are the basics used to predict the diffusion of innovation in counties. Details of the theory and methodology will be discussed in chapters three and four, respectively.

Hypothesis 1:
The number of Wisconsin Land Information Association professionals in a county is positively correlated with an Multi-purpose Land Information System (MPLIS) component, information technology, and data automation index as indicators of the extent to which modernization has diffused in the county.

Hypothesis 2:
The number of formal and informal institutional arrangements in a county is positively correlated with an MPLIS component, data automation, and information technology index as indicators of the extent to which modernization has diffused in the county.

Hypothesis 3:
The investment prior to WLIP as a function of total investment is positively correlated with an MPLIS component, data automation, and information technology index as indicators of the extent to which modernization has diffused in the county.

External variables represent opportunities and uncertainties in the environment that influence the implementation of innovation. External environmental variables affect the potential for adoption because new projects must have fiscal support, along with organizational support, for effective implementation. Favorable economic conditions provide more secure environments which may free up resources for potentially risky ventures, while adoption of innovation may be slowed if resources are limited. Per capita tax base expenditures and county growth rates will be used as indicators of economic conditions. Potential land records activity will be used as indicators of opportunity that exists for counties to modernize land records due to revenues from WLIP.

Hypothesis 4:
Per capita tax base in a county is positively correlated with a MPLIS component, data automation, and information technology index as indicators of the extent that modernization has diffused in the county.

Hypothesis 5:
Population growth in a county is positively correlated with a MPLIS component, data automation, and information technology index as indicators of the extent that modernization has diffused in the county.

Hypothesis 6:
The ratio of retained fees to number of parcels in a county is positively correlated with a MPLIS component, data automation, and information technology index as indicators of the extent that modernization has diffused in the county.

Legislative initiative was taken to improve the condition of land records information with the hopes of developing a state mandate that might assure the development and maintenance of a land records information network (Chrisman et al., 1984). WLIP is the result of this legislation. Measuring the status of modernization activity within WLIP's implementation plan is the core of this research and is discussed in the next chapter.

CHAPTER 2 - THE WISCONSIN LAND INFORMATION PROGRAM

MOVING TOWARD MODERNIZATION

A crucial step in developing a plan to promote land records modernization occurred in August of 1985 when Wisconsin's Governor Anthony Earl officially established the Wisconsin Land Records Committee (WLRC). WLRC's goals were to examine the status of land records and provide recommendations for data custodianship to better manage land records. In addition to developing guidelines for agencies, the committee suggested approaches to solve long term issues relating to land records modernization for the entire state (Clapp et al., 1988). The WLRC was made up of 32 professionals whose jobs were related to land information. They were divided into 12 subcommittees to examine the capitalization of land records, codes and statutory requirements, data responsibility, maintenance and security, property records, interagency and intergovernmental data processing, geographic reference standards, emerging technologies, institutional arrangements, cooperative arrangements, developing model requests for proposals, and the costs and benefits of modernization. Altogether, more than one hundred land records professionals were involved through participation in subcommittees.

Recommendations for Multi-purpose Land Information Systems

Based on their findings, WLRC recommended the following five objectives be met to create an environment conducive to building multi-purpose land information systems.

- Legal Objective:
  To resolve omissions, duplication, and inconsistencies in constitutional authorities, laws and statutes, and administrative rules that hinder the overall goal of modernizing land records.

- Economic Objective:
  To develop new and existing public and private revenue sources and create incentives to maximize benefits and minimize costs

- Institutional Objective:
  To develop professional standards and cooperative arrangements among public and private agencies, including utilities.

- Educational Objective:
  To promote educational, research, and outreach efforts toward development and evaluation of supporting software, hardware, and personnel.

- Technical Objective:
  To promote technically sound procedures and practices that foster modern, efficient mapping and database management. To use these procedures to establish a geographic reference framework, and to create a land information network among the private sector, utilities, and all levels of government.

(WLRC Final Report, 1987)

As interest continued to grow in modernization, energy was focused on legislation to improve land records. Members from WLRC and the Ad-Hoc Consortium for Land Records Modernization in Wisconsin joined forces to form the Wisconsin Land Information Association (WLIA). This interest group used their political influence and the recommendations from WLRC to structure a formal program to modernize land records. From WLIA's efforts came the passage of Wisconsin Acts 31 and 339, which formed the Wisconsin Land Information Program (WLIP) and accompanying funding mechanism (WLIP, 1992c).

THE WISCONSIN LAND INFORMATION PROGRAM

The principles of WLIP are based on providing a loose structure for building components needed for a multi-purpose land information system (MPLIS), while allowing counties flexibility to fulfill their own needs. These principles include developing systems that are multi-participant and multi-purpose. WLIP is intended to be independent of specific technologies, and to foster systems that are evolutionary, geographically-based, and encompass many types of land information activities to promote basic democratic principles (WLIP, 1992d). These principles provide the foundation for constructing the three indices of implementation used in this research.

WLIP's success depends on building public-public and public-private partnerships, as the horizontal nature of maintaining land-related information makes organizing and managing data challenging in a vertically structured governmental system (NRC, 1980). WLIP promotes a "bottom-up" strategy that allows counties to plan and develop their own modernization activities. This enables new modernization activities to be compatible with and easily incorporated into the counties' existing infrastructure.

WLIP is a program that uses a decentralized decision making structure with a coordinating propagator for the diffusion of innovation. Each county has a Land Information Officer (LIO) who operates in existing offices as a point of contact and to conceive and implement its modernization strategy. The degree of coordination by propagators may influence the pattern of diffusion (Brown, 1981).

In its structure, WLIP utilizes both centralized and decentralized methods to modernize land records. WLIP is designed to support a central "clearinghouse", with the objective of providing a means to locate data for state-wide use. However, this has not yet come to fruition. The counties are also encouraged to form decentralized "confederations" for building multi-purpose land information systems (WLIP, 1991d). Formation of a decentralized confederation of counties involves facilitating activities that conform to the basic principles of land records modernization (WLIP, 1991d).

The loose structure provided by WLIP focuses on information, not specific types of hardware or software. Information is needed to build databases that can used by various agencies. Uniformity of hardware and software is not essential, for different configurations are needed for different purposes. In addition, the technology is at a point where most information can be converted into different formats without corrupting the original data. Keeping the focus on land information allows the data to remain usable while still allowing the technology to evolve.

Having information about parcels, zoning, soils, and so forth, tied to a common reference system and available to a variety of agencies can support a multitude of activities. As land information is used by many agencies, forming partnerships to share data will save time and tax-payers' dollars, for data will not have to be produced independently by each agency. Overall, the objective is to create a way of managing land records that will make better information available so that more informed decisions may be made to provide more equitable treatment to citizens.

Funding Mechanism

Many choices involved with designing and implementing a land information system are inevitably based on revenues and expenses. Economics determines what data are gathered, to what accuracy, and the frequency for updating land information (Wunderlich and Moyer, 1988). Developing an information system is a long term project. A plan is needed to cover costs for collecting, processing, and distributing data in order to justify implementation of new information systems (ASLI, 1990). A consistent source of funding is needed to provide security for projects that may not provide immediate or tangible benefits.

In recognition of this need for stable, long-term funding, WLIP provides earmarked funds via the 1990 Act 339 to support modernization activities. This funding mechanism is based on an increase of the first page recording fee at County Registers of Deeds. On 1 July 1990, the filing fee increased from $4 to $8, with a subsequent $2 increase on 1 July 1991. Every 16th day of the month all fees collected are handed to the WLIB. The counties may retain $6 of the original $8 fee as well as the additional increase so that $2 is all that is eventually maintained by the WLIB. This may be done if specified criteria have been met. A county Land Information Office needs to be established. This can be stationed in an existing office, but it must provide a means to monitor and implement activities within the counties. The second criteria is that a county-wide plan must be prepared within two years after the formation of the Land Information Office or the effective date of the Policy (1 July 1990). The last criteria is that the retained fees are earmarked to promote activities associated with the County plan (WLIP, 1992c). As of March 1994, all 72 counties had complied with these provisions.

Counties participating in the program are also eligible to apply for grants-in-aid. Grants are disbursed twice annually. Grant recipients must show in their proposals that their projects will involve cooperation with other institutional entities, focus on the foundational elements, be consistent with their county-wide plan, have tangible products, and have a high probability for success. The maximum grant allocated to any one county or local governmental unit is $100,000.

County and WLIB Obligations

To orchestrate land records modernization at a local level, a contact person (land information officer) acts in each participating county to:

- coordinate land information projects within the county, and between the county and other public and private sectors;
- develop and receive approval for a county-wide land records modernization plan;
- review and recommend projects for the grants process.

(taken from Statues and Administrative Rules Applicable to the WLIP, 1992b)

This Land Information Officer (LIO) is the primary contact, however, some counties form a committee for their land information office, drawing expertise from a wide range of professions.

In addition to the County LIOs, the Land Information Board (LIB) was created to perform the following statutorily assigned tasks:

- provide technical assistance and advice to state agencies;
- maintain and distribute an inventory of land information;
- prepare guidelines to coordinate the modernization process;
- review project applications;
- review county-wide plans.

Also, the Wisconsin Department of Natural Resources (DNR) and other state agencies, the University of Wisconsin, the State Cartographer's Office are all involved with developing methods and disseminating information to improve land information (WLIP, 1991b).

Foundational Elements

WLIP's plan for implementing modern land information systems includes incorporating basic components for modernization activities with data standards and administrative rules. The building blocks WLIP uses for modernizing land records are called "foundational elements." The five technical foundational elements include a geographic framework, parcels, soils, wetlands, and zoning mapping, which form the framework for a multi-purpose land information system (MPLIS). However, to make the program effective, administrative structures are needed. The three remaining foundational elements -- institutional arrangements; education, communication, and training; and public access arrangements -- fulfill the organizational void. As a part of the implementation "environment," these latter elements are of particular interest to this study.

WLIP supports professional coordination by providing a framework for an integrated, decentralized confederation of land information systems. To facilitate cooperative ventures, WLIP has incorporated institutional arrangements as one of its eight foundational elements to support integration of data within and between agencies. Even though technical standards exist, they will have fairly limited applications in a land information network if they are not shared by others. Arrangements must be made to include different agencies sharing data so as many needs may be met as possible. The relation of communication channels to the level of modernization implementation will also be explored in this research.

Another step towards modernization is sharing information about innovations or problems with other members of the land records community. This task can be accomplished by incorporating communication, education and training as another of its foundational elements. According to theory, increased communication among peers and understanding new procedures facilitate the modernization process.

Public access arrangements is the last of the institutional foundational elements. After organizing and collecting information, data must be made available to the public, for they are the ones who primarily finance land records modernization. It is believed that quality information made available to decision-makers will enable better decisions to be made to support the public good.

In addition to changing the way professionals think about land records, methods to manage land records must also be altered. The nature of LIS demands attention to technical objectives. WLIP facilitates the sharing of information between and within agencies by supporting a common format for exchange of data, and by calling for standards to support the five technical foundational elements for modernizing land records.

WLIP's technical foundational elements include guidelines and standards for forming a geographic framework, parcels, soils, wetlands, and zoning mapping. These elements are the basis for an MPLIS. The bulk of the standards are related to parcels information and geographic frameworks because of their complex nature and the fact that they provide the basis for the two most crucial elements for an MPLIS, the base map and geodetic control. If a system is to be utilized by multiple users, standardization must occur at this basic level. Without such a common denominator, data sharing and overcoming management problems may be inhibited.

In an attempt to coordinate technical efforts, the following geographic framework standards have been integrated into WLIP:

- Geodetic Reference System: coordinates are based on the Federal Geodetic Control Committee (FGCC) procedures;
- Remonumentation of PLSS corners must adhere to State Administrative Codes;
- Coordinates values for PLSS sections must meet or exceed FGCC Third Order Class I standards;
- Vertical geographic control must meet or exceed FGCC Third Order, Class II standards;
- Human made and natural resource features must abide by National Map Accuracy Standards.

(WLIP, 1992d)

In addition, WLIP prescribes standard for parcels. They are as follows:

- Registers of deeds records must meet or exceed requirements set forth by the State statutes,
- Parcel identification systems must abide by data interchange standards.

Standards for the remaining technical foundational elements require that wetlands mapping activities must adhere to DNR wetland standards and state statutes, soils mapping activities must adhere to U.S. Soil Conservation Service standards, and zoning mapping must be based on compiling existing local zoning maps (WLIP, 1992d). By supporting these standards from various levels, information may be more easily disseminated through various levels of government by multiple users.

RELEVANCE TO WORK

The pieces for the framework to build a modern MPLIS may exist in law, but the extent that modernization has been adopted and implemented has yet to be quantified and traced over time. WLIP's foundational element focus forms the framework for indices to measure the extent of automated land information systems. WLIP's objectives emphasize basic components necessary for modernizing land records and provides a means of resolving problems germane to land records.

WLIP's foundational elements will be used as the basis for measuring implementation of the modernization activities in the counties. The technical and institutional nature of the foundational elements represent a framework for the diffusion of land information systems. The institutional elements will be used as variables to predict the level of implementation of innovation and the technical elements will be used to measure the actual implementation of innovation in counties. Developing indices of implementation based on the degree of land records modernization activity is a means to evaluate the level of innovation diffusion in Wisconsin counties.

CHAPTER 3 - DIFFUSION OF INNOVATION

Diffusion of innovation has been studied across many disciplines. The use of this concept by a wide range of disciplines stems from the perceived need to improve traditional methodologies for increasing effectiveness as well as a means to understand social or cultural changes (Rogers, 1983; Wilson, 1984; Brown, 1981; van der Leeuw and Torrence, 1989).

Diffusion describes the cumulative change that results from bringing innovation into general use (Wilson, 1984; Weinberg, 1972). Innovation is not a means to an end but is cyclic (Wilson, 1984). For example, computers are continuously upgraded. The early days of computer technology were characterized by hulking machines that filled rooms and were painstakingly slow. Now, computers fit on the top of a desk, have increased storage capacity, and are capable of faster processing at drastically reduced costs. The technology continues to advance.

The extent to which an innovation diffuses is a function of environmental conditions--factors internal or external to an organization that potentially influence the diffusion process. Environmental variables that may promote or inhibit the diffusion of automated land information systems (LISs) are still under investigation (Onsrud and Pinto, 1993; Ventura et al., 1993). It is not always possible to examine *a priori* variables, as is recommended by some methodologists, since the emergence of an innovation is not always conspicuous (Campbell and Stanley, 1963; Brown, 1981; Kraemer et al., 1991). However, it is possible to take a look at a specific point in time to examine the status of the innovation and examine the environment in which it is diffusing to look for correlations between the environment and the diffusion of innovation (Holland, 1986).

Rogers (1983) developed a paradigm that illustrates the diffusion process and subsequently can be used to understand social behavior associated with adopting and implementing innovation. He uses four elements to define the diffusion process: (1) innovation (2) is communicated (3) to a social group (4) over time. The definition is so broad it can have many applications. Therefore, the above definition has been reformed to reflect the objectives of this research: (1) the implementation of land information systems (3) by land records professionals (4) since the inception of the WLIP (2) is related to internal and external environmental variables.

ELEMENTS OF DIFFUSION

Innovation is a new idea, object, or way of performing a task. Innovation in the world of land records involves the use of automated land information systems (LISs). For many land records professionals, moving from an analog to a digital environment is a new way of managing land records. Some contend that the shift to LIS is a response to satisfying operational mandates and to the increasing problems associated with current systems used to manage land records (Ventura et al., 1993). Systems are inadequate and make queries costly and time consuming. More complete information is needed for decision makers, for many data are not available or contemporary. Therefore, creating digital information systems is one method to cope with difficulties in managing land records.

Diffusion of innovation is a type of communication that centers on the spread of new ideas. The uncertainty presented by new ideas is due to their lack of predictability, structure, and information. Channels for communication between homogeneous groups are the means by which innovation is passed from user to potential adopter (Rogers, 1983). Interpersonal communication allows potential users to evaluate innovation on the basis of what individuals, like themselves, think about the implementation of innovation (Kraemer et al., 1989). Rogers (1983) believes that individuals with similar characteristics have a greater impact on potential adopters' decision to adopt than the results of scientific research or other forms of technology transfer. Individuals are more likely to trust individuals with similar backgrounds and goals than outsiders who may motivated by different goals. Problems arise when communication is not effectively transmitted due to different backgrounds or an inability to share a common frame of reference. Communication is definitely a factor, but it only explains a part of the internal dynamics in the diffusion process (Rogers, 1983).

The arena for communication is the social system, which is filled with those who affect the viability of the innovation (Goodman, 1993). The social system provides a boundary for innovation to diffuse. System norms dictate acceptable behavior which acts to promote or inhibit diffusion of innovation. Within the system are opinion leaders and change agents that act to influence the diffusion process. Opinion leaders provide information about innovation. They are usually characterized by their high degree of technical competence, social accessibility, and conformity to social norms. Rogers (1983) explains that they are also (1) more exposed to external communication, (2) more cosmopolitan, (3) of higher social status and (4) more innovative. However, the most essential criterion is that they are at the center of interpersonal communication networks so they may exert their influence to promote diffusion. Change agents differ in that they are generally not a part of the social system. Their goal is to influence the direction of diffusion, either positively or negatively, by using opinion leaders. The role of opinion leaders and change agents has been recognized in

LIS and are often called LIS champions (Ventura, 1991). Their role has just begun to be studied in detail (Jeffress, 1992).

Stages of Diffusion

Many authors have provided their individual perspectives on the process of diffusing innovation. McGlade and McGlade (1989) base diffusion of innovation on the following stages: adoption and rejection with awareness, interest, evaluation, trial, and adoption- which may lead to discontinuation. Similarly, Myers and Marquis (1969) view the innovation process as recognition, idea formulation, problem solving, solution, utilization and diffusion. Federal technology transfer agents viewed the process in the following manner:

> idea generation -- problem solving -- innovation
> adoption -- diffusion -- unanticipated consequences
> stimulus -- conception -- proposal -- adoption
> recognize problem -- search process -- innovation -- diffusion

(HUD, 1976 p. 131)

Alternatively, van der Leeuw and Torrence (1989) prefer to view the diffusion process as a phenomena that cannot be adequately described in small set of stages or variables because the process is so complex. They do not see the process as an event that can be defined.

The model found most recurrent throughout the literature is Rogers' (1983) (see Figure 1.3). The first stage of diffusion, knowledge, is a general awareness and understanding of the innovation. As knowledge of something new is acquired, attitudes are formed about the innovation. At this point, the potential adopter moves from a cognitive to an affective state where the type of information and how it's perceived plays a significant role. The next step is to decide whether or not to adopt the innovation based on the information received and attitudes developed by the potential adopter. Implementation is the act of putting the adopted innovation into use, and confirmation is the reinforcement of the innovation by providing positive messages about the innovation.

Although the diffusion of innovation appears as a linear progression, a constant feedback loop exists which may act to speed up or change the direction of the diffusion process. Some stages may even be skipped. In an organization's decision-making structure, decisions are reported at one level and made at another (McGlade and McGlade, 1989). The persuasion stage may be skipped at lower levels making those responsible for implementing new technology unsupportive. For example, the incentives for joining WLIP may be strong enough to elicit participation in the program, but resistance from personnel who have not been sufficiently persuaded or educated about the process may prevent the implementation of automated land information systems. Innovation may also be discontinued.

For the purposes of this research, Wisconsin counties will be placed beyond Rogers' (1983) adoption-decision phase. By participating in the Wisconsin Land Information Program (WLIP) one may assume that participants are familiar with and agree to conform to the objectives of the Program. Counties completing the activities necessary to be admitted into WLIP demonstrate their knowledge, persuasion, and an overt decision to implement the goals of WLIP.

Adoption of Innovation

The adoption of innovation is dependent on many variables. Rogers and Shoemaker (1971) thought that innovation must have a relative advantage over existing ways of doing things and be compatible with current practices. Knight (1967) noted that the perceived complexity of innovation by potential users affects the diffusion of innovation because tasks that build on an existing knowledge base are more likely to be adopted than ones that require new skills to be learned (. Also, the ability to test an innovation on a trial basis affects the diffusion process. This may impede LIS adoption, because LIS requires a substantial investment in time and money before benefits may be felt. Once benefits have accrued, the LIS products must be visible to other potential adopters, because increased visibility stimulates discussion and subsequent diffusion to other users (Rogers, 1983).

Not everyone adopts an innovation at the same time. The majority of people are not willing to move from the status quo to try something that has not been fully tested. The initial stage of diffusion is called the lag stage, where adoption decisions are overshadowed by fears of the unknown. Initially, only a few people are likely to use the capabilities of the innovation. As more information is disseminated through communication networks, more individuals begin to adopt the innovation. The next stage is the log stage, characterized by exponential growth after reaching what Rogers (1983) calls a "critical mass". At this point, the adoption of the innovation "takes off" and innovation can be said to have become a part of the communications network. At the log phase of adoption the innovation is generally seen as advantageous and more and more individuals adopt. The final stage of the curve is a stabilization process. At this point the innovation has been communicated through certain channels to most members of a population (Rogers, 1993). The innovation has become integrated into the system and now functions as a part of the status quo. If implementation is successful it may then be confirmed and

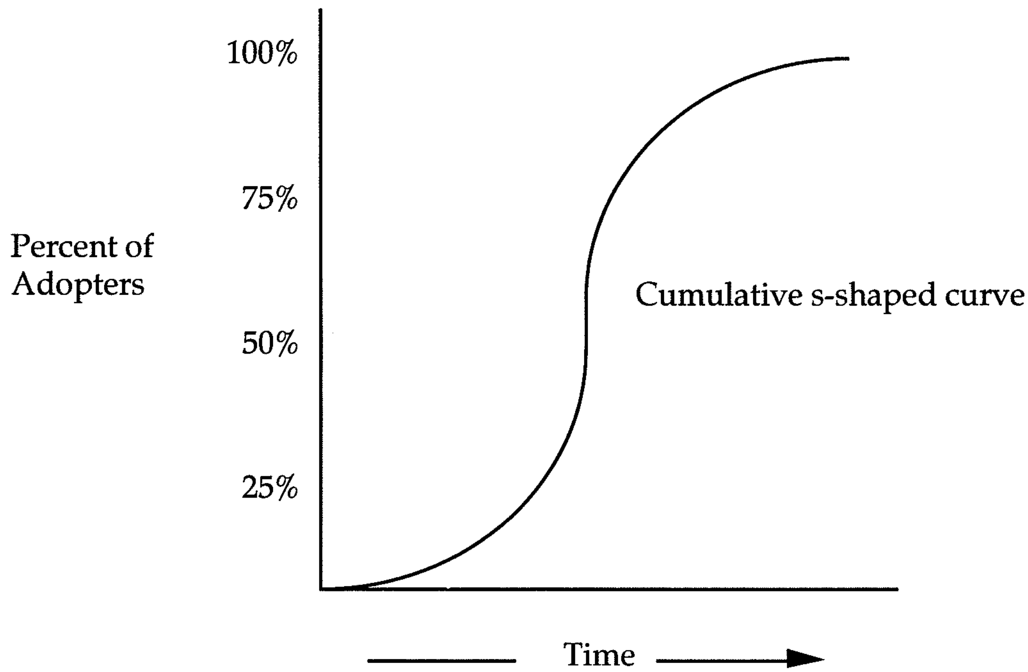

Figure 3.1 Cumulative Curve for Adopter Distribution
(from Rogers, 1983. p 95)

institutionalized (Goodman, 1993). The entire diffusion process follows an s-shaped curve (figure 3.1).

DIFFUSION MODELS

Content models isolate variables involved in the diffusion phase. The variables described in the literature related to LIS adoption are virtually endless. Variables used to measure internal and external environmental conditions that affect the diffusion process have been discussed in the literature (Brown, 1981; HUD, 1976; Kraemer et al., 1989; Kraemer and Dutton, 1991). For this research, only a handful of variables that would appear to be likely will be used to evaluate associations with the diffusion of innovation.

Content models are generally inconclusive, as they stand alone; they should be combined with a more comprehensive diffusion model (Onsrud and Pinto, 1993). This research will use a generic systems integration model to illustrate how variables are associated with the diffusion of LIS (see Figure 1.4). The content portion of the model will then be coupled with a process oriented model to identify to what extent counties have modernized land records.

An example of a systems interaction model is URBIS (Urban Information Systems) which focuses on the environment in which local government information systems operate (Huxhold, 1993). For example, the formation of WLIP was a response to prevailing environmental and institutional conditions. The diffusion of LIS requires that relationships between drivers of change and the influence exerted in each county be examined to understand the dynamics between environment, organization, and technology. For longitudinal studies, changes in environmental conditions, as reflected in this model, would be useful to explain the rate of diffusion of innovation. Other models mentioned by Kraemer et al. (1989) ignore either institutional variables or fail to recognize the results of specific actions as a response to environmental conditions.

While Rogers' (1983) model defines the stages of the diffusion process, models described by Kraemer et al. (1989) illustrate how variables affect the diffusion process (Figure 3.2). In the internal environment, the organization has some influence over the diffusion process (e.g. forming institutional arrangements). In the external environment, variables are outside the control of the organization (e.g. per capita tax base). An example of the effect external environmental variables might effect diffusion is when poor economic conditions prevail. Shifting to new practices may strain economic resources and restrict the adoption of innovations. When resources are more secure,

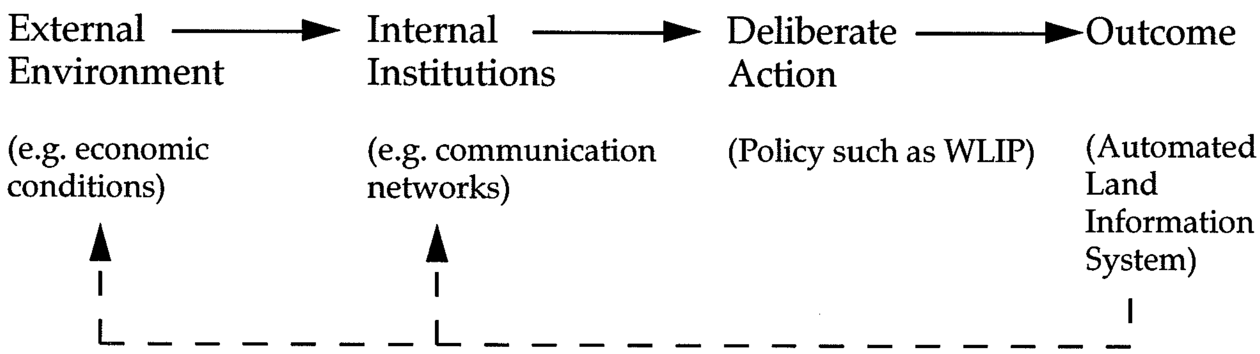

Figure 3.2 Systems Interaction Model for Innovation
(Kraemer et al., 1989. p 10)

additional expenditures on what may be perceived as non-essential or more risky ventures may be more likely.

Kraemer et al. (1989) model diffusion with environmental factors primarily effecting diffusion. The environment presents opportunities and uncertainties for which action must be taken to elicit desired outcomes. Action is a response to environmental stimuli that enhances opportunities currently available or reduce constraints in the environment. Action is a reflection of circumstance and it is viewed in the context of the organization, not the individual. The outcomes reflect the favorable or unfavorable environmental conditions surrounding the organization (Brown, 1981).

A systems interaction model is a more specific model for change. It assumes organizations are in equilibrium, shifting their actions in response to environmental conditions. The assumption that an organization will reach a pinnacle state is flawed, since the environment in which an organization exists is constantly changing. Diffusion is a process that reflects the changes both inside and outside the organization. By concentrating on internal and external environmental variables that upset the balance, change can be predicted. Kraemer et al. (1989) propose that adoption of innovation is largely a result of external environmental forces, while implementation of information systems is bound to internal environmental forces.

Change results from organizational constraints and opportunities. Organizations will continue to function until an environmental catalyst acts to change conditions. WLIP is a major organizational factor, it provides a source of funding specifically for land records modernization. In this research, we have an opportunity to see how counties respond to a policy designed to promote modernized land information systems.

Variables Influencing Diffusion

LIS adoption has specific characteristics related to its diffusion. First, LIS technology is constantly changing bringing about reinvention (Masser and Onsrud, 1993; Rogers, 1993). Rogers (1983) defines re-invention is "the degree to which an innovation is changed or modified by a user in the process of adoption and implementation." Re-invention stems from the wide range of applications supported by land information, thus, creating a need for continuous feedback loops in diffusion models. The other characteristic germane to LIS is the fact that adoption occurs at the organizational level rather than at the individual level and diffusion is highly dependent on organization variables (Rogers, 1983; Douven et al., 1993). Therefore, the forum for this research is at the organizational level: the county land information offices.

In this research, variables based on internal and external environmental conditions will be used to account for changes in land records modernization activities. For example, internal organizational support is needed to administer and allocate resources to implement a multi-purpose land information system.

The adoption/implementation theories would suggest that having a central contact person within an organization will put them in a better position to modernize land records. Also, finding available resources inside or outside the agency to support such ventures could be another limiting factor in the diffusion process.

Six variables will be used as part of a content-based model to evaluate a county's affinity for implementing innovation. Variables reflecting economic (external environment) and organizational (internal environment) aspects of adoption are:

External environment
- economic capacity
- land market pressure
- land records modernization capacity

Internal environment
- professional communication networks
- communication channels
- history of modernization investment

External Environmental Variables

Starting a LIS requires capital investment (Kraemer et al., 1989). Therefore, the availability of resources to support such projects may be related to the likelihood of LIS implementation. Per capita tax base will be used to measure the capacity for new capital outlay in a county. Local governments do not have equal opportunity to raise capital used for public services. Usually higher tax bases provide greater capacity to raise funds for services (Aronson and Hilley, 1986). Because most general revenues for local government are based on property taxes, jurisdictions with large property values generally have large budgets. With a greater amount of resources available, more funds could potentially be available for modernization activities (Fletcher et al., 1992; Burrough and Jones, 1993).

However, growing counties with rising property values must also expend more resources to meet the demands of a larger population.

We can also hypothesize that pressures from land market activities also influence implementation. Growth rates within counties is a reflection of the degree of land related activities. More efficient means to complete real estate title searches, deed transfers, or generate mailing lists may be needed as the demand and the perceived value for high quality land information increases.

Related to the growth rate is the projected return on modernization activities. This variable reflects the availability of resources supported by WLIP's funding mechanism. Counties with more parcels and number of transactions at the Register of Deeds office most likely generate more revenue for modernization activities, and will have more incentive to implement innovative systems than counties with smaller amounts of funds being generated from the WLIP funding mechanism. In many counties, outside funds can be used as leverage for obtaining internal funding to pursue modernization activities (Kraemer et al., 1989). The funding mechanism, as described in the preceding chapter, is based on retaining a portion of the filing fee at the Register of Deeds office. WLIP has created an awareness and consequently a demand for these earmarked funds.

Table 3.1 Extra-organizational Variables Used to Predict the Implementation of Innovation

External Environment	Measure
economic capacity (Fletcher et al. 1992; Kraemer et al., 1989)	per capita tax base
land market pressures (Kraemer et al., 1989)	population growth or decline
projected benefit (Kraemer et al., 1989)	amount of retained fees per parcel

Internal Environmental Variables

Rumor (1993) reports that organizational change is based in part on skilled personnel, adherence to standards and coordination, and long-term investment plans as a means to modernize land records. The variables used to assess the internal environment of counties are similar in that they include history of modernization activities, membership in professional organizations, and formal and informal institutional arrangements. An environment conducive to change must have the means to communicate and share ideas. Therefore, an organization that is involved with professional organizations and who have many contacts across different agency boundaries have the capacity to diffuse information about innovation, especially to those involved in the decision-making process. WLIP provides the organizational support by including institutional arrangements as one of its foundational elements in its plan to implement modern land information systems. These elements of WLIP will be used as variables in the implementation of automated land information systems.

As the technology to process huge amounts of information advances, we still need to understand how to communicate information to users (Gore, 1992). The most significant element in generating initial acceptance of a new idea, as well as successful adoption, is to educate users about the topic (Maggio, 1991). Education and training are effective ways to communicate new ideas to potential adopters. Professional organizations with an educational agenda, such as WLIA, provide a means to measure the extent of professional communication networks in counties.

Membership in professional organization such as the Wisconsin Land Information Association (WLIA) is a means to gauge communication networks. Sharing ideas also helps to resolve problems faced by peers, thus, increasing the rate of diffusion (Zmud, 1983). Contacts with technology leaders or innovators within the county will support and shape perceptions within the county.

Providing a means to communicate and share ideas is a vehicle to diffuse innovation (Greer, 1993). The manner in which innovation is received is dependent on the perceptions of peers within a social system. Coleman et al. (1966) found that communication between peers influenced the adoption decision more than those outside the social system. For example, due to the common goal of automating land information systems between land records professionals, those who have recently adopted new technology are more likely to influence other potential land records professional's adoption decision than a software or hardware vendor. The means to diffuse technology must be accepted by users in the community.

We suspect that forming formal and informal institutional arrangements provides an outlet for sharing ideas about innovation. Burrough and Jones (1993) agree that internal environmental variables can potentially enhance or retard the adoption of LIS. Overcoming institutional inertia, commitment to long-term investment, institutional rivalry, and attitudes surrounding data sharing are key factors for diffusing innovation. Data sharing maximizes the net return on investments of public resources (de Neufville and Croissant, 1990). Cooperation is needed to share potentially prohibitive costs of modernizing land records. Portner (1982) found in his survey that individuals tend to act in a manner that disregards the collective good. Different professionals have different beliefs as to what is significant to incorporate into a database. Part of the goal of modernization that must be conveyed by communication is to transform non-uniform methods, standards, and expectations to ones that are similar and beneficial to land records of professionals.

A county with a history of promoting land records modernization activities should be more likely to continue that trend. LIS requires skilled labor and commitment to adoption and use (Kraemer et al., 1989). A county with a mission or philosophy that promotes change will be more apt to have strategies to cope with innovation. Such strategies will enable the counties to modernize at a faster rate as the initial investment in technology has already occurred. This can be measured by examining the amount of investment in modernization activities prior to the inception of WLIP because small values are indicative of little activity in this area.

Table 3.2 Organizational Variables Used to Predict the Implementation of Innovation

Internal Environment	Measure
professional communication networks (Rogers, 1983; Zmud, 1983)	number of WLIA members
existence of formal and informal communication channels (Onsrud and Pinto, 1993)	number of institutional arrangements
history with information technology in the county (Fletcher et al., 1992)	technical investment prior to WLIP as a function of total investment

MEASURING THE EXTENT OF DIFFUSION

The above variables are indicators of internal and external forces acting to facilitate or inhibit change within counties. The next step is to measure the extent of implementation in each county. WLRC's recommendations and requirements and the National Research Council's (NRC) findings were used to form indices to measure the extent to which modernization activities have spread through counties in Wisconsin.

Participating in WLIP is an indicator that innovation has already diffused in Wisconsin. As mentioned previously, a major assumption in this research is that a county's participation in WLIP represents a progression through the knowledge, persuasion, and decision stages of Rogers' (1983) model for diffusion. Most counties are *in the process* of implementing their county-wide plans to modernize land records. Indices of implementation were used to measure the various levels of implementation existing within each county. Combining both content and process models to examine the diffusion process will allow us to determine whether a correlation exists between the variables influencing change and the level of modernization implementation.

A content model has been used to describe variables associated with the adoption-decision process. A process model will be used to illustrate the extent of one specific phase of diffusion: implementation. In this research, variables in counties have been used to explain the diffusion of innovation. Now, the task is to measure the extent of diffusion. Some general elements are found consistently in the models explaining the effective diffusion of innovation: hardware, software, management, costs, and environmental conditions (Onsrud and Pinto, 1993; Maggio et al., 1992). These common elements, along with elements from WLIP's implementation plan, will be the foundation for constructing indices of implementation.

Developing Indices for Implementation

Indices of implementation are based on the components necessary to build a multi-purpose land information system as recommended by the NRC and the WLRC. These recommendations, coupled with WLIP's implementation plan, will form the indices of implementation. The extent of implementation in each county will be measured by developing indices based on the extent to which information technology has been integrated in to the functioning of land records management, degree that data has been automated, and the extent that the components of multipurpose land information systems have been established in each of the Wisconsin counties (Appendix 2).

For each of the following indices developed in this research, the methods chapter will specify which conditions are modern or innovative, and which are status quo.

MPLIS Component Index

The multi-purpose land information system (MLPIS) index measures the extent to which the basic components for a MPLIS exist in a county. These elements focus on: common geographic reference framework, accurate maps, parcel indexing system using state standards, other standards, and re-monumentation activity.

Information Technology Index

LIS is one of the fastest growing types of information technology in local government (Fletcher et al., 1992). The information technology index focuses on the computer software, peripheral equipment, and hardware configurations associated with establishing an automated land information system.

Data Automation Index

Layers of information are needed to operate a MPLIS. The data automation index is based on the information related components supported by WLIP: parcels, wetland, soils, and zoning data. These are basic layers used to build land information systems, as specified by WLIP, although many other versions of what comprises "basic" data exist. The emphasis is on counties using data that is automated, up-to-date, and accurate. An emphasis towards parcels data is created, for it is commonly used for a variety of applications throughout local city government.

The indices of implementation will be used to measure the extent of implementation to determine what sort of relationship exists with the internal and external environmental variables that act to promote or inhibit the diffusion of innovation. Methods will be discussed in the following chapter.

CHAPTER 4 - METHODS

SURVEY ADMINISTRATION

Counties participating in the Wisconsin Land Information Program (WLIP) served as the unit of analysis in this research since the administrative focus of WLIP is at the county level. A survey instrument was sent to each of the counties as the primary tool to assess counties' progress in modernizing their land records. Data gathered by this instrument was evaluated with the indices of implementation to measure the level of modernization in each county. Environmental conditions in each county were examined to determine if a relationship exists between the extent of modernization and these factors.

Identification of Survey Population

Land records modernization is the result of activity by many actors in local government, so the population of interest is land records professionals in Wisconsin. However, a bias towards a subset -- WLIP land information officers -- exists in the sampling strategy. Based on their required participation and their role as proponents of modernization, the Land Information Officers (LIOs) in each county served as the target for survey administration. Each county's Land Information Office (LIO) is composed of the designated Land Information Officer, and/or a committee of staff members, and/or County Board members.

This research assumes that LIOs are on the forefront of diffusing innovation in Wisconsin counties, because they are responsible for developing an implementation plan for county-wide land records modernization. It cannot be assumed that attitudes and experiences are homogeneous for land records professionals throughout the county. As representatives of various land records professionals, the responses of LIOs will be used to provide data about the degree of modernization diffusion in their county.

The goal of the survey was to obtain data from a specific group of land records professionals about the status of land records modernization activities in the county in which they serve. WLIP was instrumental in meeting the information intensive requirements needed to complete this research. As a function of participating in the Program, counties are required to complete an inventory as a part of their Annual Report (Appendix 3). Responding to the questions in the survey sent to each county demanded a great deal of time, detailed information, and more effort than is usually requested from a survey respondent. The responses given by LIOs also serve as "official" responses to the Wisconsin Land Information Board.

Due to the length and detailed responses required to complete this instrument, a memo was sent to each county Land Information Office with guidelines to follow to prepare the LIO for the survey's arrival. The inventory was mailed to county LIOs by WLIP staff. The inventory packet contained a cover letter outlining the objective of the instrument, instructions for completion, and a return envelope to make the process as convenient as possible for the respondent.

An inventory was sent to each participating county's LIO to gather baseline data needed to assess the degree of implementation within counties in Wisconsin based on their degree of modernization activities. Instructions accompanied the inventory along with suggestions for completing the instrument (e.g. the survey may be answered more easily if those people needed for answering questions surrounding the foundational elements are gathered together, e.g., the County Surveyor). The inventory required significant effort on the part of some of the respondents, because counties with more modernization activities had more questions applicable to them. Respondents were also asked to sign the survey attesting to its accuracy. Of the 72 counties in Wisconsin, 71 participated in WLIP at that time. Seventy counties responded to the instrument.

Quality of response for surveys is a function of enthusiasm, endurance, and time constraints faced by respondents. The Land Information Officers were faced with a tremendous task of cooperating with the intensive information demands of the survey. Results from the pilot study and from individuals suggested that the time to complete the survey was anywhere from 30 minutes to four hours.

Construction of Survey Questionnaire

The construction of the inventory was an iterative process involving meetings with University faculty and WLIP staff. The instrument was designed to describe the amount and type of modernization activities in each county so the status and level of investment in modernization activities within counties could be measured. The instrument was designed to be multi-purpose, meeting the information demands of WLIP, other concerned parties, and completing this research. For the purposes of this thesis, only the relevant questions from the WLIP 1992 Annual Report Survey will be examined (highlighted in Appendix 3).

A pilot study containing primarily closed-ended questions was administered to county staff from six Wisconsin counties participating in a University-sponsored land records modernization research consortium (Project LOCALIS) (WLIN, 1993). They reviewed the instrument for content and clarity. This group of county officials have worked with hardware and software vendors to test, evaluate, and adopt spatial information technology for use in local government planning and management (WLIN, 1993). Suggestions and comments were also made by WLIP staff and board members to refine the instrument and eliminate as many ambiguities in the questions as possible. Changes were made based on recommendations from the respondents.

MEASURING INDEPENDENT AND DEPENDENT VARIABLES

Independent variables based on ideas from the literature that seemed to fit the Wisconsin situation were used as predictors for the implementation of innovation within counties. Internal and external environmental conditions were the two categories used to account for the inhibition or promotion of modernization related activities. Kraemer et al. (1989) define environment in terms of the organization where internal environment is inside the organization and the external environment is beyond the organization. For the purposes of this research, internal and external environment is distinguished in terms of control. For example, the number of institutional relationships formed is an internal environmental variable because the number of arrangements that are made can be controlled by those interested in sharing information with other professionals. An example of an external environmental variable is per capita tax base because one cannot directly influence its outcome for a county.

Variables Influencing Adoption

The following sections describe what data were extracted from the WLIP 1992 Annual Report Survey (ARS) and the 1990-1992 Wisconsin Blue Book.

Internal Environmental Variables

The following independent variables reflect internal environmental conditions that were used to predict the adoption of innovation in each county (from chapter 1 hypotheses, page 17):

- professional communication networks
- communication channels
- history of modernization investment

Professional communication networks were measured by counting the number of members of the Wisconsin Land Information Association (WLIA) per county. WLIA members represent a diverse group of land records professionals and encompass both technical and social professions to reflect both the technical and social nature of GIS.

Communication channels were measured by extracting the number of formal and informal institutional arrangements reported in the WLIP 1992 Annual Report Survey. Communication with a diverse group of land records professionals is supported by the objectives of WLIP and acts to facilitate the exchange of information for multi-purpose land records activities.

The history of modernization was measured by dividing the total investment in foundational elements prior to WLIP as reported in the 1992 ARS by the total investment in foundational elements to index previous innovativeness apparent in some counties.

External Environmental Variables

The following independent variables reflect the external environmental factors that were used to predict the adoption of innovation in each county (from chapter 1 hypotheses, page 17-18):

- economic capacity
- land market pressure
- degree of land records activity

Per capita tax base was calculated using data from the 1990-1992 Wisconsin Blue Book. The Property Assessments, Taxes, and Rates tables provided data on full value assessments and population totals for each county to calculate per capita tax base. By dividing total assessed value by total population, an "ability to pay" normalization was attempted. However, it should be noted that many counties have a substantial number of out-of-county land-owners, particularly in the northern lakes tourist areas of Wisconsin. This may decrease the reliability of this normalization.

Land market pressure was measured by looking at the change in population from 1980 to 1990. Percent growth or decline was taken from Basic Data on Wisconsin Counties in the 1990-1992 Wisconsin Blue Book. The data were re-scaled to avoid negative values using the following equation:

$$\frac{\text{county x value - lowest county}}{\text{highest county - lowest county}}$$

The degree of land records activity was measured by taking the amount of retained fees collected by the Register of Deeds office and dividing that number by the number of parcels in the county to normalize the data--essentially an index of transactions per parcel.

Measuring Implementation

The factors related to diffusion address the social factors that control the diffusion process. Now, the more technical aspects that indicate the presence of automated land information systems will be addressed. The three indicators are based on establishing basic components for base mapping (MPLIS Index), using comprehensive and current data sets (Data Automation Index), and the ability to produce digital information products (Information Technology Index). Each index of implementation is based on the presence or absence of each element of the index (Appendix 2).

MPLIS Component Index

Questions 11, 12, 15, 20, 27, 34, and 43 from the 1992 ARS were used to form the multi-purpose land information (MPLIS) index (Appendix 2). Nine variables derived from these questions were used to reflect basic components needed for a MPLIS. Presence of the following elements each counted for one point (out of a possible nine) to form an index for regressions: geodetic reference systems with a datum and with coordinates, unique and geocode parcel identification scheme, standards for accuracy and procedures, monuments with and without coordinates, and parcel with generic attributes. The presence of this group of elements work to build transferable data sets and facilitate the sharing of information for multiple purposes.

Data Automation Index

Twelve variables were used to reflect components of data automation used by counties. Elements from questions 25, 33, 37, 46, 54, 62, 73, and 76 were extracted from the 1992 ARS and used in this index. Parcels, zoning, wetlands, and soils data are the primary data layers supported by WLIP. The largest portion of the index (5 of 12 data element points) was allocated to parcels mapping because it the layer that is most commonly used for multiple purposes. Presence of digital and analog data, quality and standards used, and whether the information is updated on a transactional basis are the five parcel-based measures. Zoning, wetlands, and soils data are often used as an overlay on parcels data for queries and analyses. Presence of digital and analog information was used for these data layers. Updating zoning data on a transactional basis was also included because the information tends to change much more frequently than wetland or soils information.

Information Technology Index

Six variables were used to reflect the extent information technology is used in counties. Questions 3, 7, 8, and 9 were extracted from the 1992 ARS to measure software, hardware, and network configurations. Computer applications having graphics capabilities only and those having both graphic and analytical capabilities were used for the first third of the index. The second third of the index focused on the hardware. Both input and output devices used for processing digital data were included in the index so that equal bias was placed on both producers and users of digital data. The remaining third of the index was allocated for digital networks that measure the capacity for desktop access to digital data on minicomputers and workstations.

ANALYTICAL METHODS

Scatter plots between each of the six independent variables and each of the three index sums were made to examine the data distributions and check for initial trends in the data.

SAS statistical software (1987) was used for stepwise linear regressions to measure the effect the six independent variables had on the dependent variables. Multiple linear regression analyses uses the known values of independent variables to predict the value of dependent variables. Internal and external environmental variables were regressed against each index of implementation. Alpha less than 0.05 was used to determine if differences were significant. Alpha is the probability of concluding that a relationship exists when it doesn't. F-distribution were calculated because it uses two-sided rejection region and is robust against moderate degrees of heterogeneous variances. F-values are calculated by dividing the relationship between X and Y (independent and dependent variables) by the variation in Y due to error. F-values provide evidence to reject the null hypothesis (no relationship exists) and accept the alternative hypothesis (a relationship exists between dependent and independent variables) (Younger, 1979).

In addition to the stepwise linear regression, a series of four different multiple linear regressions were done against each of the indices of implementation in the model to elicit further relationships. First, all of the independent variables were used in the model statement. Only the three internal environmental variable were used in the second set of regression analyses. External environmental variables were also examined in a separate regression analysis. Finally, the model was reduced to the variables that showed the smallest p-value in previous regressions.

Logistic regression was used with a maximum likelihood estimation as an additional analytical method. Results of this test are expected to be similar to those found in the multiple linear regression. Logistic regression was used because of the continuous independent variables and the binary dependent variables in this data set. The dependent variables comprising the indices were aggregated as in previous analyses. With logistic regression, each of the dependent variables were looked at separately. A total of 27 dependent variables were examined - nine from the MPLIS index, 12 from the data automation index, six from the information technology index. The individual elements from the index were examined separately, but the output from the logistic regression was aggregated and interpreted at the index level.

Principal components analysis or any other data reduction analysis were not done in order to preserve data interpretability. Modernization is an evolutionary process. As counties continue to modernize, more dependent variables will need to be addressed. Since the counties are at various stages of the modernization process, assessing what the key elements are for modernization is meaningless. The purpose of this research was not to determine how modernization evolves or what factors lead to *successful* modernization. That has already been started (Onsrud and Pinto, 1993). The focus is on determining what sort of relationship exists between factors in the counties and the level of modernization implementation.

Correlation Between Independent Variables

A correlation matrix between the three internal environmental variables was done to test for independence. A moderate relationship exists between the number of professionals involved with WLIA and the amount of investment in modernization activities prior to the inception of WLIP (table 4.1). It is likely that these professionals did not suddenly become advocates of land records modernization only after WLIP began, but rather they have been working within their county to modernize land records for quite some time. This is one explanation for the relationship observed between these two variables. These factors are statistically related, but they measure modernization activity at two different times. Since we are looking at the status of land records modernization since the inception WLIP and 1992, both the number of contemporary professionals and the history of modernization activity may help explain how the modernization process is influenced. No strong correlation was observed between the remaining variables.

Table 4.1 Correlation Between Internal Environmental Variables

	1	2	3
1 history of modernization	1		
2 communication channels	0.12156	1	
3 professional communication networks	0.613419	0.100982	1

Since some relationship exists between two of the internal environmental variables, only one of the variables was used in reduced models of the regression analyses.

A correlation matrix between the three external environmental variables was also done to test for independence. A slight correlation exists between per capita tax base and growth rate as measures of economic capacity and land market pressures (table 4.2). One possible explanation for this relationship is that counties experiencing growth will have more construction and consequently an increased tax base. Alternatively, stronger tax bases have the capacity to expend more money on amenities. The more features a county has to offer, the more attractive a county becomes to the population. No strong correlation was observed between the remaining variables.

Table 4.2 Correlation Between External Environmental Variables

	1	2	3
1 economic capacity	1		
2 land market pressure	0.315697	1	
3 degree of land records activity	0.052043	0.095345279	1

Correlation Within Dependent Variables

Correlation matrices were compiled for each of the indices of implementation (dependent variables) to determine if the indices were valid measures. It was expected that items measuring the same process would be correlated. However, this was not the case because levels of modernization activity varies in each county. Modernization is challenging to measure because it is multi-dimensional. Three indices were developed to measure various aspects of the modernization process. Modernization was partitioned into MPLIS framework components, data needed for an automated land information system, and technology needed to operate needed a land information system.

The MPLIS Index combines both related and different measures of modernization. All of the variables reflect some aspect of the different components of modernization. Within each of the components is a measure of modernization sophistication. An example is the relationship between remonumentation with coordinates and remonumentation without coordinates. The same task is accomplished, yet remonumentation with coordinates is more meaningful to the modernization process because modern land information systems are based on tying areas of location to coordinates. Notice the relationship is slightly negative (correlation = -0.01469). A similar relationship is found between another group of like variables, geocode identification (i.d.) scheme and unique parcel identifier (i.d.) (correlation = -0.1236).

Some elements are related, while others are not (table 4.3). For example, both measures of standards are moderately related. Coordinates are moderately related to every other variable except remonumentation without coordinates and a geocode identification scheme. Monuments that do not have coordinates tied to them should not be correlated to presence of coordinate system. The use of a geocode identifier would be expected to be more closely related to coordinates, but a geocode identifier is relatively innovative and represents a more modern approach to forming a parcel identifier.

Table 4.3 Correlation Between MPLIS Index Variables.

	1	2	3	4	5	6	7	8	9
1 coordinates	1								
2 datum	0.679	1							
3 geocode id	0.099	0.122	1						
4 unique id	0.1	0.165	-0.1236	1					
5 accuracy standards	0.635	0.618	-0.0038	0.0628	1				
6 procedural standards	0.403	0.495	-0.0358	0.1384	0.514	1			
7 parcel attributes	0.356	0.157	0.0054	0.2664	0.2724	0.03576	1		
8 remonu-mentation with coords	0.449	0.476	0.0838	0.1123	0.4901	0.43642	0.15169	1	
9 remonu-mentation w/o coords	0.029	-0.02	-0.0289	0.1612	0.0262	-0.0518	0.12677	-0.0146	1

The correlation between the variables is not overwhelmingly strong. This is due to the many approaches taken by many different counties to modernize land records. As its title states, this index is biased towards activities with multiple purposes. Most counties appear to modernize on a project by project basis, so they do not place an equal emphasis on all elements of a multi-purpose system. As time goes on, it is expected that more of the elements in a multi-purpose land information system will be addressed as more projects are completed, and consequently the variables will be more tightly related.

The twelve variables in the data automation index explore the use of digital and analog data for parcels, zoning, soils, and wetlands mapping. Like items were slightly more related to each other than unlike items (table 4.4). A slight relationship was observed between the different types of digital data. Similarly a slight relationship was observed between the different types of analog data and between the two types of standards for mapping. Also the action of

Table 4.4 Correlation Between Data Automation Index Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1 digital parcel data	1											
2 analog parcel data	0.286	1										
3 parcel info updated regularly	0.212	0.250	1									
4 boundary accuracy known	0.180	0.232	0.299	1								
5 NMA Standard used	0.096	0.026	-.139	-.239	1							
6 digital zoning data	0.375	0.172	0.058	-.135	0.281	1						
7 analog zoning data	0.187	0.111	0.037	-.081	0.256	0.302	1					
8 zoning info updated regularly	0.179	0.135	0.43	0.096	0.267	0.237	0.336	1				
9 digital wetlands data	0.203	0.093	0.031	0.017	0.068	0.379	0.164	0.128	1			
10 analog wetlands data	-.108	0.114	-0.02	-.074	0.156	0.069	0.435	0.114	0.203	1		
11 digital soils data	0.231	0.018	0.006	-.232	0.326	0.28	0.072	0.152	0.091	-.114	1	
12 analog soils data	-.026	0.212	-.045	0.007	0.075	0.210	0.581	0.227	0.072	0.326	.134	1

updating both parcel data and zoning data was related. A slight relationship also exists between the digital and hard copy data for each group of data. Digital and analog zoning mapping is correlated with digital and analog wetlands mapping. One possible reason for the relationship may be due to recent wetland zoning regulations. Digitally overlaying or otherwise combining wetlands and zoning information in obtain information necessary to comply with wetlands zoning legislation may be influencing the use of these two data layers.

Single purpose indices were more highly correlated than indices reflecting activities with multiple purposes. The information technology index focused on the computer side of modernization. Three groups of elements were examined: software, peripheral hardware, and communication between hardware.

The relationship between the variables in the information technology index was stronger than what was found in other indices (table 4.5). One possible explanation is that all but one of the variables is a characteristic of sophisticated modernization activities. Variables with differing levels of modernization sophistication were not correlated as strongly. For example, software with graphics capabilities only is less modern than a software package with graphics and analytical capabilities. The graphics only software package had the weakest correlation with the remaining, more sophisticated modernization activities. As

Table 4.5 Correlation Between Information Technology Index Variables

	1	2	3	4	5	6
1 graphic and analytical capacity	1					
2 graphics only capability	0.712423	1				
3 digital input devices	0.918671	0.662876	1			
4 digital output devices	1	0.712423	0.918671	1		
5 pc to workstation link	0.33541	-0.05525	0.365104	0.33541	1	
6 workstation to minicomputer link	0.308132	0.084382	0.33541	0.308132	0.578954	1

a result, those indices that consider modernization as an evolutionary process reflecting different levels of modernization tend to have weaker internal correlations.

Classifying Counties

Counties were grouped into four different levels of implementation based on their score on the three indices of implementation. The four categories were laggard, late majority, early majority, and innovator. Each category represented a quartile. Counties were categorized based on the sum total scored on the index. For example, counties scoring between zero and twenty-five percent of the index total were classified as laggards. Other authors use standard deviations to classify innovators, but their classification scheme is based on all or nothing implementation, not an evolutionary process (Rogers, 1983). Wisconsin counties have not reached that level at this point in time. Percentiles were used to illustrate trends in the level of implementation. Results of these classifications follow in the next chapter.

Thus far, questionnaire design and administration have been described. Correlation matrices were constructed to determine the initial strength of the relationship between and within the independent variables and the dependent variables. The results of the correlation between both internal and external environmental variables gave insight on how to interpret the results given in the following chapter. In addition to the results of logistic and multiple linear regressions, results of how counties were classified based on their extent of modernization implementation are found in the next chapter.

CHAPTER 5 - RESULTS AND DISCUSSION

The return rate was 98.6% for the questionnaires sent out to the 71 counties participating in the Wisconsin Land Information Program (WLIP), though completeness of responses was quite variable. This high response rate was due to the counties' obligation to WLIP to submit an annual report describing their modernization activities. The responses given by land records professionals represent the modernization activities for the entire county. The extent modernization activities were reported may vary based on the experiences the Land Information Officers (LIOs) have had with different agencies in their county. With the broad spectrum of questions asked in the questionnaire, LIOs with a wide knowledge of activities may be more likely to respond to more of the questions. The extent to which the questionnaire was answered may also be a function of the accessibility of information or ease of obtaining land information in the county. Those counties with little communication between agencies or have cumbersome methods for accessing land information may be less likely to spend the time needed to obtain the information to answer parts of the questionnaire.

The remainder of this chapter presents results from multiple linear regressions. The first group of results was used as an initial assessment of data relationships. Then, more specific data models were performed to test the strength and the veracity of the statistical relations.

INITIAL RESULTS

Stepwise Linear Regression

Stepwise linear regressions were used to determine which of the six independent variables, if any, were influencing the dependent variables. The results of the stepwise regressions were used to formulate more specific data models to test for statistical significance i.e variables with strong association in stepwise regressions were used as input in the reduced regression models. Eliminating the less influential independent variables would reflect a more accurate picture of the relationship with the dependent variables. Finally, each of the independent variables was tested against all of the dependent variables to gauge the strength of each variable on the other. Testing independent variables separately eliminated the effect competing independent variables had on dependent variable so the effect of each independent variable may be determined.

Of the six independent variables used in stepwise linear regression, one variable was significant - the number of institutional arrangements. One iteration was done for alpha less than 0.05 as an indicator of statistical significance for all three indices of implementation (Table 5.1). The rest of the independent variables were not significant.

The results of multiple linear regression indicate that factors other than the variables analyzed in this research are likely to be contributing to the indices as evident by the low r^2 values. The three internal environmental variables contributed more to predicting the outcome of dependent variables than the external environmental variables. The greater r^2 value suggests that internal environmental variables were having more of an influence on implementing automated land information systems at this point in time. As counties become more sophisticated in their modernization activities, levels of significance may change.

Table 5.1 Summary of Forward Stepwise Regression Selection Procedure for Institutional Arrangements

variable	r^2	**F**	**probability >F**
MPLIS Index	0.1560	12.7519	**0.0007***
Data Automation Index	0.0818	6.1444	**0.0156***
Information Technology Index	0.2102	18.3617	**0.0001***

*significant for alpha <0.05

Implementing modernization activities is an active process, as is forming and utilizing institutional arrangements. Other variables, such as per capita tax rate and investment prior to the inception of WLIP are passive processes, much like the decision to adopt is passive on the conceptual level. Although many arrangements and much energy may be spent on convincing land records professionals to make the decision to adopt innovations, such as making evaluations and commitments to resources, decision-making is still a cognitive process. On the other hand, implementation not only requires the acceptance of the innovation, but goes a step further toward making theoretical concepts a reality. Variables that were not significant for implementation may be related to the adoption-decision stage when economic factors are more likely to be considered in the decision making process.

Reduced Regression Models

Three different data models were used to isolate the interaction among independent variables. Splitting the independent variables into two categories formed the first two models -- internal and external environmental variables. Multiple linear regressions were performed (Table 5.1). Based on these initial results, a third reduction model was performed. Results for internal and external independent variables were regressed against each variable in the indices of implementation (dependent variable) and will be discussed in the following two sections.

MODEL 1 - INTERNAL ENVIRONMENTAL VARIABLES

Institutional arrangements was the only variable that was significant in all iterations of regression analyses for all of the indices of implementation (Table 5.2). The investment in modernization activities prior to the inception of WLIP and the number of WLIA professionals are not significant as predictors of modernization implementation.

Table 5.2 Summary of Multiple Linear Regression for Internal Environmental Variables vs. Indices of Implementation

Variable	MPLIS Index P-value	Data Automation P-value	Information Index P-value
internal environment			
pre-WLIP investment	0.218599	0.797108	0.120697
institutional arrangements	**0.001346***	**0.0000768***	**0.019579***
WLIA professionals	0.590242	0.823276	0.433889
r^2	0.205908	0.211048	0.114969

*significant for alpha <0.05

Investment Prior to WLIP

Investment in modernization activities prior to the inception of WLIP was not statistically significant for any of the indices. However, relationship between independent and dependent variables was stronger for the MPLIS and information index than it was for the data automation index (p-value ~0.22, 0.12, and 0.80, respectively) (Table 5.2). The lack of statistical significance may be associated with the fact that automating data is a relatively new way of managing land records and not many counties are pursuing this goal. The process of automating analog data is also cumbersome and expensive. Many local governments may be able to meet their objectives with the data they have already acquired. They may not be interested in automating the data themselves or contracting out for the data as a means to limit expenditures.

The closer relationship between investment and information technology may have surfaced because computers have been used in local governments for quite some time. Investment in technology prior to WLIP may have made it easier to incorporate or add new technology into counties than if little or no investment had been previously made. Installing additional software or peripheral equipment may have been a function of adding to existing platforms. More powerful computers at lower costs make investment in new technology less risky due to the decreased capital investment.

The relationship between investment and each of the indices may have been stronger if more reliable expenditure data could be obtained from counties. Investment in land records activities prior to the inception is difficult to trace. Therefore, data is available at a coarse level. Budgets may not include itemized expenditures for costs related to specific modernization activities. It may not be possible to separate out investment in specific geographic reference, parcels, wetlands, soils, and zoning activities since these products may be a part of a package delivered by consultants.

Institutional Arrangements

The number of institutional arrangements is related to the indices of implementation in a statistically significant way (p-values ranged from 0.02 to

0.0001 for alpha less than 0.05 (Table 5.1).) Institutional arrangements may be a significant factor related to the MPLIS index because building a system for multiple purposes requires coordination between different agencies.

The elements of the data automation index are also based on obtaining parcels, wetlands, soils, and zoning information. Coordinated efforts are necessary to gain data from four potentially different sources because no single agency is generally the custodian for all the information listed in the index. It is reasonable that agencies with a large number of institutional contacts would have access to different sources of data. Sharing information reduces costs and allows resources to be allocated for other modernization activities.

Institutional arrangements were related to the information technology index too, but at a lower level than it was for the other two indices. The importance of institutional arrangements may be based on the fact that counties with more contacts with other land records professionals may have more technical support for managing or acquiring software or hardware. Decisions to automate data or obtain information may be based on the relationships between agencies and how easy or difficult it may be to achieve tasks.

WLIA Professionals

The number of WLIA professionals in a county was not related to the dependent variable in a statistically significant way in any multiple linear regressions. One reason for the lack of relation may be that WLIA professionals may not be the decision makers; they may be the users of the technology within their agency. Membership may be too diffuse throughout the county to form a coalition to support modernization efforts. Perhaps more concentrated efforts or more active support is needed by members to make more of an impact in modernization implementation. WLIA Professionals may also consider extending their networks beyond the scope of their county.

MODEL II - EXTERNAL ENVIRONMENTAL VARIABLES

The external environmental variables correlated less with the indices of modernization than the group of internal environmental variables. Results of regression analyses suggest that the only external environmental variable related to the modernization process is the amount of retained fees collected by counties (Table 5.3). Retained fees were related to modernization (alpha less than 0.05) only when the external environmental variables were regressed against the MPLIS index, though predictive ability of the regression (r^2 values) were low. Significant relations were not found for either the data automation index or the information technology index. Per capita tax base and growth rate were not significant in any part of the regression.

Table 5.3 Summary of Linear Regression for External Environmental Variables vs. Indices of Implementation

Variable	MPLIS Index P-value	Data Automation P-value	Information Index P-value
external environment			
tax base	0.91322	0.773431	0.509973
growth rate	0.128881	0.867208	0.838182
retained fees	**0.025696***	0.092601	0.392144
r^2	0.115583	0.043462	0.021573

*significant for alpha <0.05

Per Capita Tax Base

Per capita tax base was not an indicator of the extent automated land information systems were implemented. P-values did not fall below 0.5 for any of the indices. Per capita tax base reflects a county's available resources, but obtaining funds for new projects is not an easy task. Competition between items in a budget is fierce. County officials may find it difficult to rationalize allocating resources from the budget to pay for an activity that already has funds earmarked. Poorer counties who do not have funds available from their budget may choose to access their retained fees. However, they may have a difficult time rationalizing the use of these earmarked expenditures for activities that are seen by some as frivolous, especially when the county can't afford to repair the steps leading to the courthouse.

As mentioned previously, costs are often a function of the adoption-decision. The use of per capita tax base as a predictor variable might be more appropriate for measuring adoption, rather than implementation. Fees retained by the county was significantly related to the MPLIS index, which suggests that counties economic status has no impact on the modernization process. The lack of significance of this variable may be a function of the funding mechanism and grants supported by WLIP. If counties have an earmarked source of funding, they may not need to rely on general purpose revenues for modernization activities.

Growth Rate

Growth rate was not significant for any of the indices. P-values did not fall below 0.8 for data automation or information technology indices, indicating that counties experience growth are not faced with a strong need to get land information into a digital format. Growth rate was more closely related to the MPLIS index (p-value = 0.12). As counties grow, the demand for managing land records more efficiently is likely to increase. Modernizing may be one way to cope with growth. A shift to automated land information systems may not have occurred because switching to new systems is not always feasible with increased workloads. Adjusting to new conditions may backlog work even more. New systems may be gradually be integrated with existing systems for a smoother transition. Many counties have reported many planned activities in their responses in the questionnaire. As these planned activities are realized, their level of implementation will be reflected in their index scores. Therefore, the lack of relation may be due to the timing of the survey relative to the inception of WLIP.

Retained Fees

The amount of fees collected and retained by counties was significant only for the MPLIS index. Based on activities for which grants were awarded, counties have been spending a lot of resources on the basics. Counties have focused their modernization activities on gaining control points for their geographic reference system. The funds to support these activities came from grants, using retained fees, and county levies. The trend has been a linear progression, starting with gaining control and eventually automating different thematic maps. Counties have recently started to discuss a different strategy for modernizing land records. At the 1994 WLIA annual conference, members questioned the implementation of a geographic framework as a first step in the modernization process. Alternative routes that are more application driven were thought to be more effective than current strategies. Data automation and information technology indices are not significantly related to dependent variables at this time, but may become more closely related as modernization continues to evolve.

MODEL III - CONFIRMATION OF RESULTS

Statistical models were reduced further to confirm results of the previous two models. Internal and external environmental variables having strong relationships to the dependent variables were tested again to determine the strength of the relationship was between competing variables. Because of multicollinearity between two of the independent variables (correlation = 0.61), institutional arrangements and number of WLIA members were not used together in this reduced set of analyses. Logistic regressions were done as a second data reduction model to further identify significant variables while eliminating influences of independent variables and to confirm initial results.

Results of Data Reduction Models

Again, institutional arrangements were significantly related to all three indices (Tables 5.4 - 5.6). Retained fees was not statistically significant in the MPLIS index by a small margin (0.005) even though it was significant in the external environment model. In this secondary reduction, investment became significant in the MPLIS index when it previously had low p-values. It is possible that some interaction was occurring between investment and retained fees in the MPLIS index. The number of WLIA members was not significant in the reduced model even though it too had low p-values in the information technology index. Overall, the availability of funds and the ability to communicate to others appear to be influencing the level of implementation.

Table 5.4 Reduced Model vs. MPLIS Index

Variable	**P-value**
model reduction	
investment	**0.023553***
institutional arrangements	**0.010247***
retained fees	0.055144
r^2	0.245286

*significant for alpha <0.05

Table 5.5 Reduced Model vs. Data Automation Index

Variable	P-value
model reduction	
institutional arrangements	**0.00024***
retained fees	0.521972
r^2	0.214961

Table 5.6 Reduced Model vs. Information Technology Index

Variable	P-value
model reduction	
institutional arrangements	**0.021984***
r^2	0.106786

*significant for alpha <0.05

Results of Logistic Regression

Results of logistic regression were similar to multiple regression analyses. Each independent variable was logistically regressed against each of the dependent variables in the indices to eliminate the effect of competing independent variables. Institutional arrangements and retained fees were significant once more. Growth rate and number of WLIA members were significant in the logistic regression when they had not been previously. Institutional arrangements had the most frequent number of significant values - it was significantly related to eight of the twenty-seven dependent variables. The amount of retained fees was second most frequent variable with three significant values. The number of WLIA members were significant with two dependent variables, and growth rate had a single significant value.

MPLIS Index

Results of logistic regression were aggregated back to the MPLIS index to show how each of the elements in the index was related to each of the significant independent variables. Organizing the data in this fashion allows results of logistic regression to be compared with multiple linear regression results. Three of the nine dependent variables in the MPLIS index were significantly related to individual independent variables (Table 5.7). Remonumentation with coordinates was significantly related to the number of WLIA members; procedural standards were significantly related to institutional arrangements; and datum was significantly related to both the number of WLIA members and the amount of retained fees. Use of coordinates, geocode ids, unique ids, common parcel attributes, remonumentation without coordinates, and use of accuracy standards were not significantly related to any of the independent variables. The lack of relation may be due to the lack of attention given to these modernization elements, or, more likely, the relative immaturity of systems.

Table 5.7 Summary of Significant P-Values vs. MPLIS Index for Logistic Regression

Variables	remonumentation with coordinates	procedural standards	datum
institutional arrangements		0.0229	
WLIA professionals	0.0100		0.0311
retained fees			0.0328

alpha < 0.05

The number of WLIA members was significantly related to remonumentation and the presence of a datum in the MPLIS index. Via professional communications, members are informed about modernization proposals that have received grants. Counties have tried to follow in the footsteps of successful grant applicants. The exchange of grant application ideas among land records professionals may have shaped the strategy that counties have taken to modernize land records. Thus far, the focus for many grant applications and awards has been on creating a geographic reference framework.

Retained fees were significantly related to presence of a datum. Much activity has centered around building a reference framework. It is reasonable to expect that retained fees would be related to these activities, since they have been used to finance these efforts.

Finally, correlations between groups of related dependent variables were examined. It was expected that some relationship might exist between groups of implementation activities. Procedural standards for establishing coordinates were related to remonumentation and datum (correlation 0.436 and 0.476, respectively). The relationship between the dependent variables and the independent variables may provide the beginning elements of a more comprehensive model for diffusion implementation. Dependent variables that are closely related may evolve first in the modernization process, or they may hinder diffusion. This relationship has yet to be explored. If two or more dependent variables demand more resources, they may slow implementation based on the assumption that economics may effect the adoption decision. Close relationships between dependent variables may indicate that both items may need to be addressed concurrently for successful implementation.

Data Automation Index

The number of institutional arrangements, growth rate, and amount of retained fees were related at a significant level to several of the variables in the data automation index (Table 5.8). Institutional arrangements were significantly related to the use of digital and analog zoning data, updating zoning data on a transactional basis, accurate parcel information, and presence of digital parcels data. Institutional arrangements may be bridging the gap between those responsible for maintaining accurate parcels records and those who are concerned with changing attributes of parcels information.

The amount of retained fees was significantly related to the presence of high quality parcels data and use of map standards. Larger amounts of retained fees may support the use of accurate land information and maps because more accurate information is more expensive. Use of digital and analog soils and wetlands data along with updating parcels data were not significantly related to any of the independent variables. This may be due to the lack of attention that counties have been giving these foundational elements.

Growth rate was significantly related to presence of analog parcels data. Counties experiencing rapid growth may find they need better quality parcel maps to keep track of parcels for tax purposes.

Table 5.8 Summary of Significant P-Values vs. Data Automation Index for Logistic Regression

Variables	analog parcel data	digital parcel data	map stan-dards	accurate parcel data	analog zoning data	digital zoning data	zoning updates
institutional arrangements		0.0116		0.0279	0.0149	0.0225	0.0309
retained fees			0.0235	0.0241			
growth rate	0.0415						

alpha < 0.05

Correlations between groups of related dependent variables were examined. It was expected that some relationship might exist between groups of implementation activities that were significant with independent variables. The strongest correlation occurred between the five dependent variables that were related to institutional arrangements; correlations were between parcels and digital mapping (correlation = 0.3747), and between analog maps and updating zoning information (correlation = 0.3362). Other activities were related to a lesser extent.

Information Technology Index

The number of institutional arrangements was the only significant variable in the information technology index (Table 5.9). Institutional arrangements were associated with links between Workstation and PCs and use of graphic display software. No relation was evident for any of the independent variables and use of microcomputers, digital input devices, digital output devices, and the use of software with graphics and analytical capabilities. The use of GIS as a new information technology is still emerging in many counties. It may be possible that information systems have only limited applications at this time. As the diffusion process continues to evolve, more elements of this index may surface as the technology continues to be implemented.

Table 5.9 Summary of Significant P-Values vs. Information Technology Index for Logistic Regression

Variables	links between PCs and work-stations	graphics display software
institutional arrangements	0.0295	0.0410

alpha < 0.05

Description of Counties

Counties were aggregated into four groups based on their level of implementation as measured by each of the indices of implementation. Categories for each index were assigned based on sum of activities implemented in each index. The following categories are based on a percentile system: non-implementors are those counties who have implemented fewer than 25% of the activities in the index; late adopters are those participating in more than 25%, but less than 50% of implementation activities; early adopters are those who have implemented between 50% and 75% of activities in the index; and implementors are those counties who have implemented greater than 75% of the activities in the index. Implementors are those counties most active in implementing automated land information systems. Non-implementors are at the opposite end of the spectrum. As automated land information systems continue to diffuse, a shift is expected to occur between categories -- fewer counties are expected to be in the non-implementor category. The goal is to have all counties eventually attain the "implementor" class. Diffusion is still in its early stages as evident by the low percent of implementor counties.

Counties have been more active in implementing the basic components of a MPLIS, as indicated by nearly forty percent of the counties grouped in the implementor category (Table 5.10). Counties appear to be establishing the structure for their automated land information systems before moving on to application oriented modernization efforts that would require automated data.

Table 5.10 Extent of Implementation as measured by MPLIS Index

Classification	Number of Counties	Percent of Total
Non-Implementors	09	13%
Late Adopters	16	23%
Early Adopters	18	25%
Implementors	28	39%

Counties have not implemented as many modernization activities associated with data automation as they have for the MPLIS activities (Table 5.11). The difference in activity level between the two indices reflects the counties basic strategy toward creating automated land information systems. Major effort has been channeled into setting geodetic monuments in the ground and acquiring coordinates. This focus on control may be a function of the grants process. Many successful grants recipients have put their energy on PLSS remonumentation. Other counties applying for grants have tended to follow in the path of those who have been successful.

Table 5.11 Extent of Implementation as measured by Data Automation Index

Classification	Number of Counties	Percent of Total
Non-Implementors	11	15%
Late Adopters	36	51%
Early Adopters	22	31%
Implementors	02	03%

A large number of counties were in the non-implementor stage and the early adopter stage for information technology implementation, as indicated by the a bimodal distribution (distributions highlighted in Appendix 5) (Table 5.12). The difference in activity level was *thought* to be due to the different technological needs between digital data users and digital data producers. Data producers require more technology to automate land records than those contracting out for digital data. The large number of counties in the non-implementor category suggest that a nominal investment has been made in information technology to date. Upon closer examination of early adopter modernization activities, both types of LIS software are generally present in counties, as well as the use of both input and output devices. However, the dual aggregation does not appear to be a function of differences between data users and producers. Counties appear to be in an all or nothing mode when they are investing in information technology.

The diffusion of implementation appears to be following a clustered pattern. Several regions are consistently active in implementing automated land information systems. These include counties in the Southeastern Wisconsin

Table 5.12 Extent of Implementation as measured by Information Technology Index

Classification	Number of Counties	Percent of Total
Non-Implementors	36	51%
Late Adopters	06	08%
Early Adopters	24	34%
Implementors	05	07%

Regional Planning Commission (SEWRPC) region, Douglas County, and areas around Portage, Wood, and Outagamie Counties. Douglas and Outagamie were the only two counties classified as implementors for all three indices of implementation. Four counties were in both the MPLIS and the information technology index - Sheboygan, La Crosse, Oneida, and Winnebago.

Implementation of MPLIS components appears most active south from Dane County extending east to the SEWRPC counties. In other areas, activities are adjacent to leading counties. The same is observed in the information technology and data automation indices (Figures 5.1-5.3).

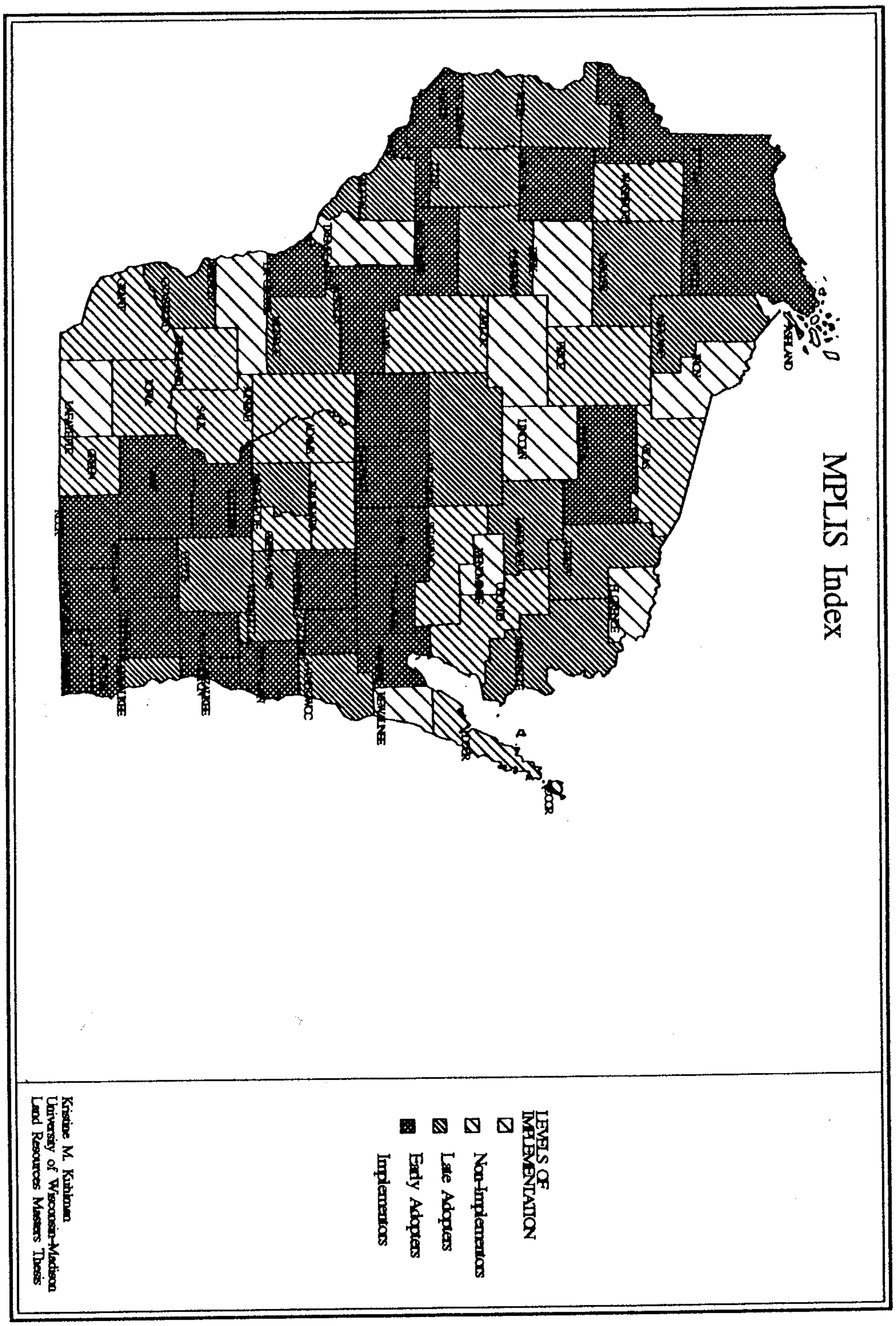

Figure 5.1 MPLIS Index of Implementation Spatial Distribution

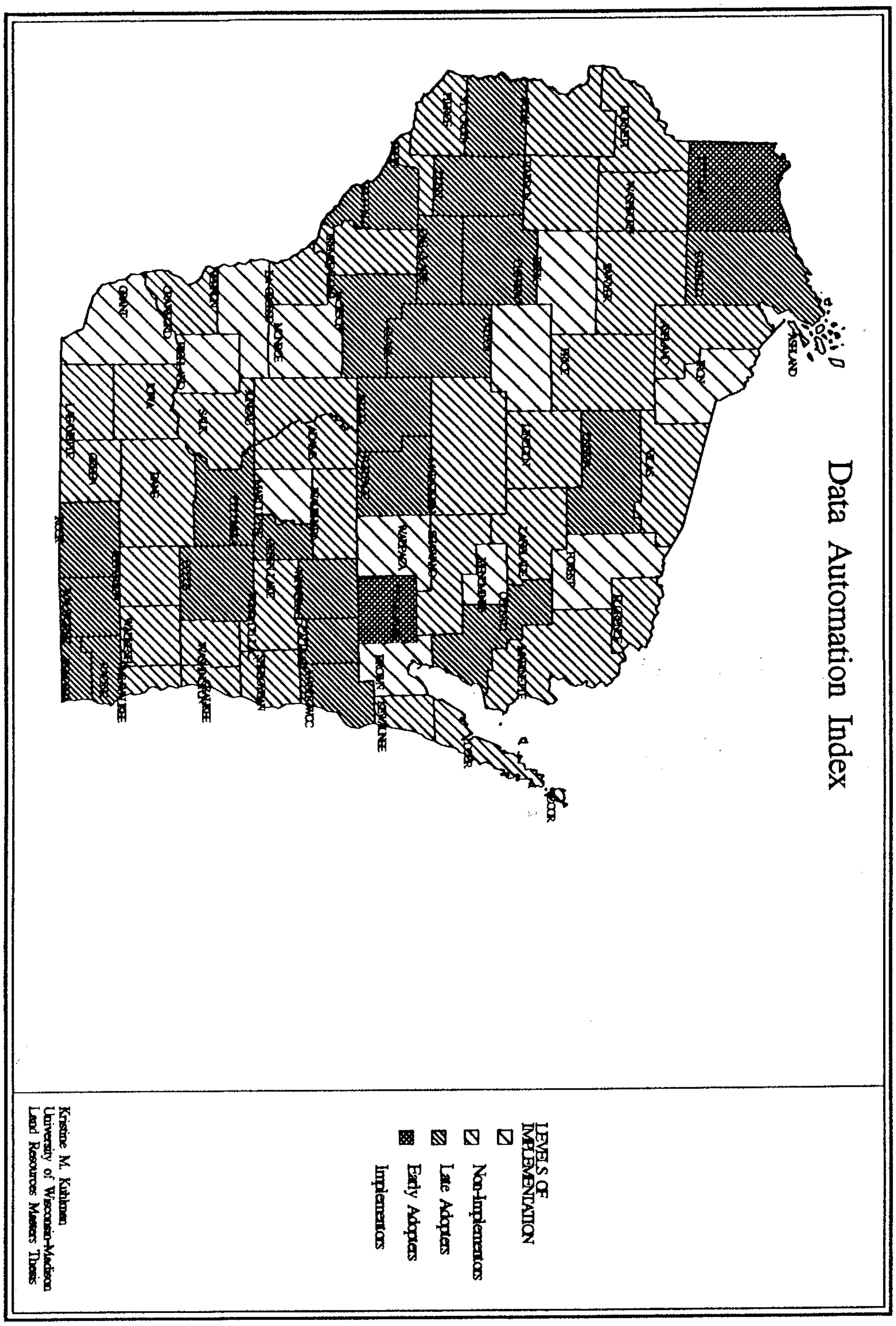

Figure 5.2 Data Automation Index Spatial Distribution

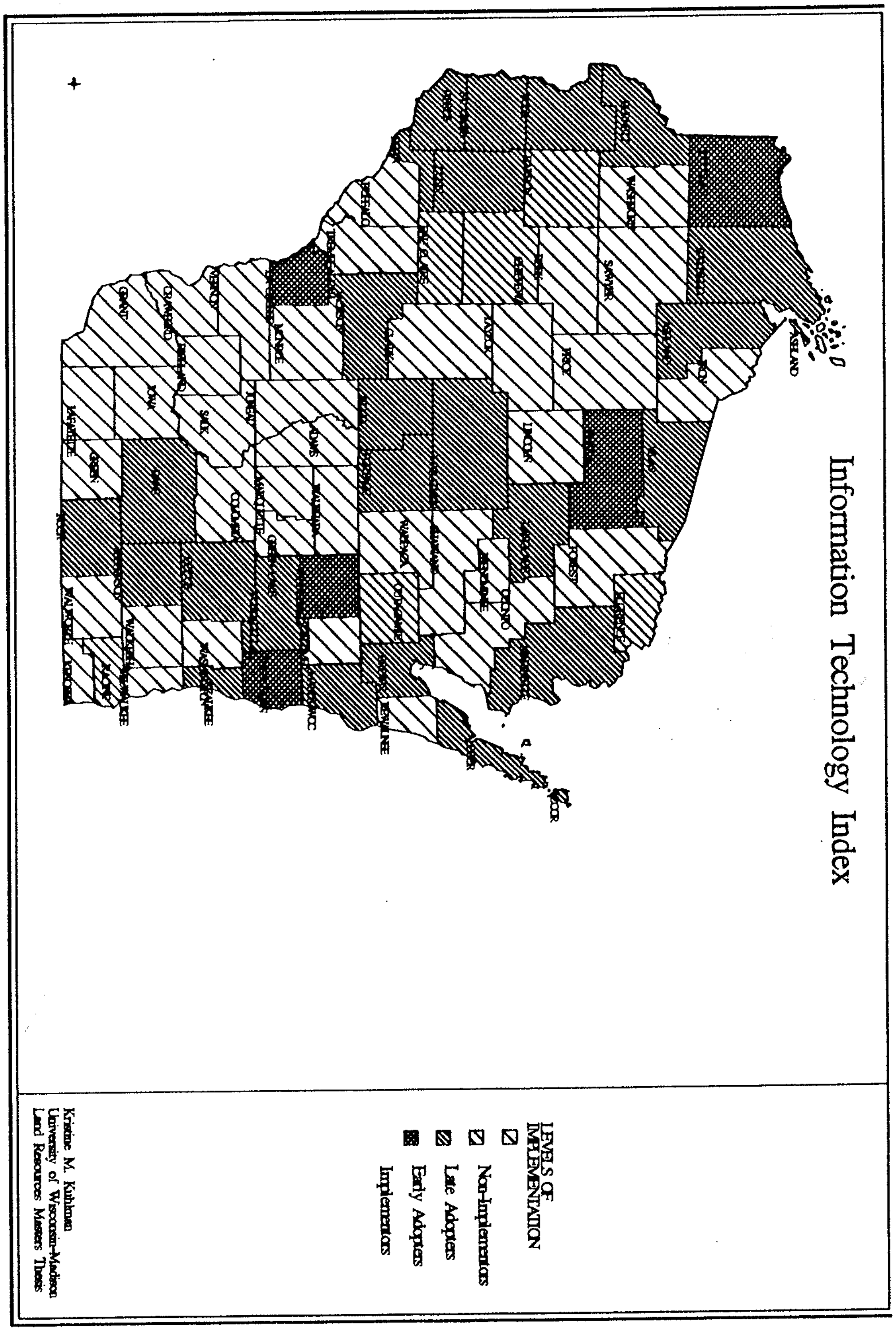

Figure 5.3 Information Technology Index Spatial Distribution

CHAPTER 6 - CONCLUSIONS

Recent increases in local governments' responsibilities have made managing land records more challenging than ever. Compliance with mandates and the increasing number of permits are a few of the activities that have put pressure on current land records management systems. Struggling to meet the demands placed on them, land records professionals are looking for alternative ways to more efficiently and effectively manage land information. Use of automated land information systems (LIS) is one way users of land records can cope with the deficiencies in current land records management systems.

Automated land information systems were not traditionally used to manage land records. Paper maps, files, and records were the way many organizations keep track of land information. Cutting and pasting from paper maps, drawing boundaries with markers, and coloring in areas of interest have been the norm for aggregating land information. These methods may get the job done, but replicating or completing further analyses with the same information is challenging. Computer technology has the capacity to perform land related spatial analyses in a digital environment. Use of multiple types of digital land information in an LIS can accomplish the same task as cutting and pasting. The resulting digital information products are often more accurate, aesthetically pleasing, and effective in conveying spatially complex analyses.

Introducing an innovative new technology brings in new fears, new tasks, and new skills. Not all professionals are comfortable with change. Resistance in the workplace may be felt because of the fear of the unknown. Professionals might feel their job may be eliminated, or they may fear they might not be able to meet the new demands or adequately perform new skills. This uncertainty must be overcome if new technology is to be implemented.

Overcoming technical and institutional barriers to transform the way land records are currently managed requires an understanding of the diffusion process. In order for new ideas to diffuse, land records professionals need to be aware that the innovation exists. Potential adopters need to be informed about the capacities and limitations of the new technology so expectations are not unrealistic. Implementing a LIS requires a large investments in time and money. Professionals will have to alter the way they currently operate. Unless those involved in the diffusion process are supportive, an otherwise smooth transition may be fraught with frustration. People do not like to deviate from the norm. Deviating from the status quo must offer some reward, such as saving time, reducing costs, or providing better quality information to make the risk worthwhile. If potential adopters decide to accept the risk of adopting the innovation they must make strides to implement it. The innovation may continue to be supported depending on its success, or adopters may decide to reject the technology. Diffusion functions as a continuous feedback loop. The innovation is said to be confirmed when it is used by the entire community and becomes the norm for managing land records.

Support is needed if the innovation is to overcome the institutional inertia faced during the implementation process. As a result of investigations by the Wisconsin Land Records Committee (WLRC) and action by the Wisconsin Land Information Association (WLIA), the Wisconsin Land Information Program (WLIP) was legislatively formed to facilitate the use of automated land information systems as a new way of managing land records in local governments. WLIP provides a technical and administrative framework for building "modern" information systems and a funding mechanism to support activities.

RESEARCH OVERVIEW

A number of factors influence the adoption and subsequent implementation of innovation. Characteristics of the innovation, decision making units, and the environment effect the diffusion of innovation. Understanding the extent such factors influence the diffusion process speed up or slow the diffusion of an innovation. This research examined factors controlled by the organization (internal environmental variables) and factors outside the control of an organization (external environmental variables) to account for the implementation of innovation as they fit into Rogers (1983) and Kraemer et al. (1989) models for diffusion.

This research has established a framework for a longitudinal study. The methodology developed in this work is one way to track the extent land information systems are implemented in counties. The extent independent variables are associated with the diffusion process may provide insight into the dynamics of the diffusion process. Understanding the influence environmental conditions are exerting at different levels of diffusion may help counties prioritize the allocation of resources based on where they are now in the diffusion process and where they want to be in the future.

The goal of this research was to determine the extent a group of six factors were related to the implementation of automated land information systems in Wisconsin counties. The independent variables were divided into two categories, internal and external environmental variables, and were used in different regression models to assess the extent of innovation implementation in counties. Three indices of implementation (dependent variables) were constructed to reflect different elements of the modernization process.

External environmental variables include a county's economic capacity, land market pressures, and the capacity to support WLIP's funding mechanism. Internal environmental variables reflect the professional communication networks, communication channels, and history of modernization prior to the inception of WLIP.

The three indices of implementation address the basic elements of a multi-purpose land information system (MPLIS), data automation activities, and the use of information technology. A questionnaire was sent out under the auspices of WLIP to the seventy-one participating counties to ascertain the status of land records modernization activities in their county. This information collected by this instrument provided the data that were used as independent and dependent variables. The status of implementation for each county was derived from the indices of implementation.

FINDINGS AND RECOMMENDATIONS

Results of stepwise multiple linear regression supported one of six hypotheses -- that the number of institutional arrangements in a county had a significant effect on the level of modernization implementation in a county. Although the F-values for institutional arrangements were significant in some of the statistical models, the low coefficients of determination (r^2) suggest that factors other than the six variables measured in this research are influencing the modernization process; or, that different factors are important in different counties. Results from evaluations of subsets of model variables indicated that the internal environmental variables contributed more to the modernization process than external environmental variables.

Of the six indicator variables tested with logistic regression analyses, four showed significant predictive ability for individual elements of automated land information systems. Institutional arrangements were significantly related to all three indices of implementation (refer to Tables 5.7-5.9). Institutional arrangements were most closely related to items in the data automation index. Presence of digital and hard copy parcels and zoning data and updating zoning information was related to the number of institutional arrangements. Relationships between information technology elements and standards were observed to a lesser extent.

The number of WLIA members acted in a limited role to influence the implementation of MPLIS elements (Table 5.7). Remonumentation activities and presence of a datum were the only factors that exhibited a relationship for all of the dependent variables. WLIA members have been active in the WLIP's grants process. The relationship between these two variables is reasonable since the major activities pursued by counties in grants applications has been for activities in the MPLIS index. WLIA members may act to diffuse innovation to other land records users, but diffusion must also occur vertically if the innovation is to gain broad-based acceptance and extensive use.

The amount of retained fees appeared to be financing the activities WLIA members are promoting in the MPLIS index, because both are related to presence of a datum and obtaining precise data. Retained fees were also used to support the acquisition of high quality maps as found in the data automation index (refer to Tables 5.7 and 5.8).

Growth rate was related to the acquisition of analog parcel maps (refer to Table 5.8). This result is not surprising since counties experiencing growth are apt to keep closer track of parcel data, since tax parcels are a major means of generating revenue for local governments.

Per capita tax base and investment prior to the inception of WLIP were not significant for any of the elements in the indices of implementation. It was expected that counties with a higher per capita tax base would be more generous with their purse strings and have the flexibility to support new activities. It was also expected that counties having a history of modernization would be further along than those who had not previously attempted to modernize. Some counties may have tried to modernize and found that it was not worth the investment. It may also be possible that those who have previously invested in modernization have not continued to progress or build on initial modernization activities.

These results suggest that anyone can play the modernization game. Lack of significance for per capita tax base and history of investment prior to the inception of WLIP affirm that counties do not have to be rich and do not have to have had previous experience in modernizing land records. With the WLIP's funding mechanism, counties are not limited by their economic status, as indicated by the statistical significance of retained fees with implementing the basics of an MPLIS. The importance of retained fees suggests that legislation is only part of the process; programs need to be backed with bucks.

Counties were classified as non-implementors, late adopters, early adopters, or implementors based on the number of activities being addressed in each of the indices of implementation. Overall, counties were most innovative in implementing the basic components of automated land information systems. Their modernization strategy has been to establish a geographic framework before moving on to more application driven activities, as reflected by the thirty-nine percent of counties classified as implementors in the MPLIS index. Three percent of counties were classified as innovator counties in the data automation index. However, the large number of counties in the late adopter category (51%) suggests that automating data for different applications was a bit slower to diffuse. Counties appeared to be taking an all or nothing approach in implementing information technology. Fifty-one percent of the counties were considered non-implementors, while thirty-seven were considered early adopters.

Counties more active in implementation appear to be spatially clustered around urban areas. Implementors are clustered in three geographic regions: north, around Douglas County where Superior is a major urban area; central, around Outagamie, Marathon, and Portage Counties with Appleton, Wausau, and Stevens Point as major urban areas; and southeast, around the SEWRPC (Southeastern Wisconsin Regional Planning Commission) region with Milwaukee as a major urban area. Increased numbers of institutional arrangements between adjacent counties may be responsible for the aggregation of high activity.

Although the response rate was high (>98%), this researcher felt that the quality of data collected in the 1992 ARS (Annual Report Survey) did not paint a clear picture of modernization activities in counties. The extent to which modernization activities were reported may be a function of the level of communication between agencies from whom data was collected in order to respond to the survey. Based on their rapport with other agencies, counties may not have had the means to efficiently and effectively obtain information, therefore, they may not have provided a representative picture of modernization activities in their county.

IMPLICATIONS OF RESEARCH

Kraemer et al. (1989) and Rogers (1983) have both proposed that communication channels are important in the diffusion process. Kraemer et al., (1989) suggests that arrangements may be more significant in the implementation stage than in earlier stages of the diffusion process. Rogers (1983) suggests that communication between agencies is a function of the diffusion paradigm (see Figure 1.3). The recurrent significance of institutional arrangements with the indices of implementation suggest that Rogers' (1983) paradigm, where communication is needed at every phase of the diffusion process, closely reflects the conditions in Wisconsin counties. While counties are in various stages of the diffusion process, the number of institutional arrangements was still exerting some influence over the modernization process.

Counties are still in the early stages of the diffusion process as indicated by the small percent of implementors in the classification scheme. It may be a bit premature to evaluate factors related to implementation, but rather, it may have been more appropriate to focus on the adoption decision stage. As innovations continue to diffuse, the three indices developed in this research reflecting the elementary components for implementing automated land information systems may need to be expanded. It is expected that counties who currently fall in the upper quartile for all three technical categories would be more likely to score higher on more sophisticated measures of modernization.

FUTURE DIRECTIONS

Another avenue to explore is the relationship of independent variables to various stages of the diffusion process, rather than focusing on a single stage of the diffusion process. Counties would be classified with the same indices of implementation, then they would be aggregated into different samples based on their level of modernization. Statistical tests of significance would be done on the stratified samples. These analyses may provide more information about the extent that factors are uniformly affecting the diffusion process, and what factors may be specific to particular stages in the diffusion process. Economic variables related to the adoption-decision would be expected to be significant for counties in the late adopter category if one follows the paradigm of Kraemer et al. (1989). Administrative variables such as institutional arrangement would be expected to be seen in all stages of diffusion if one follows Roger's (1983) paradigm.

Although institutional arrangements were significant for all indices of implementation, the degree these arrangements were utilized by counties ranged from formal data sharing arrangements to in name only arrangements. The degree of this activity is another area to explore to determine if p-values continue to be significant for all level of diffusion and if r^2 values changed as a result of categorizing institutional arrangements based on their degree of activity or type of information shared. It may be possible to determine what types of arrangements are more significant at different levels of implementation.

The results of these analyses suggest that institutional arrangements are vital in the modernization process. As more information is gathered about factors influencing the diffusion, a more complete diffusion model can be made.

Additional factors need to be incorporated into indices to further reflect the diffusion process. Spatial aggregations of more innovative counties suggest that the level of urbanization may play a role in the diffusion process. Educational opportunity, leadership, and access to resources in urban counties may be acting to influence the level of modernization and may be explored in future research.

Many counties are making strides to attain the technical elements related to modernization. They are generating and making products using a different medium - digital data. The technology has matured to the extent that the computers can more effectively analyze and process land information, but the administration of automated land information systems may still lag behind. Counties may not be changing the way they are functioning. Technical merits are only one part of the diffusion process. Changes need to be made in the administrative functions and procedures.

Future studies should evaluate administrative structure within counties. Modernization not only means changing the medium for land records, but it also means changing administrative structures. Data may still be generated for single purposes. Agreements may be formed between agencies without realizing any benefits. Indices need to be developed to determine the extent decentralized confederations are being formed. In addition, it would be beneficial to know which arrangements exert the greatest influence in the diffusion process.

The lack of significance for external environmental variables and investment prior to the inception of WLIP, and conversely the statistical significance of retained fees for some of the elements in the implementation indices suggest that WLIP may have a causal relationship on the modernization process. These findings may support the Ventura et al. (1993) assertion that societal mandates have a causal effect on technology diffusion.

REFERENCES

Aronson, R.J. and J.L. Hilley. 1986. Financing State and Local Governments. Washington, D.C.: The Brookings Institution.

Brown, L.A. 1981. Innovation Diffusion: A New Perspective. New York: Methuen and Co.

Burrough, P.A. and K. Jones. 1993. "Assessing Cultural Institutional Issues." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Boston: Kluwer Academic Publishers.

Campbell, D.T. and J.C. Stanley. 1963. Experimental and Quasi-Experimental Designs for Research. Boston: Houghton Mifflin Company.

Chrisman, N.R., Moyer, D.D., Niemann, B.J. 1990. Concept for a Multipurpose Land Information System. Primer on Multipurpose Land Information Systems, B.J. Niemann, and D. D. Moyer eds.

Clapp, J.L. and B.E. Weisman. 1988. "Integrating Land Information Statewide: The Wisconsin Land Records Committee Endeavor." in Niemann and Moyer, eds. A Primer on Multipurpose Land Information Systems. Wisconsin Land Information Report 4. Institute for Environmental Studies Report 133. University of Wisconsin- Madison.

Cook, R.N. and J.L. Kennedy. 1966. Tri-State Conference on a comprehensive, Unified Land Data System (CULDATA). Cincinnati: College of Law

Davies, S. 1979. The Diffusion of Process Innovations. Cambridge: Cambridge University Press.

De Neufville, R. and J. Croissant. 1990. "A Policy for Technology Leadership." *URISA Journal.* Vol. 2(2) pp. 7-15.

Deuker, K.J. and D. Kjerne. 1989. "Multipurpose Cadastre Terms and Definitions." American Society for Photography and Remote Sensing and American Congress on Surveying and Mapping. Falls Church, VA., p. 12.

Douven, W., M. Grothe, P. Nilkamp, and H. Scholten. 1993. "Urban and Regional Planning Models and GIS." Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

Final Report of the Wisconsin Land Records Committee: Modernizing Wisconsin's Land Records. 1987. Madison: Center for Land Information Studies.

Fletcher, P.T., S.I. Bretschneider, and D.A. Marchand. 1992. Managing Information Technology: Transforming County Governments in the 1990's. New York: Syracuse University, School of Information Studies.

Ginzberg, M.J. 1981. "Key Recurrent Issues in the MIS Implementation Process." *MIS Quarterly*. 5:2 pp. 47-59.

Goodman, P.S. 1993. "Implementation of New Information Technology." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

Gore, Senator A. 1992. Earth in Balance: Ecology and the Human Spirit. Boston: Houghton Mifflin Co.

Hardin, G. 1968. The Tragedy of the Commons. *Science*. Vol. 162(13) pp. 1247-1248.

Holland, P.W. 1986. "Statistics and Causal Inference." *Journal of the American Statistical Association*. Vol. 81(396) pp. 945-960.

Housing and Urban Development Department (HUD). 1976. Factors Involved in the Transfer of Innovations: A Summary and Organization of the Literature. Office of Policy Development Research.

Huxhold, W.E. 1984. "Modernizing Land Information Systems for City Planning and Management: Problems and Opportunities." in Niemann, ed. Seminar on the Multipurpose Cadastre: Modernizing Land Information Systems in North America Wisconsin Land Information Report 1. Institute for Environmental Studies Report 123. University of Wisconsin- Madison.

Huxhold, W.E. 1993. "The Application of Research and Development from the Information Systems Field to GIS Implementation in Local Government: Some Theories on Successful Adoption and Use of GIS Technology." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

Jeffress, G.A. 1992 Survey: A Study of the Adoption of Geographic Information Systems in Local Government. National Center for Geographic Information and Analysis: University of Maine.

Knight, K.E. 1967. "A Descriptive Model of the Intra-Firm Innovation Process." *Journal of Business* . Vol. 40(4) pp. 478-496.

Kraemer, K.L., J.L. King, D.E. Dunkel, J.P. Lane. 1989. Managing Information Systems: Change and Control in Organizational Computing. San Francisco: Jossey-Bass Publishers.

Kraemer, K.L. and W.H. Dutton. 1991. "Survey Research in the Study of Management Information Systems" in Kraemer, ed. The Information Systems Research Challenge: Survey Research Methods. Boston: Harvard Business School. Vol. 3 pp. 3-57.

Larsen, B.J., J.L. Clapp, A.H. Miller, B.J. Niemann, and A.L. Ziegler. 1978. Land Records: The Cost to the Citizen to Maintain the Present Land Information Base --A Case Study of Wisconsin. Wisconsin Department of Administration, Office of Program and Management Analysis.

Maggio, R.C. 1991. "Planning for a GIS Installation in a Local Government." GIS/LIS Conference Proceedings. Anaheim, CA. Vol. 1 pp. 413-420.

Masser, I. and H.J. Onsrud. 1993. "Diffusion and Use of Geographic Information Technologies: An Introduction." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

McGlade, J. and J.M. McGlade. 1989. "Modeling the Innovative Component of Social Change." in Van der Leeuw and Torrence, eds. What's New? A Closer Look at the Process of Innovation. London: Unwin Hyman Ltd.

McLaughlin, J.D. 1988. "Parcel-Based Land Information Systems." in Niemann and Moyer, eds. A Primer on Multipurpose Land Information Systems. Wisconsin Land Information Report 4. Institute for Environmental Studies Report 133. University of Wisconsin- Madison.

Myers, S. and Marquis, D.G. 1969. Successful Industrial Innovations: A Study of Factors Underlying Innovation in Selected Firms. Washington D.C.: U.S. Government Printing Office.

National Research Council (NRC). 1980. Need for a Multipurpose Cadastre, Panel on a Multipurpose Cadastre. Committee on Geodesy, Assembly of Mathematical and Physical Sciences. Washington D.C.: National Academy Press.

Niemann, B.J., Jr. (editor). 1984. Seminar on the Multipurpose Cadastre: Modernizing Land Information Systems in North America. Wisconsin Land

Information Report 1. Institute for Environmental Studies Report 123. University of Wisconsin- Madison.

Niemann, B.J., Jr. 1993. "It's Too Good to Lose." *Wisconsin Mapping Bulletin.* Vol. 19(2) pp. 8-9.

Onsrud, H.J. and J.K. Pinto. 1991. "Diffusion of Geographic Information Innovations." International Journal of Geographic Information Systems. Vol. 5(4) pp. 447-467.

Onsrud. H.J. and J.K. Pinto. 1993. "Evaluating Correlates of GIS Adoption Success and the Decision Process of GIS Acquisition." *URISA Journal* Vol. 5(1) pp. 18-39.

Perry, J.L. and K.L. Kraemer. 1979. Technological Innovation in American Local Governments: The Case of Computing. New York: Pergamon Press.

Portner, J. 1982. Beliefs Regarding Issues Relating to Land Records. Unpublished M.S. Thesis. University of Wisconsin-Madison.

Rogers, E.M. 1983. The Diffusion of Innovations. New York: The Free Press.

Rogers, E.M. 1993. "The Diffusion of Innovations Model." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

Rogers, E.M. and F.F. Shoemaker. 1971. Communications of Innovations. New York: The Free Press.

Rumor, M. 1993. "The Use of Geographic Information Technology in the City of Padova." in Masser and Onsrud, eds. Diffusion and Use of Geographic Information Technologies. Dordrecht: Kluwer Academic Press.

SAS Institute Inc. SAS/STAT Guide for Personal Computers, Version 6 Edition. Cary, NC: SAS Institute Inc., 1987. 1028 pp.

Schultz, R.L., Slevin, D.P. and Pinto, J.K. 1987. "Strategy and Tactics in a Process Model of Project Implementation." Interfaces. Vol. 17(3) pp. 34-46.

State of Wisconsin Blue Book. 1992. Wisconsin Legislative Reference Bureau. Wisconsin Department of Administration.

A Study of Land Information Systems (ASLI): The Federal Land Exchange Facilitation Act of 1988. 1990. Department of Interior.

Sullivan, J.G., J.C. Clapp, and J. McLaughlin. 1985. "Toward a Method for the Evaluation of Multipurpose Land Information Systems." Conference of the Urban and Regional Information System Association. Vol. 1 pp. 1-10.

Van der Leeuw, S.E. and R. Torrence. 1989. "What's New About Innovation." in Van der Leeuw and Torrence, eds. What's New? A Closer Look at the Process of Innovation. London: Unwin Hyman Ltd.

Ventura, S., P.K. Kishor, B.J. Niemann, K. Kuhlman, E. Epstein, and W. Holland. 1993. "Laws That Drive Change: GIS/LIS Development by Local Governments. and the Wisconsin Land Information Program." GIS/LIS Annual Conference Proceedings. Minneapolis, MN. Vol. 2 pp. 681-690.

Ventura, S.J. and D.A. Giampetroni. 1992. "Wisconsin Conservationists Respond to Field Office Overload." *Journal of Soil and Water Conservation.* Vol. 18(2). pp. 83-89.

Vonderohe, A.P., R.F. Gurda, S.J. Ventura, and P.G. Thum. 1991. Introduction to Local Land Information Systems for Wisconsin's Future. Wisconsin State Cartographer's Office.

Weinberg, I. 1972. "The Concept of Modernization: An Unfinished Chapter in Sociological Theory. in Harvey, ed. Perspectives on Modernization. Toronto: University of Toronto Press.

Wilson, H.T. 1984. Tradition and Innovation: The Idea of Civilization as Culture and Its Significance. Boston: Routledge and Kegan Paul.

Wisconsin Land Information Newsletter (WLIN). 1993. "Project LOCALIS: Land Information Systems for Local Governments." Madison: University of Wisconsin Land Information and Computer Graphic Facility. Vol. 7(2) pp. 1-2.

Wisconsin Land Information Program (WLIP). 1992a. "Historical Background to the Wisconsin Land Information Program." In: Wisconsin Land Information Program-Modernizing Wisconsin's Land Records Through Decentralized and Integrated Land Information Systems. Madison: Department of Administration.

Wisconsin Land Information Program (WLIP). 1992b. "Statues and Administrative Rules Applicable to the Wisconsin Land Information Program." In: Wisconsin Land Information Program-Modernizing Wisconsin's Land Records Through Decentralized and Integrated Land Information Systems. Madison: Department of Administration.

Wisconsin Land Information Program (WLIP). 1992c. "Policy Objectives and Program Implementation in Light of the Enabling Legislation, 1989 Wisconsin

Acts 31 and 339." In: Wisconsin Land Information Program-Modernizing Wisconsin's Land Records Through Decentralized and Integrated Land Information Systems. Madison: Department of Administration.

Wisconsin Land Information Program (WLIP). 1992d. "Recommendations and Requirements for County-Wide Plans for Land Records Modernization." In: Wisconsin Land Information Program-Modernizing Wisconsin's Land Records Through Decentralized and Integrated Land Information Systems. Madison: Department of Administration.

Wisconsin Land Information Program (WLIP). 1992e. "Aid to Counties: Procedures, Standards and Criteria for Grants in Aid to Local Governmental Units." In: Wisconsin Land Information Program-Modernizing Wisconsin's Land Records Through Decentralized and Integrated Land Information Systems. Madison: Department of Administration.

Wortman, K. 1993. "Implementing the Spatial Data Transfer Standard." URISA Annual Conference Proceedings. Atlanta, GA. Vol. 2 pp. 111-116.

Wunderlich, G., and D.D. Moyer. 1984. "Economic Features of Land Information Systems." in Niemann, ed. Seminar on the Multipurpose Cadastre: Modernizing Land Information Systems in North America. Wisconsin Land Information Report 1. Institute for Environmental Studies Report 123. University of Wisconsin- Madison.

Younger, M.S. 1979. Handbook for Linear Regression. North Seituate, MA: Duxbury Press.

Zmud, R.W. 1983. "The Effectiveness of Internal Information Channels in Facilitating Innovation Within Software Development Groups." MIS Quarterly. Vol. 7(2) pp. 43-58.

APPENDIX 1:
GLOSSARY

APPENDIX 1 - GLOSSARY

land records
land records are the medium in which land information is stored (WLIP, 1992).

land information
land information refers to any physical, legal, or economic information concerning land, water, ground water, subsurface resource, or air (WLIP, 1992).

land information systems
land information systems is the means by which land information is organized and managed in an orderly fashion (WLIP, 1992).

land records modernization
land records modernization, which embraces, over time, the capture of technology to invigorate and update land information, land records, and land information systems (WLIP, 1992).

innovation
an innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption. Five attributes of innovation are: relative advantage, compatibility, complexity, trialibility, and observability (Rogers, 1993).

geographic information systems
GIS: a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth (Deuker and Kjerne, 1989)

diffusion
the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 1983).

initiation (adoption): The organization becomes aware of the innovation and decides to adopt it (Onsrud and Pinto, 1993).

implementation: An organization engages in the activities necessary to put the innovation into practice and incorporate it into existing and developing operations (Onsrud and Pinto, 1993).

APPENDIX 2:
INDICES OF IMPLEMENTATION

APPENDIX 2 - INDICES OF IMPLEMENTATION

MPLIS Component Index

9 variables:

(1) coordinate system used
(2) datum used
(3) parcel index attribute in database

parcel i.d.
(4) geo-code system
(5) unique number

standards
(6) FGCC orders of accuracy for g.c.
(7) FGCC procedures used for coords

remonumentation occurs
(8) with coordinates or mixed or
(9) without coordinates

Information Technology Index

6 variables:

computer software used
(1) graphics, DBase, and
(2) analytical capability (ARC/INFO)
graphics capability (AUTOCAD)

peripheral equipment
(3) input digital data
(4) output digital data

GIS-microcomputer
(5) workstation accessibility
GIS-minicomputer
(6) workstation accessibility (AS400)

Data Automation Index

12 variables:

parcels data
(1) in digital or mixed format or
(2) in hard copy
(3) accuracy known
(4) use national map accuracy standard
(5) updated regularly

zoning data
(6) in digital or mixed format or
(7) in hard copy
(8) updated regularly

wetland data
(9) in digital or mixed format or
(10) in hard copy

soils data
(11) in digital or mixed format or
(12) in hard copy

APPENDIX 3:
HIGHLIGHTS FROM
WLIP 1992 ANNUAL REPORT SURVEY

APPENDIX 3 - HIGHLIGHTED SURVEY QUESTIONS

MPLIS Component Index

11 On what datum is your geodetic reference system established?
[]NAD '27
[]NAD '83 (1986)
[]NAD '83 (1991)
[]Other ________

12 What coordinate system is used for your most recent datum?
[]County Based
[]State Plane Coordinates (SPC)
[]Universal Transverse Mercator (UTM)
[]Wisconsin Transverse Mercator (WTM)
[]Other ________________

15 Standards for geodetic control include:
[]FGCC classification for orders of accuracy
[]B order or above
[]First Order, Class ______ surveying standards
[]Second Order, Class _____ surveying standards
[] Third Order, Class ______ surveying standards
[] Other ________________________
[] None

20 Is your county using the Federal Geodetic Control Committee's procedures for determiningcoordinates? []yes []no []planned

27 Remonumentation has occurred
[] with coordinates
[] without coordinates
[] mixed
[] none

34 Please check all boxes that apply. Parcel Identification consists of a:
[] unique number assigned to parcels
[] geo-code parcel identification scheme (e.g. Board Recommended scheme)
[] other ____________________

43 What attributes do you use in your parcel database
[]PLSS description
[]property value
[]physical address
[]WLIP parcel identifier
[]owner's name
[]other _______

Information Technology Index

3 Which Geographic Information System(s) does your organization currently use? Check all that apply. In addition, please list how long you have owned each system/program and what computer platform it is run on (e.g. Pc, VAX mainframe, Intergraph workstation). Lastly, check any systems you have used in the past which you have since discontinued.

When answering the following questions please use the following key regarding computer platform:

PC = Personal Computer (DOS) WKS = Work Station
MF = Main Frame MAC = Macintosh

	Used Currently	Year Acquired	Computer Platform	Planned to acquire	Used prior to WLIP
ARC/INFO	[]	______	[]PC []WKS []MF []MAC	[]	[]
ATLAS-GIS	[]	______	[]PC []WKS []MF []MAC	[]	[]
EPPL-7	[]	______	[]PC []WKS []MF []MAC	[]	[]
ERDAS	[]	______	[]PC []WKS []MF []MAC	[]	[]
AUTOCAD	[]	______	[]PC []WKS []MF []MAC	[]	[]
GRASS	[]	______	[]PC []WKS []MF []MAC	[]	[]
IDRISI	[]	______	[]PC []WKS []MF []MAC	[]	[]
MGE/MGA (Intergraph)	[]	______	[]PC []WKS []MF []MAC	[]	[]
IGDS/DMRS	[]	______	[]PC []WKS []MF []MAC	[]	[]
MAPINFO	[]	______	[]PC []WKS []MF []MAC	[]	[]
OSU-MAP	[]	______	[]PC []WKS []MF []MAC	[]	[]
TYDAC (SPANS)	[]	______	[]PC []WKS []MF []MAC	[]	[]
Genasys	[]	______	[]PC []WKS []MF []MAC	[]	[]
FMS/AC	[]	______	[]PC []WKS []MF []MAC	[]	[]
GEO/SQL (Generation 5)	[]	______	[]PC []WKS []MF []MAC	[]	[]
UltiMap	[]	______	[]PC []WKS []MF []MAC	[]	[]
Other: ______________	[]	______	[]PC []WKS []MF []MAC	[]	[]

7 The following peripheral hardware is used for land records modernization:

[] digitizers
[] document scanner
[] pen plotter
[] postscript/laser printer (black and white)
[] postscript/laser printer (color)
[] electrostatic plotter
[] Other ____________________

8 Geographic Information Systems (GIS) workstation capabilities can be accessed through microcomputer display []yes []no

9 Links have been made between mainframe/minicomputer database systems (e.g.AS400) and GIS workstation technology: []yes []no

Data Automation Index

25 Standard(s) used for mapping

[] National Map Accuracy Standard for base mapping
[] Other __________________
[] None

33 Category 2. **Parcel Administration.** What methods were used for parcel administration. Please check all boxes that apply.

BASIS FOR ADMINISTRATION	METHOD OF INPUT			
	Digitized/Scanned	COGO	Manual	Digital File
tract index	[]	[]	[]	[]
attaching evidence of title to areas of land	[]	[]	[]	[]
zoning classification	[]	[]	[]	[]
attaching property tax and assessment files to areas of land	[]	[]	[]	[]
attaching owner name to areas of land	[]	[]	[]	[]
subdivision plats & certified maps of survey	[]	[]	[]	[]
other _____________________	[]	[]	[]	[]

37 In what format does parcel data exist?

[] hard copy
[] digital
[] mixed %hard copy _____ %digital_____
[] other _______

46 What is the schedule for updating parcel boundary information?

[] monthly basis
[] transactional basis
[] other period ______

54 In what format does wetlands data exist?

[] hard copy
[] digital
[] mixed %hard copy ___ %digital ___
[] other _________

62 In what format does soils information exist?

[] hard copy
[] digital
[] mixed %hard copy ___ % digital ___

73 In what format does zoning information exist?

[] hard copy
[] digital
[] mixed %hard copy ___ %digital ___
[] other __________

76 What is the schedule for updating zoning information?

[]monthly basis
[] transactional basis
[] other period __________

Internal Organizational Variables from Questionnaire

78 Please list the institutional arrangements **that exist for your county.** Please also indicate if the nature of the arrangement is formal or informal or if arrangements are to be negotiated in the future.

Multi Departmental/Single Governmental Unit

	Nature of Arrangement		
	Formal	**Informal**	**Negotiating**
Cartographer	[]	[]	[]
County Conservationist	[]	[]	[]
County Register of Deeds	[]	[]	[]
County Sheriff	[]	[]	[]
County Surveyor	[]	[]	[]
County Treasurer	[]	[]	[]
County Zoning Office	[]	[]	[]
Data Processing Department	[]	[]	[]
Department of Emergency Government	[]	[]	[]
Department of Planning and Zoning	[]	[]	[]
Emergency Government Department	[]	[]	[]
Forest and Parks Administration	[]	[]	[]
Highway Commission	[]	[]	[]
Land Conservationist	[]	[]	[]
Land Information Office	[]	[]	[]
Real Property Lister	[]	[]	[]
Solid Waste Department	[]	[]	[]
Zoning Administrator	[]	[]	[]
Other ____________	[]	[]	[]

Multi Jurisdictional

	Nature of Arrangement		
	Formal	**Informal**	**Negotiating**
City of ____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
Town of ____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
Village of ____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]
Regional Planning Commission	[]	[]	[]
Other ____________	[]	[]	[]
____________	[]	[]	[]
____________	[]	[]	[]

Multi County

	Nature of Arrangement		
	Formal	Informal	Negotiating
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]

Private Sector Participation

	Nature of Arrangement		
	Formal	Informal	Negotiating
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]

State Agency Participating Entity

	Nature of Arrangement		
	Formal	Informal	Negotiating
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]

Federal Agency Participating Entity

	Nature of Arrangement		
	Formal	Informal	Negotiating
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]
____________________	[]	[]	[]

EXTERNAL ENVIRONMENTAL VARIABLES

36 List the total number of parcels in the county ______________

28 Based on the preceding information, please **estimate** the total amount of money from your county spent on: PLSS REMONUMENTATION **WITH** COORDINATES:

WLIP Retained		$______________
WLIP Grant		$______________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$______________
	Collected **before** 1 July 1990 (for the previous 3 years)	$______________
Amount from Utilities		$______________
Other Revenue	Cost-share agreement with other agency (describe)______________	$______________
	Other ________________	$______________

29 Please **estimate** the total amount of money from your county spent on: PLSS REMONUMENTATION **WITHOUT** COORDINATES:

WLIP Retained		$______________
WLIP Grant		$______________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$______________
	Collected **before** 1 July 1990 (for the previous 3 years)	$______________
Amount from Utilities		$______________
Other Revenue	Cost-share agreement with other agency (describe)______________	$______________
	Other ________________	$______________

30 Please estimate the total amount of money from your county spent on control densification (e.g. monumentation, survey, and adjustment).

WLIP Retained		$______________
WLIP Grant		$______________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$______________
	Collected **before** 1 July 1990 (for the previous 3 years)	$______________
Amount from Utilities		$______________
Other Revenue	Cost-share agreement with other agency (describe)______________	$______________
	Other ________________	$______________

31 Please fill in the following columns relating to the total amount of money your county has spent on additional **control** to support mapping (e.g. aerial photography costs).

WLIP Retained		$______________
WLIP Grant		$______________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$______________
	Collected **before** 1 July 1990 (for the previous 3 years)	$______________
Amount from Utilities		$______________
Other Revenue	Cost-share agreement with other agency (describe)______________	$______________
	Other ________________	$______________

47 Please indicate the total amount of money **spent** on parcels mapping within your county.

WLIP Retained		$__________
WLIP Grant		$__________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$__________
	Collected **before** 1 July 1990 (for the previous 3 years)	$__________
Amount from Utilities		$__________
Other Revenue	Cost-share agreement with other agency (describe)__________	$__________
	Other __________	$__________

57 <u>Please indicate the total amount of money **spent** on wetlands mapping within your county</u>.

WLIP Retained		$__________
WLIP Grant		$__________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$__________
	Collected **before** 1 July 1990 (for the previous 3 years)	$__________
Amount from Utilities		$__________
Other Revenue	Cost-share agreement with other agency (describe)__________	$__________
	Other __________	$__________

65 Please indicate the total amount of money **spent** on soils mapping within your county.

WLIP Retained		$________
WLIP Grant		$________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$________
	Collected **before** 1 July 1990 (for the previous 3 years)	$________
Amount from Utilities		$________
Other Revenue	Cost-share agreement with other agency (describe)________	$________
	Other ________	$________

77 Please indicate the total amount of money spent on zoning mapping within your county.

WLIP Retained		$________
WLIP Grant		$________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$________
	Collected **before** 1 July 1990 (for the previous 3 years)	$________
Amount from Utilities		$________
Other Revenue	Cost-share agreement with other agency (describe)________	$________
	Other ________	$________

79 Please indicate the total amount of money **spent** on institutional arrangements.

WLIP Retained		$______________
WLIP Grant		$______________
Amount from county/ municipal levy	Collected **after** 1 July 1990	$______________
	Collected **before** 1 July 1990 (for the previous 3 years)	$______________
Amount from Utilities		$______________
Other Revenue	Cost-share agreement with other agency (describe)______________	$______________
	Other ________________	$______________

APPENDIX 4: DATA SETS

Table 1 Independent External Variables

COUNTY	normalized per capita tax base	normalized growth rate	normalized retained fees
Adams	0.585348	1	0
Ashland	0.294102	-0.17181	0.006521
Barron	0.373224	0.315789	0.545221
Bayfield	0.498934	0.08167	0.013775
Brown	0.415335	0.666667	0.029105
Buffalo	0.35824	-0.30672	0.008219
Burnett	0.583083	0.364791	0.193783
Calumet	0.386661	0.670901	0.096303
Chippewa	0.344443	0.027223	0.573224
Clark	0.291053	-0.2323	0.00702
Columbia	0.434344	0.261343	0.220813
Crawford	0.343822	-0.22505	0
Dane	0.474033	0.814277	0
Dodge	0.361379	0.120387	0.357995
Door	0.97455	0.15971	0
Douglas	0.297158	-0.36237	0.362335
Dunn	0.300642	0.281307	0
Eau_Claire	0.333059	0.489413	0.025083
Florence	0.469964	0.606171	0.038828
Fond_du_Lac	0.379367	0.076225	0.014213
Forest	0.426649	-0.17907	0
Grant	0.313413	-0.28917	0.002527
Green	0.430834	0.065941	0.112823
Green_Lake	0.506607	0.092559	0
Iowa	0.443899	0.106473	0
Iron	0.418779	-0.51845	0
Jackson	0.355539	-0.08711	0.073409
Jefferson	0.36853	0.149425	0.05305
Juneau	0.377922	0.176044	0.026614
Kenosha	0.39723	0.248034	0.488081
Kewaunee	0.362026	-0.20448	0
La_Crosse	0.363926	0.45493	0.164975
Lafayette	0.430533	-0.464	0.023992
Langlade	0.348823	-0.14338	0.132796
Lincoln	0.328455	0.099819	0
Manitowoc	0.336799	-0.18209	0.076514
Marathon	0.390866	0.22444	0

COUNTY	normalized per capita tax base	normalized growth rate	normalized retained fees
Marinette	0.399331	0.189958	0.312534
Marquette	0.502542	0.336358	0.192124
Menominee	0.220746	0.927405	0
Milwaukee	0.399192	-0.03569	0.698641
Monroe	0.314424	0.268603	0.009063
Oconto	0.416541	0.267393	0.045943
Oneida	0.627318	0.089534	0
Outagamie	0.424954	0.553539	0.046198
Ozaukee	0.602816	0.528131	1.0001
Pepin	0.351552	-0.29946	0
Pierce	0.367343	0.313975	0.076372
Polk	0.431246	0.453116	0.014115
Portage	0.412746	0.419843	0.488381
Price	0.361847	-0.07199	0.338902
Racine	0.390432	0.066546	0
Richland	0.329516	0.015729	0.017945
Rock	0.353691	0.00363	0.006444
Rusk	0.299448	-0.19782	0.008733
Sauk	0.455538	0.488203	0.341788
Sawyer	0.596999	0.630369	0
Shawano	0.369796	0.206897	0.271125
Sheboygan	0.398288	0.176044	0
St_Croix	0.468886	0.977616	0.038496
Taylor	0.307884	0.027223	0
Trempealeau	0.312483	-0.2069	0
Vilas	1.000007	0.428917	0.114473
Walworth	0.651967	0.295221	0.244313
Washburn	0.469941	0.274652	0.026104
Washington	0.471729	0.747126	0.338202
Waukesha	0.632354	0.529341	0
Waupaca	0.382939	0.46219	0.008224
Waushara	0.531902	0.280702	0.009499
Winnebago	0.426503	0.392619	0.210585
Wood	0.374796	0.067151	0.168149

Table 2 Independent Internal Variables

COUNTY	normalized investment prior to WLIP	normalized institutional arrangements	normalized number of WLIA members
Adams	0	0.288136	0.05333
Ashland	0.072754	0.186441	0
Barron	0.066503	0.305085	0
Bayfield	0.369897	0.457627	0
Brown	0.072868	0.355932	0.13333
Buffalo	0.10657	0.355932	0
Burnett	0.067144	0.677966	0.04
Calumet	0.103639	0.440678	0.10667
Chippewa	0.030073	0.491525	0.01333
Clark	0.065122	0.847458	0.02667
Columbia	0.872014	0.372881	0.05333
Crawford	0.027245	0.389831	0
Dane	1.000365	0.440678	1
Dodge	0.046638	0.644068	0.05333
Door	0.10128	0.254237	0.08
Douglas	0.013714	0.745763	0.01333
Dunn	0.058279	0.474576	0.06667
Eau_Claire	0.142406	0.474576	0.08
Florence	0.008287	0.271186	0
Fond_du_Lac	0.071833	0.389831	0.08
Forest	0.010937	0.220339	0
Grant	0.056465	0.186441	0.01333
Green	0.201769	0.118644	0
Green_Lake	0.032416	0	0.02667
Iowa	0	0.254237	0.01333
Iron	0	0.101695	0
Jackson	0.207294	0.949153	0.05333
Jefferson	0.111154	0.288136	0.05333
Juneau	0.229406	0.474576	0.05333
Kenosha	0.042582	0.525424	0.04
Kewaunee	0.039229	0.423729	0.01333
La_Crosse	0.070956	0.355932	0.04
Lafayette	0.000664	0.101695	0.01333
Langlade	0.050022	0.338983	0.02667
Lincoln	0	0.338983	0.01333
Manitowoc	0	0.576271	0.04
Marathon	0.671488	0.372881	0.13333

COUNTY	normalized investment prior to WLIP	normalized institutional arrangements	normalized number of WLIA members
Marinette	0.078347	0.644068	0
Marquette	0.105877	0.440678	0
Menominee	0	0	0.02667
Milwaukee	0.005374	0.508475	0.17333
Monroe	0	0.322034	0.04
Oconto	0.067877	0.372881	0.08
Oneida	0.030903	0.847458	0.09333
Outagamie	0.120822	0.59322	0.16
Ozaukee	0.021224	0.661017	0.02667
Pepin	0.07451	0.016949	0
Pierce	0.100514	0.508475	0.02667
Polk	0.110313	0.474576	0.01333
Portage	0.104208	0.372881	0.13333
Price	0.007997	0.677966	0.01333
Racine	0.011849	0.338983	0.09333
Richland	0.097784	0.355932	0.04
Rock	0.101118	0.508475	0.05333
Rusk	0.043294	0.355932	0
Sauk	0.115503	1	0.05333
Sawyer	0.091182	0.457627	0.01333
Shawano	0.0704	0.508475	0.01333
Sheboygan	0	0.440678	0.08
St_Croix	0.058195	0.525424	0.04
Taylor	0	0	0.04
Trempealeau	0	0.067797	0.02667
Vilas	0.081209	0.423729	0.02667
Walworth	0.08083	0.59322	0.06667
Washburn	0	0.288136	0.02667
Washington	0	0	0.01333
Waukesha	0.463298	0.644068	0.12
Waupaca	0.49594	0.508475	0.04
Waushara	0.026352	0.508475	0.01333
Winnebago	0.087767	0.491525	0.10667
Wood	0	0.372881	0.02667

Table 3 MPLIS Index Variables

COUNTY	coordinate system	datum	geocode parcel id	unique id	parcel accuracy standard	parcel procedural standard
Adams	1	0	0	1	0	0
Ashland	1	1	1	1	0	0
Barron	1	1	0	1	1	0
Bayfield	1	1	1	1	1	0
Brown	1	1	0	1	1	1
Buffalo	1	0	0	0	1	0
Burnett	1	1	0	1	1	0
Calumet	1	1	0	1	1	1
Chippewa	1	1	1	0	1	0
Clark	0	1	0	1	0	0
Columbia	1	1	0	1	1	0
Crawford	1	1	0	1	1	0
Dane	1	1	1	0	1	0
Dodge	1	1	0	0	1	0
Door	0	1	1	1	0	0
Douglas	1	1	0	1	1	1
Dunn	1	1	0	0	1	1
Eau_Claire	1	1	1	1	1	0
Florence	0	0	0	1	0	0
Fond_du_Lac	1	0	1	1	0	0
Forest	1	1	0	1	1	0
Grant	0	0	0	1	0	0
Green	1	0	0	0	0	0
Green_Lake	0	0	0	1	0	0
Iowa	1	1	0	0	0	0
Iron	0	0	0	0	0	0
Jackson	1	1	0	1	1	1
Jefferson	1	1	1	0	1	0
Juneau	1	0	0	0	1	0
Kenosha	1	1	1	1	1	1
Kewaunee	0	0	0	1	0	0
La_Crosse	1	1	0	1	1	0
Lafayette	0	0	0	0	0	0
Langlade	1	1	0	1	1	0
Lincoln	0	0	0	1	0	0
Manitowoc	1	1	0	1	0	1
Marathon	1	1	0	1	0	0

COUNTY	coordinate system	datum	geocode parcel id	unique id	parcel accuracy standard	parcel procedural standard
Marinette	1	1	0	0	1	1
Marquette	1	1	0	0	1	1
Menominee	0	0	0	0	0	0
Milwaukee	1	1	0	1	1	1
Monroe	1	1	1	1	0	0
Oconto	0	0	1	0	0	0
Oneida	1	1	0	1	1	1
Outagamie	1	1	0	1	1	0
Ozaukee	1	1	0	1	1	1
Pepin	1	1	0	1	1	0
Pierce	1	1	1	1	1	1
Polk	1	1	0	1	0	0
Portage	1	1	1	0	1	1
Price	1	1	0	0	0	0
Racine	1	1	0	1	1	1
Richland	1	1	0	0	1	0
Rock	1	1	0	1	1	1
Rusk	0	0	0	0	0	0
Sauk	0	0	0	1	0	0
Sawyer	1	0	0	1	1	0
Shawano	1	0	0	1	0	0
Sheboygan	1	1	1	1	1	1
St_Croix	1	0	1	1	0	0
Taylor	0	0	0	0	0	0
Trempealeau	0	0	0	1	0	0
Vilas	0	0	0	1	1	0
Walworth	1	1	0	1	1	1
Washburn	0	0	1	0	0	0
Washington	1	1	0	1	1	1
Waukesha	1	1	0	1	1	1
Waupaca	1	1	1	0	1	1
Waushara	0	0	0	1	0	0
Winnebago	1	1	0	1	1	1
Wood	1	1	0	1	1	1

Table 3a MPLIS Index Variables (continued)

COUNTY	common parcel attributes	remonumentation with coordinates	remonumentation without coordinates
Adams	1	0	0
Ashland	1	0	0
Barron	1	1	1
Bayfield	1	0	1
Brown	1	1	0
Buffalo	1	1	1
Burnett	1	1	1
Calumet	1	1	1
Chippewa	1	0	0
Clark	1	0	1
Columbia	1	1	1
Crawford	1	1	0
Dane	1	1	1
Dodge	1	0	1
Door	0	0	1
Douglas	1	1	1
Dunn	0	1	1
Eau_Claire	1	1	0
Florence	1	0	0
Fond_du_Lac	1	1	1
Forest	1	0	1
Grant	1	0	1
Green	1	0	1
Green_Lake	1	0	1
Iowa	1	1	0
Iron	0	0	0
Jackson	1	0	1
Jefferson	1	1	1
Juneau	1	0	1
Kenosha	0	1	0
Kewaunee	0	0	1
La_Crosse	1	1	1
Lafayette	0	0	1
Langlade	1	0	1
Lincoln	1	0	0
Manitowoc	1	0	1
Marathon	1	1	1

COUNTY	common parcel attributes	remonumentation with coordinates	remonumentation without coordinates
Marinette	1	0	0
Marquette	0	1	0
Menominee	0	0	0
Milwaukee	0	1	0
Monroe	0	0	1
Oconto	1	1	0
Oneida	1	1	1
Outagamie	1	1	1
Ozaukee	1	1	1
Pepin	1	1	1
Pierce	0	1	1
Polk	1	1	1
Portage	1	1	1
Price	0	0	1
Racine	1	1	0
Richland	0	0	0
Rock	1	1	1
Rusk	0	0	1
Sauk	0	1	1
Sawyer	1	0	1
Shawano	1	0	1
Sheboygan	1	1	1
St_Croix	1	0	1
Taylor	0	0	0
Trempealeau	0	0	1
Vilas	1	0	1
Walworth	1	1	1
Washburn	1	0	1
Washington	1	1	1
Waukesha	1	1	0
Waupaca	1	1	1
Waushara	1	0	1
Winnebago	1	0	1
Wood	1	1	1

Table 4 Information Technology Index Variables

COUNTY	use GIS with display and dbase	use GIS with display only	GIS input device	GIS output device	use micro-comp uter	links between PC and workstation
Adams	0	0	0	0	0	0
Ashland	1	1	1	1	0	0
Barron	1	0	1	1	0	0
Bayfield	1	1	1	1	0	0
Brown	1	1	1	1	0	0
Buffalo	0	1	0	0	0	0
Burnett	1	1	1	1	0	0
Calumet	0	0	0	0	0	0
Chippewa	1	1	0	1	0	0
Clark	0	0	0	0	0	0
Columbia	0	0	0	0	0	0
Crawford	0	0	0	0	0	0
Dane	1	0	1	1	1	0
Dodge	1	1	1	1	0	0
Door	1	1	1	1	0	0
Douglas	1	1	1	1	1	1
Dunn	1	1	1	1	0	0
Eau_Claire	1	1	0	1	0	0
Florence	1	0	0	1	0	0
Fond_du_Lac	1	1	1	1	0	0
Forest	0	0	0	0	0	0
Grant	0	0	0	0	0	0
Green	0	0	0	0	0	0
Green_Lake	0	0	0	0	0	0
Iowa	0	0	0	0	0	0
Iron	0	0	0	0	0	0
Jackson	1	1	1	1	0	0
Jefferson	1	0	1	1	1	0
Juneau	0	0	0	0	0	0
Kenosha	0	0	0	0	0	0
Kewaunee	0	0	0	0	0	0
La_Crosse	1	0	1	1	1	1
Lafayette	0	0	0	0	0	0
Langlade	1	1	1	1	0	0
Lincoln	0	0	0	0	0	0
Manitowoc	1	0	1	1	0	1

COUNTY	use GIS with display and dbase	use GIS with display only	GIS input device	GIS output device	use micro-comp uter	links between PC and workstation
Marathon	1	1	1	1	0	0
Marinette	1	1	1	1	0	0
Marquette	0	0	0	0	0	0
Menominee	0	0	0	0	0	0
Milwaukee	0	0	0	0	0	0
Monroe	0	0	0	0	0	0
Oconto	0	0	0	0	0	0
Oneida	1	1	1	1	1	1
Outagamie	1	0	1	1	0	0
Ozaukee	1	1	1	1	0	0
Pepin	1	1	1	1	0	0
Pierce	1	1	1	1	0	0
Polk	1	1	1	1	0	0
Portage	1	0	1	1	1	0
Price	0	0	0	0	0	0
Racine	1	0	1	1	0	0
Richland	0	0	0	0	0	0
Rock	1	1	1	1	0	0
Rusk	0	0	0	0	0	0
Sauk	0	0	0	0	0	0
Sawyer	0	0	0	0	0	0
Shawano	0	0	0	0	0	0
Sheboygan	1	1	1	1	0	1
St_Croix	1	1	1	1	0	0
Taylor	0	0	0	0	0	0
Trempealeau	0	0	0	0	0	0
Vilas	1	1	1	1	0	0
Walworth	0	0	0	0	0	0
Washburn	0	0	0	0	0	0
Washington	0	0	0	0	0	0
Waukesha	0	0	0	0	0	0
Waupaca	0	0	0	0	0	0
Waushara	0	0	0	0	0	0
Winnebago	1	0	1	1	1	1
Wood	1	1	1	1	0	0

Table 5 Data Automation Index Variables

COUNTY	digital parcel data	hard copy parcel data	updated parcel data	certified maps of survey	use NMA standard	digital zoning data	hard copy zoning data
Adams	1	1	1	1	0	0	0
Ashland	1	1	1	1	0	0	0
Barron	0	1	0	0	1	0	1
Bayfield	1	1	0	1	1	0	1
Brown	1	1	0	1	0	0	0
Buffalo	1	1	0	1	1	0	1
Burnett	1	1	0	1	0	1	1
Calumet	1	1	1	1	1	0	1
Chippewa	1	1	0	0	0	0	1
Clark	1	1	1	1	0	0	1
Columbia	1	1	1	1	0	0	1
Crawford	0	1	0	1	1	0	1
Dane	1	1	1	1	0	0	0
Dodge	1	1	0	1	1	1	1
Door	1	1	1	1	0	0	0
Douglas	1	1	1	1	1	1	1
Dunn	1	1	0	0	1	1	1
Eau_Claire	1	1	1	1	0	1	1
Florence	0	0	1	1	0	0	1
Fond_du_Lac	0	1	0	1	0	0	0
Forest	1	1	0	1	0	0	0
Grant	0	1	0	1	0	0	0
Green	0	1	0	1	0	0	1
Green_Lake	0	1	1	1	0	0	1
Iowa	0	1	1	1	0	0	0
Iron	0	1	0	0	0	0	0
Jackson	1	1	1	1	1	0	1
Jefferson	1	1	0	0	0	0	1
Juneau	0	1	0	1	0	0	1
Kenosha	1	1	0	0	1	1	1
Kewaunee	0	1	0	1	0	0	1
La_Crosse	1	1	1	1	0	0	1
Lafayette	0	1	0	0	0	0	1
Langlade	1	1	1	1	0	0	0
Lincoln	0	1	1	0	0	0	1
Manitowoc	1	1	0	0	1	1	1

COUNTY	digital parcel data	hard copy parcel data	updated parcel data	certified maps of survey	use NMA standard	digital zoning data	hard copy zoning data
Marathon	0	1	1	1	1	0	0
Marinette	1	1	1	1	0	0	1
Marquette	1	1	0	1	0	0	0
Menominee	0	0	0	0	0	0	0
Milwaukee	1	1	0	0	1	0	0
Monroe	0	1	0	1	0	0	0
Oconto	1	1	1	1	0	0	1
Oneida	1	1	0	1	1	0	1
Outagamie	1	1	1	1	0	1	1
Ozaukee	1	0	0	1	1	0	1
Pepin	0	1	1	1	1	0	1
Pierce	0	1	0	0	1	0	1
Polk	1	1	0	1	0	1	1
Portage	1	1	1	0	1	1	1
Price	0	1	0	1	0	0	1
Racine	1	1	0	1	1	0	1
Richland	0	0	0	0	1	0	0
Rock	1	1	1	1	0	0	1
Rusk	0	0	0	0	0	0	1
Sauk	1	1	0	1	0	0	1
Sawyer	1	1	1	1	0	0	1
Shawano	0	1	1	1	0	0	0
Sheboygan	1	0	0	1	0	0	1
St_Croix	1	1	1	1	0	0	1
Taylor	0	0	0	0	0	0	0
Trempealeau	0	1	0	1	0	0	1
Vilas	1	1	0	1	1	0	0
Walworth	0	1	1	1	1	0	1
Washburn	1	1	1	0	0	0	1
Washington	0	0	0	0	1	0	1
Waukesha	0	1	0	0	1	0	1
Waupaca	0	0	0	1	0	0	0
Waushara	0	1	1	1	0	0	0
Winnebago	1	1	1	1	1	1	1
Wood	1	1	1	0	1	1	1

Table 5a Data Automation Index Variables (continued)

COUNTY	updated zoning data	digital wetlands data	hard copy wetlands data	digital soils data	hard copy soils data
Adams	0	0	0	0	0
Ashland	0	0	1	0	0
Barron	0	0	1	0	1
Bayfield	1	0	1	0	0
Brown	0	0	0	0	0
Buffalo	1	0	0	0	1
Burnett	0	0	0	0	1
Calumet	0	0	1	0	0
Chippewa	0	1	1	1	1
Clark	1	0	1	0	1
Columbia	1	0	1	0	1
Crawford	0	0	1	0	1
Dane	0	0	0	1	0
Dodge	0	1	1	0	1
Door	0	0	0	0	0
Douglas	1	1	1	0	0
Dunn	1	0	1	1	1
Eau_Claire	0	0	1	0	1
Florence	1	0	0	0	1
Fond_du_Lac	0	0	1	0	1
Forest	0	0	0	0	0
Grant	0	0	0	0	1
Green	0	0	1	0	1
Green_Lake	1	0	1	0	1
Iowa	0	0	1	0	0
Iron	0	0	0	0	0
Jackson	1	0	0	1	1
Jefferson	0	0	0	0	1
Juneau	0	0	1	0	1
Kenosha	0	0	1	1	1
Kewaunee	0	0	1	0	1
La_Crosse	0	0	0	0	1
Lafayette	0	0	1	0	1
Langlade	0	0	0	0	0
Lincoln	1	0	1	0	1
Manitowoc	0	0	1	0	1
Marathon	1	0	0	0	0

COUNTY	updated zoning data	digital wetlands data	hard copy wetlands data	digital soils data	hard copy soils data
Marinette	0	0	0	0	1
Marquette	0	0	0	0	0
Menominee	0	0	0	0	0
Milwaukee	0	0	1	0	0
Monroe	0	0	0	0	0
Oconto	0	0	1	0	1
Oneida	1	0	1	0	1
Outagamie	1	1	1	0	1
Ozaukee	0	0	1	0	0
Pepin	0	0	0	0	1
Pierce	0	0	1	0	1
Polk	0	0	0	0	1
Portage	1	0	0	1	1
Price	0	0	1	0	1
Racine	0	0	1	0	1
Richland	0	0	0	0	0
Rock	1	0	1	0	1
Rusk	0	0	1	0	0
Sauk	0	0	0	0	0
Sawyer	0	0	1	0	0
Shawano	0	0	1	0	1
Sheboygan	0	0	1	0	1
St_Croix	1	0	1	0	1
Taylor	0	0	0	0	0
Trempealeau	0	0	1	0	1
Vilas	0	0	0	1	1
Walworth	1	0	1	0	1
Washburn	0	0	0	0	0
Washington	0	0	1	1	1
Waukesha	0	0	1	0	0
Waupaca	0	0	0	0	0
Waushara	0	0	1	0	0
Winnebago	1	0	0	1	0
Wood	1	0	1	0	1

Appendix 5:
Plots of Independent Variables vs. Index Sums

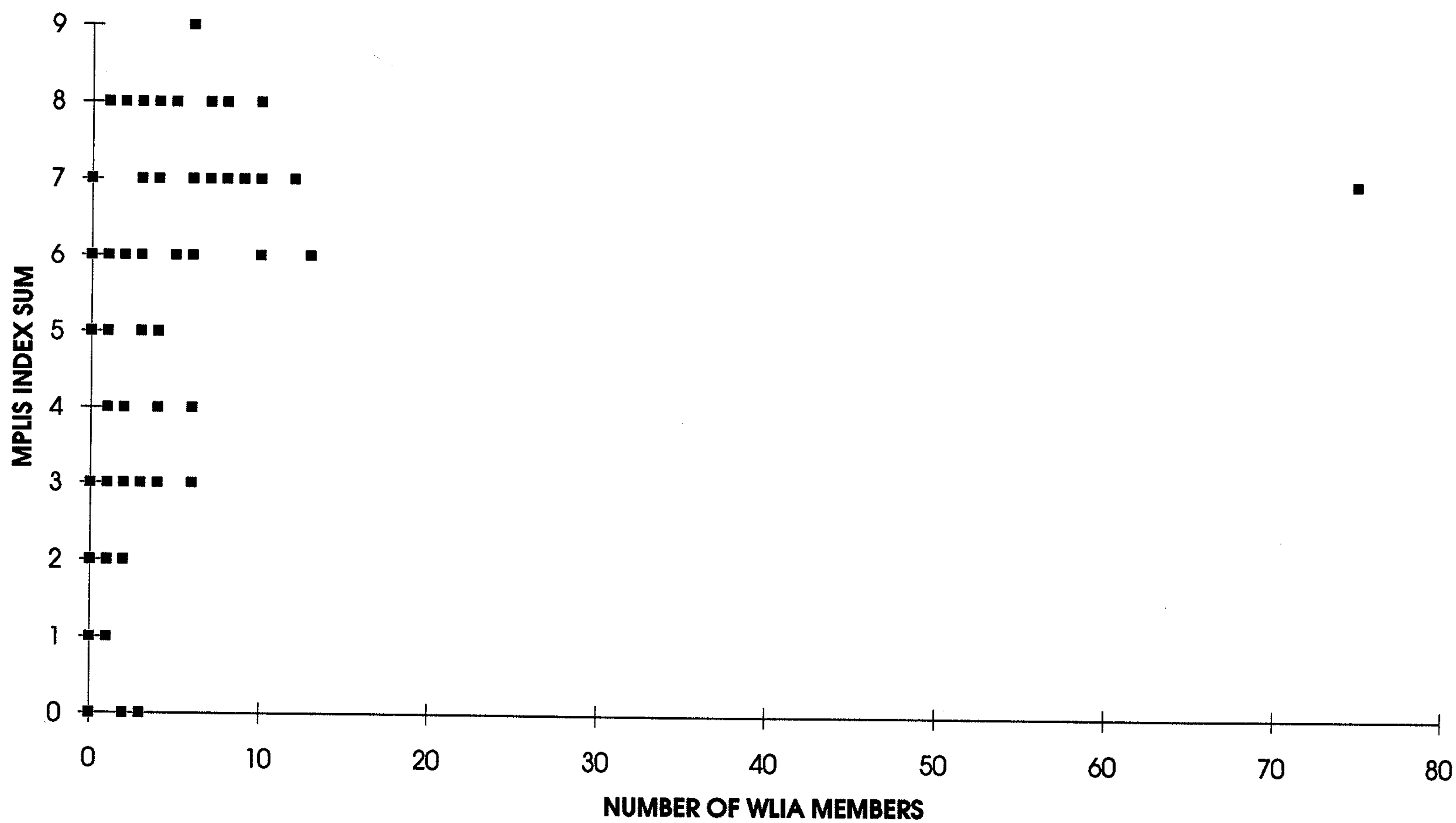

Figure A5.1 WLIA Members vs. MPLIS Index

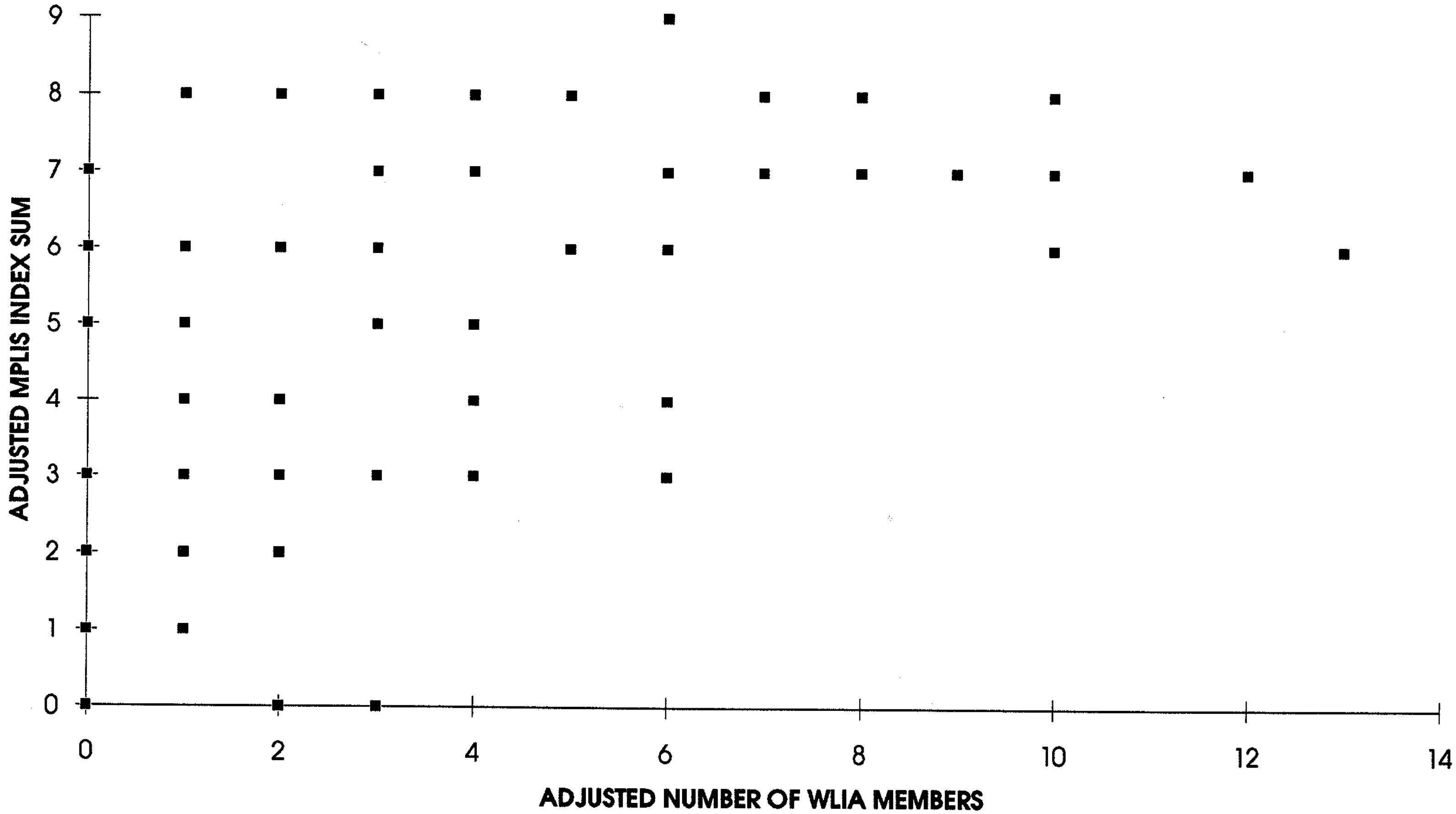

Figure A5.1a WLIA Members vs. MPLIS Index (without Dane Co.)

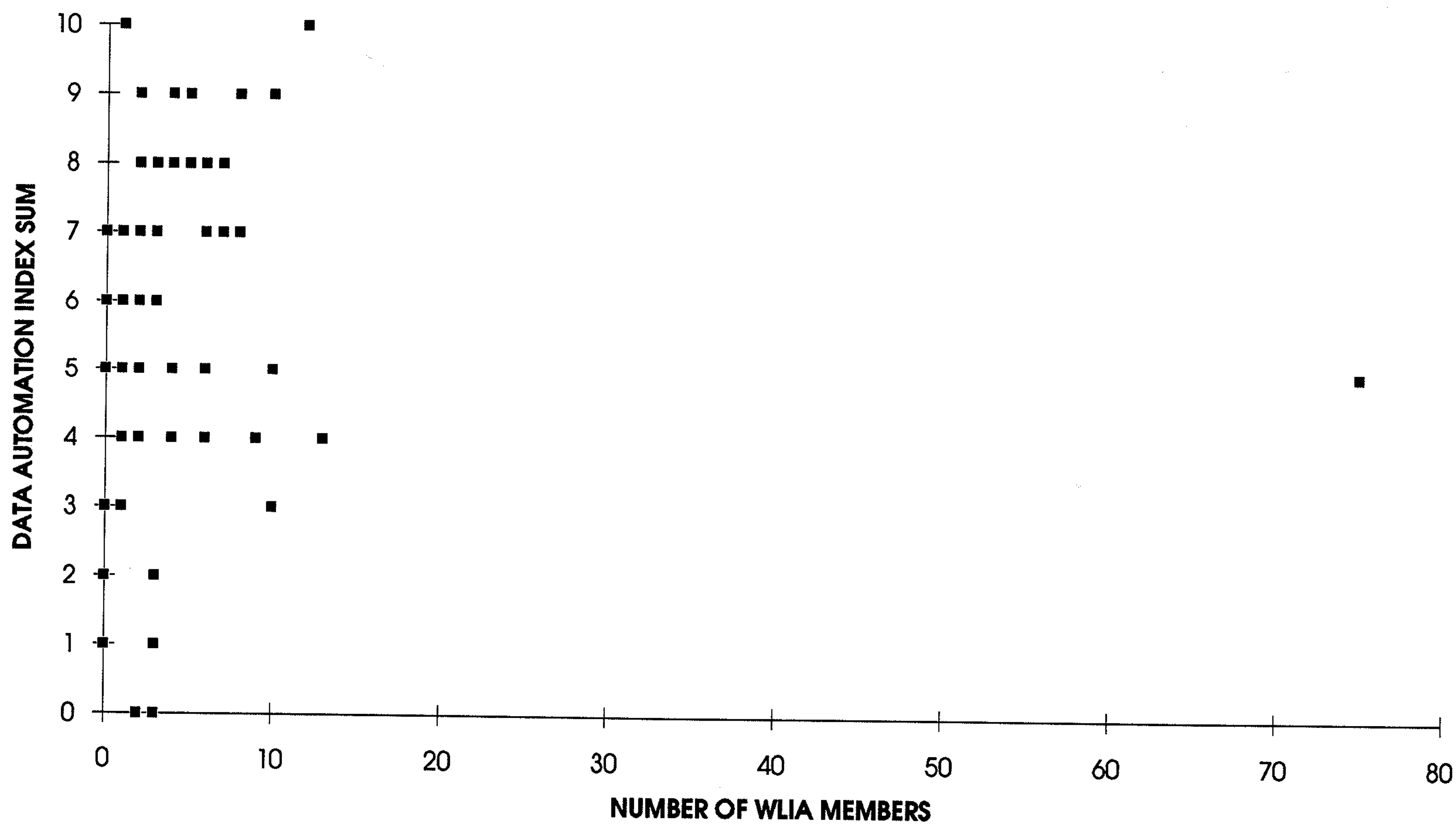

Figure A5.2 WLIA Members vs. Data Automation Index

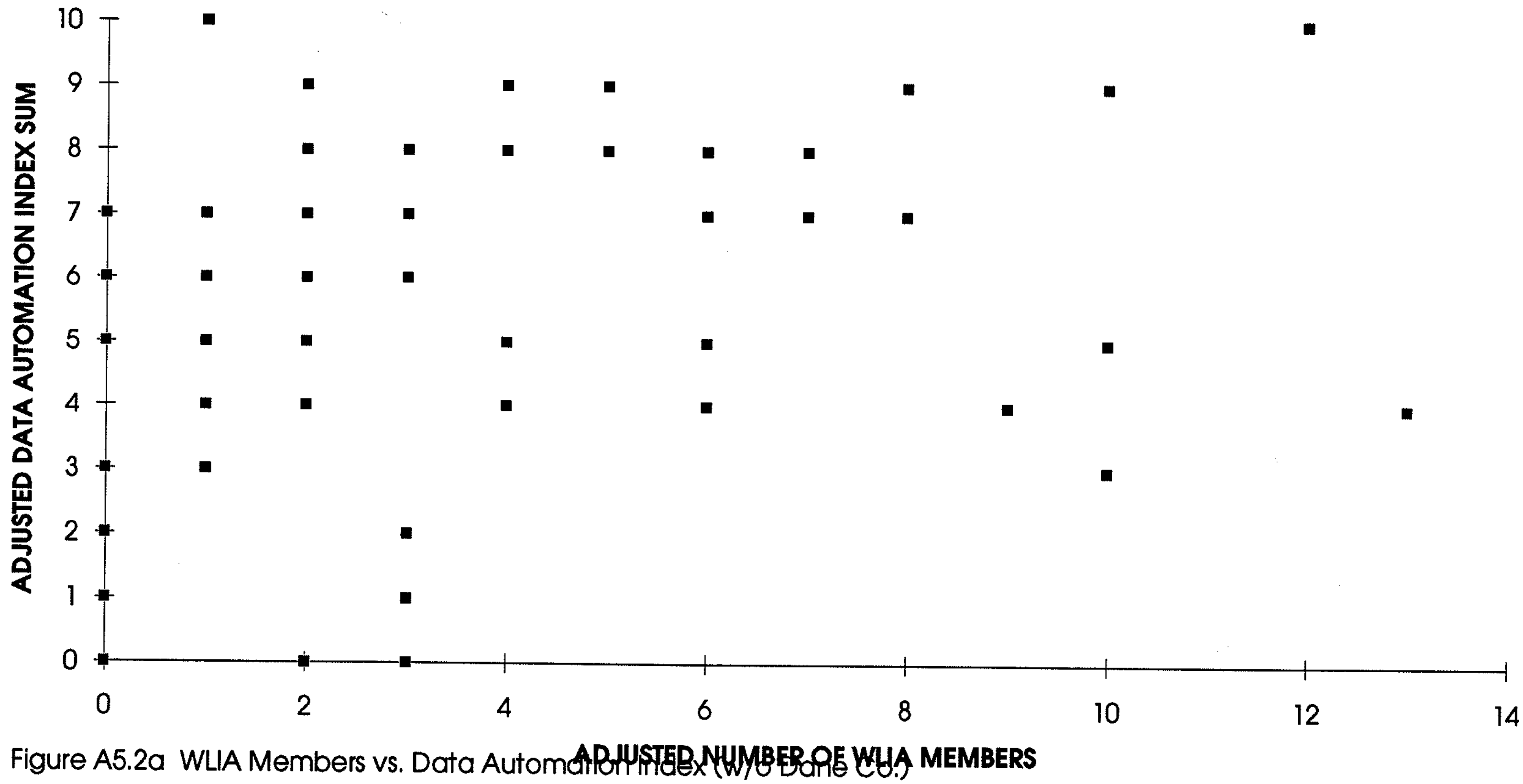

Figure A5.2a WLIA Members vs. Data Automation Index (w/o Dane Co.)

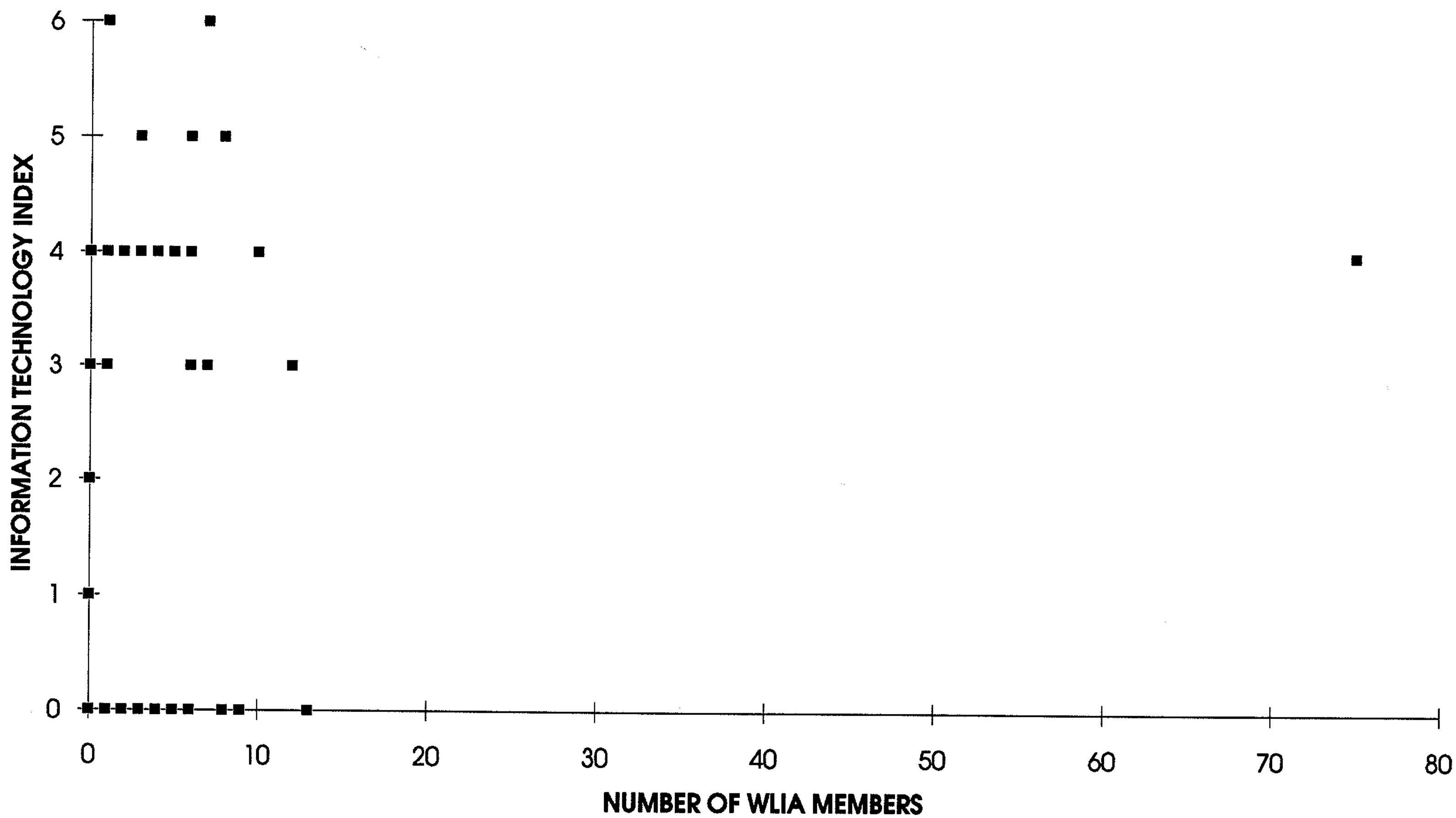

Figure A5.3 WLIA Members vs. Information Technology Index

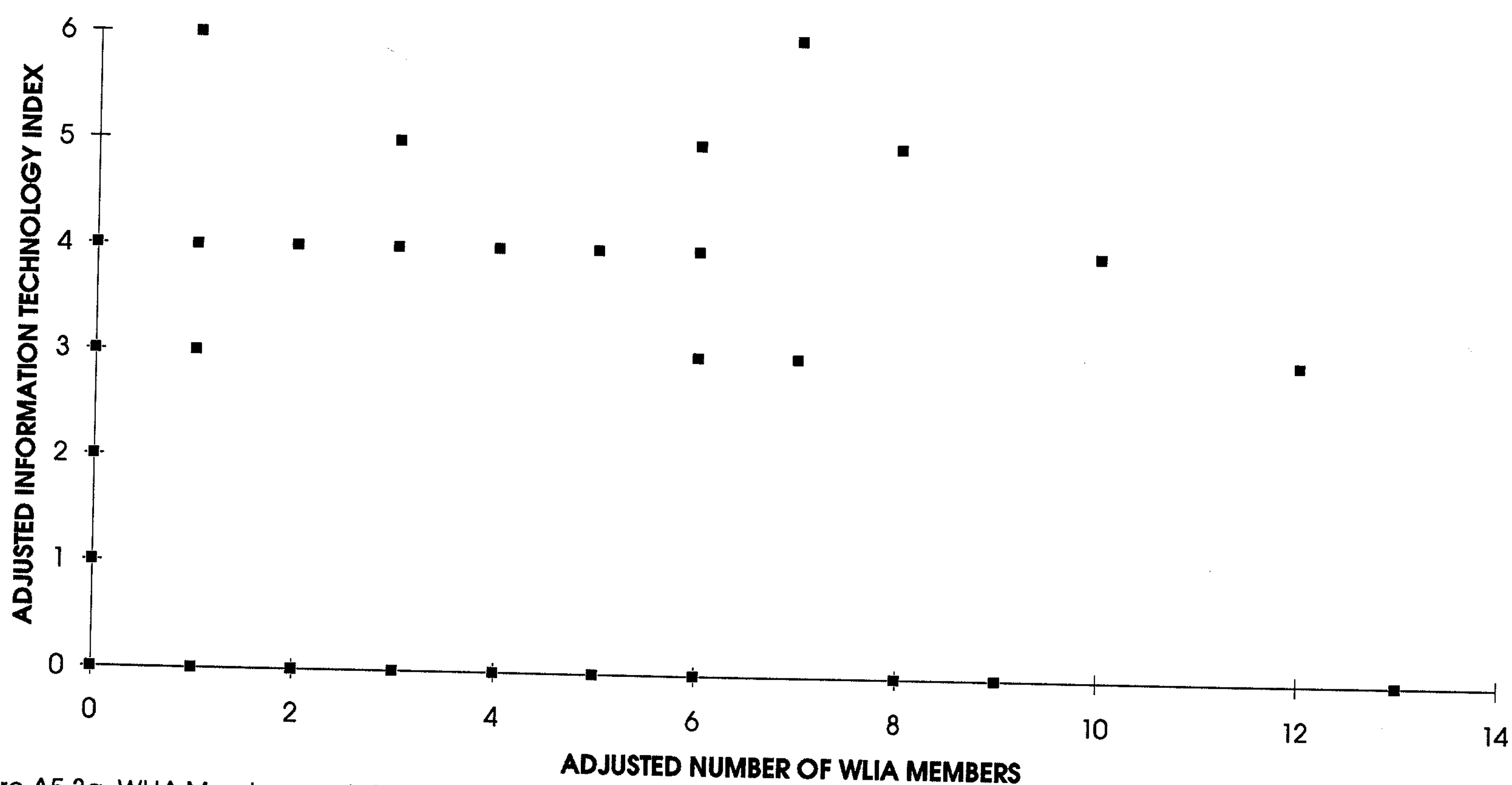

Figure A5.3a WLIA Members vs. Information Technology Index (without Dane Co.)

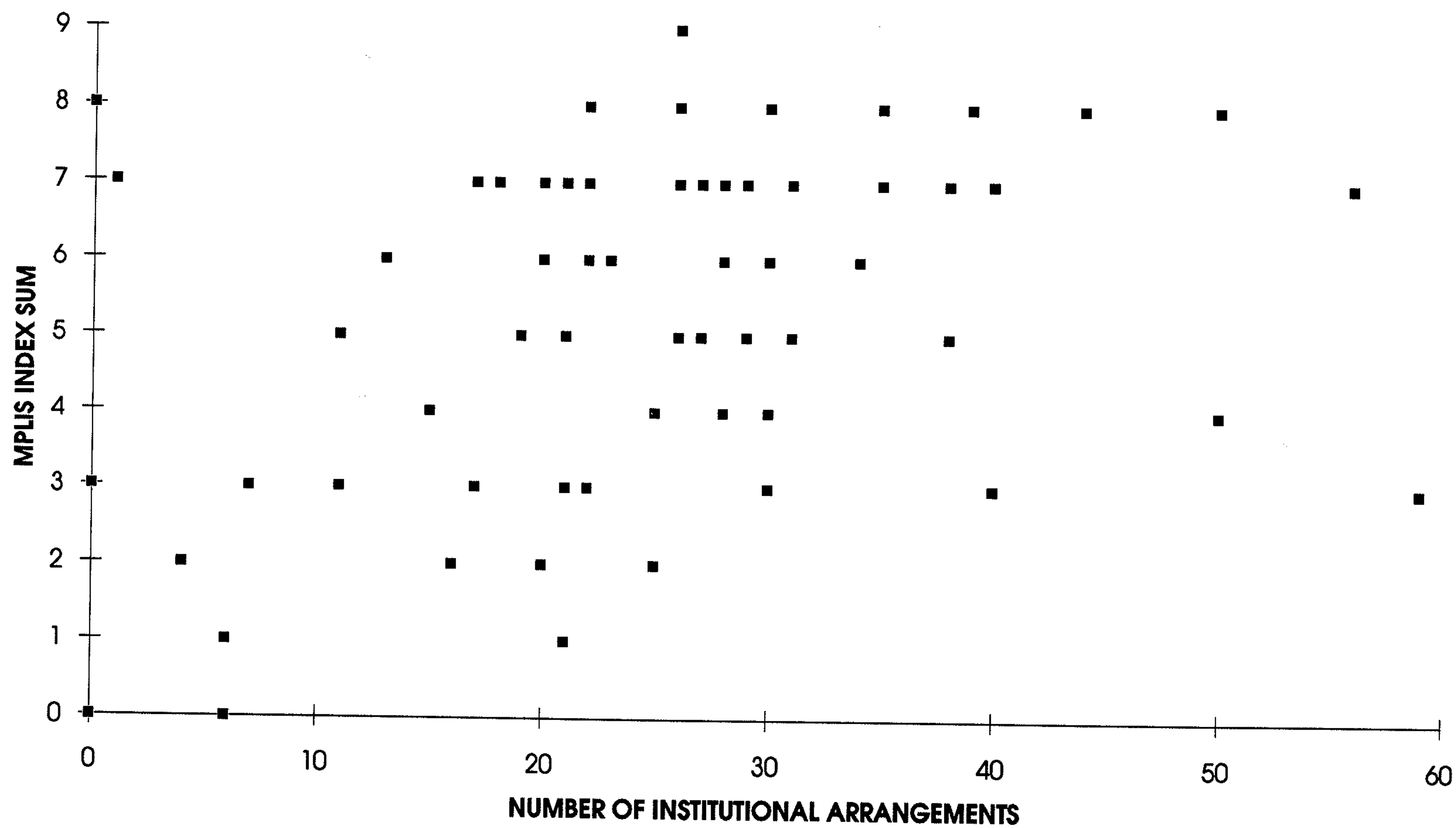

Figure A5.4 Institutional Arrangements vs. MPLIS Index

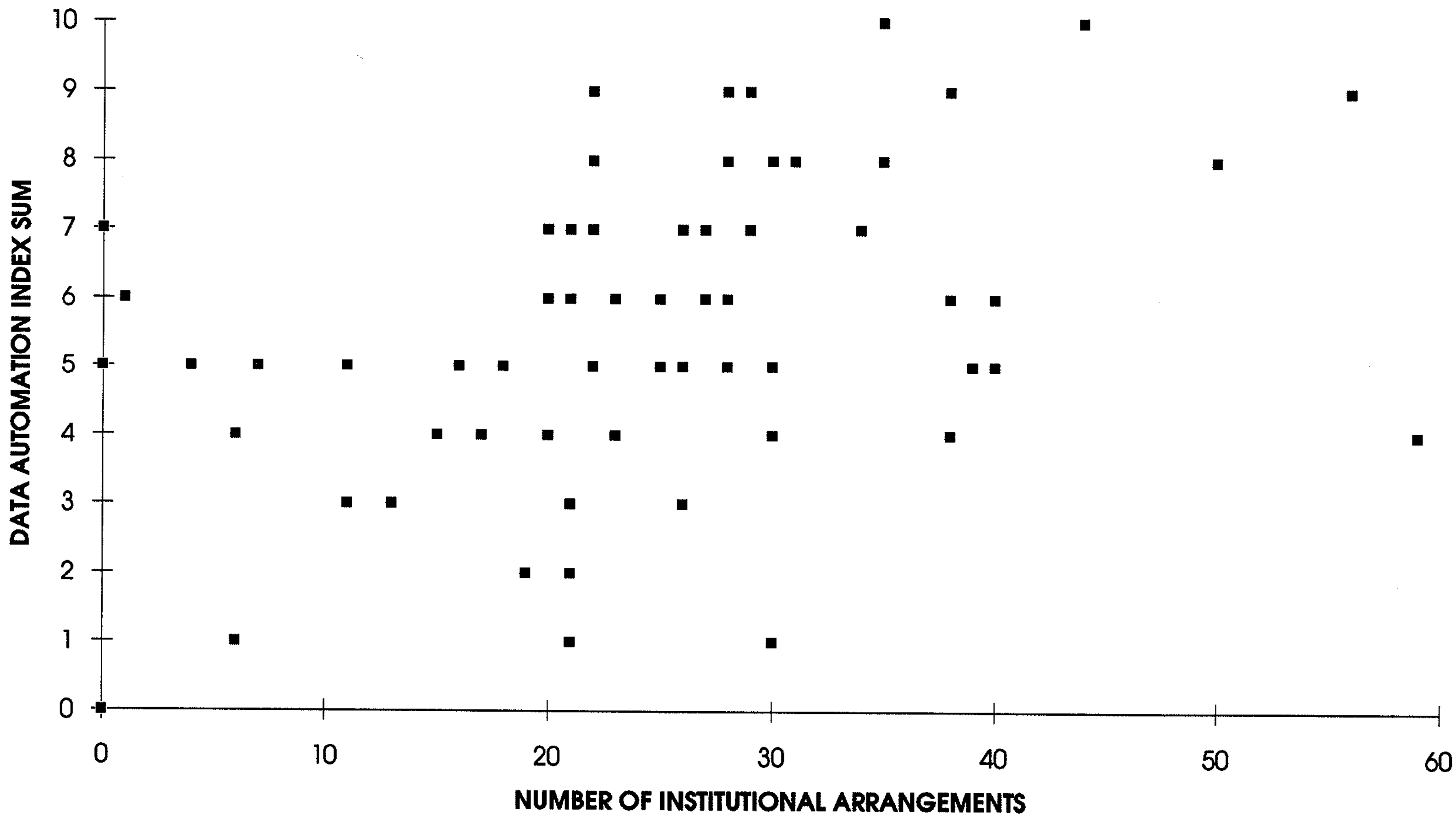

Figure A5.5 Institutional Arrangements vs. Data Automation Index

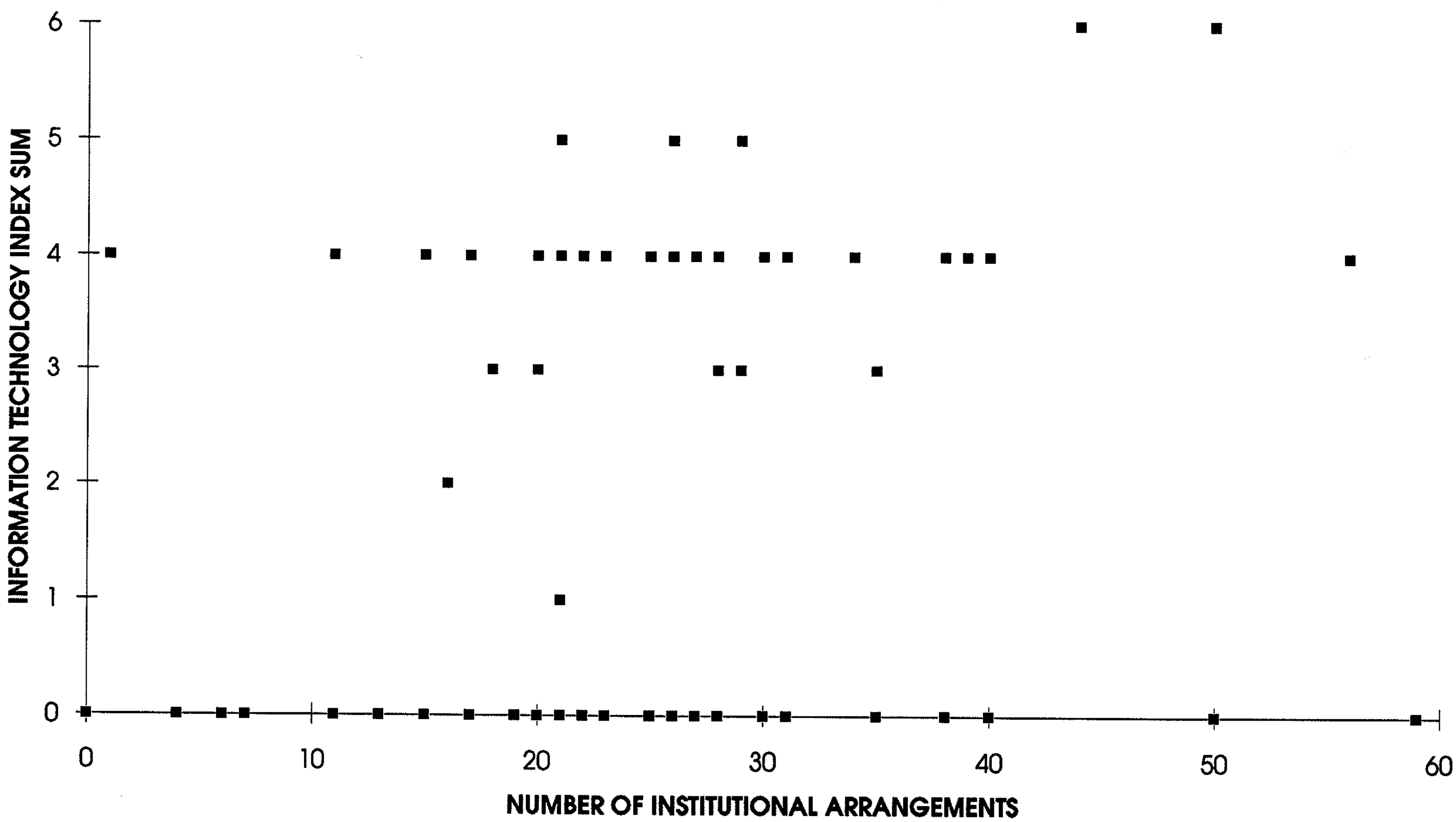

Figure A5.6 Institutional Arrangements vs. Information Technology Index

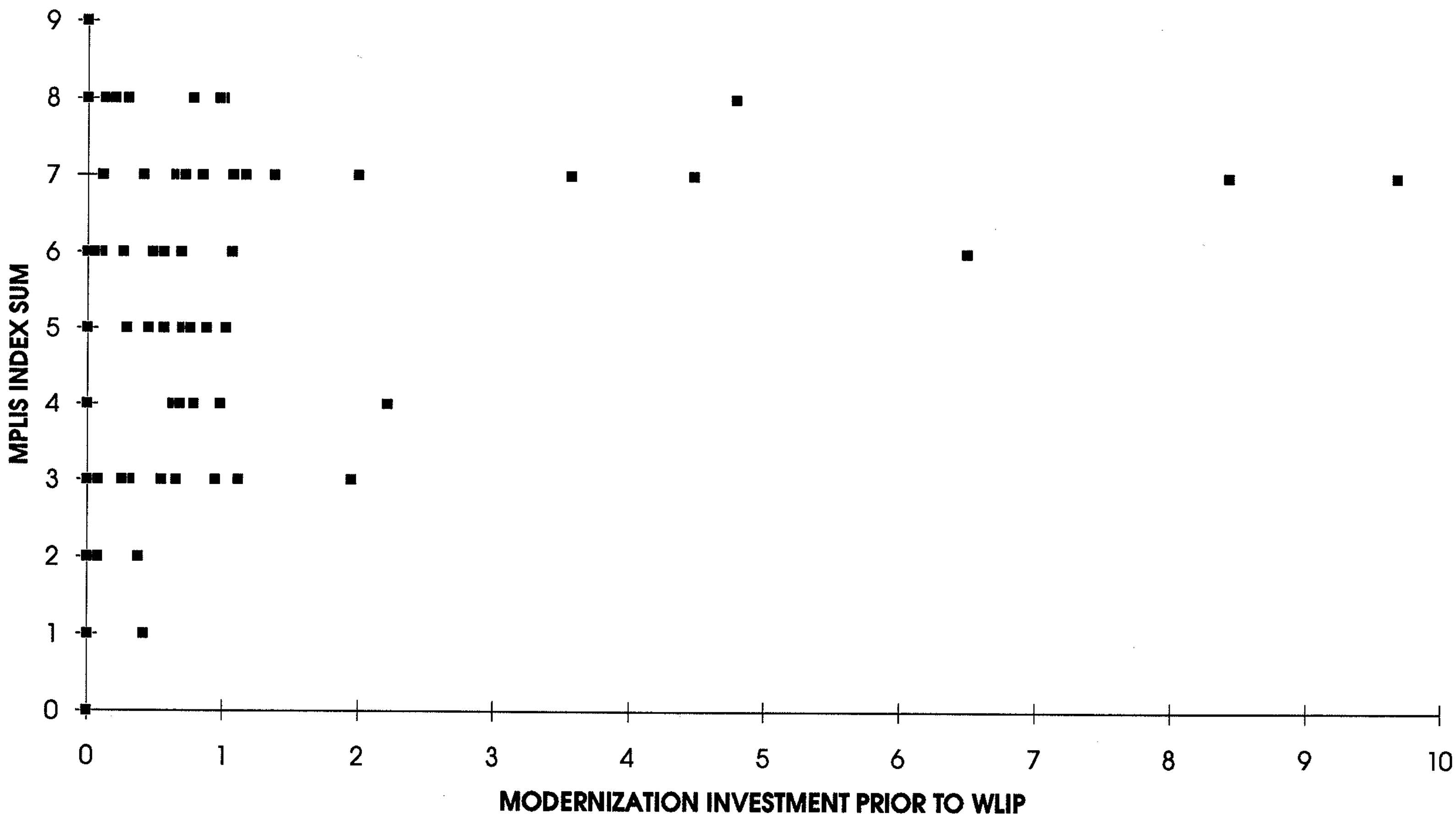

Figure A5.7. Investment vs. MPLIS Index

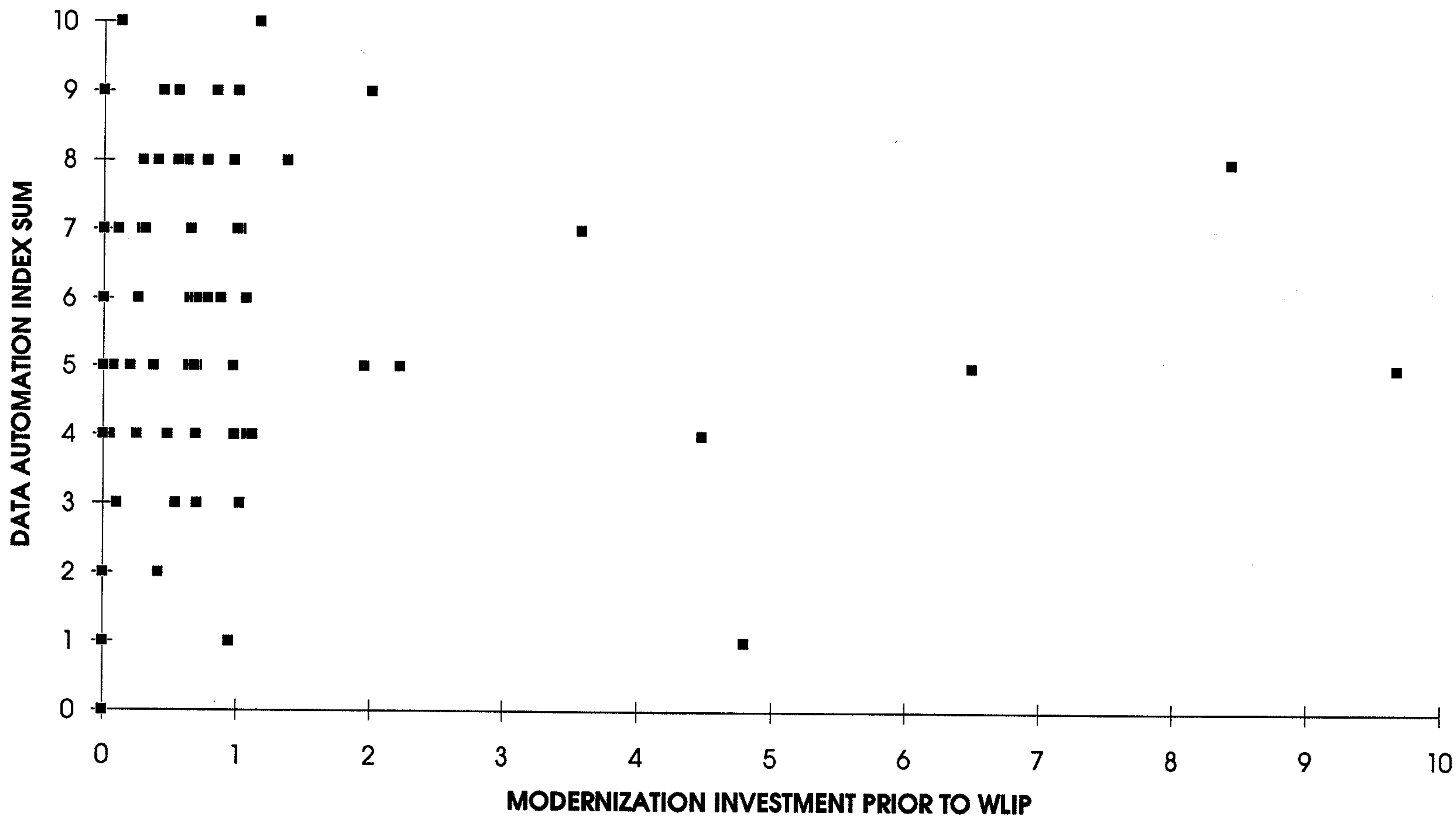

Figure A5.8 Investment vs. Data Automation Index

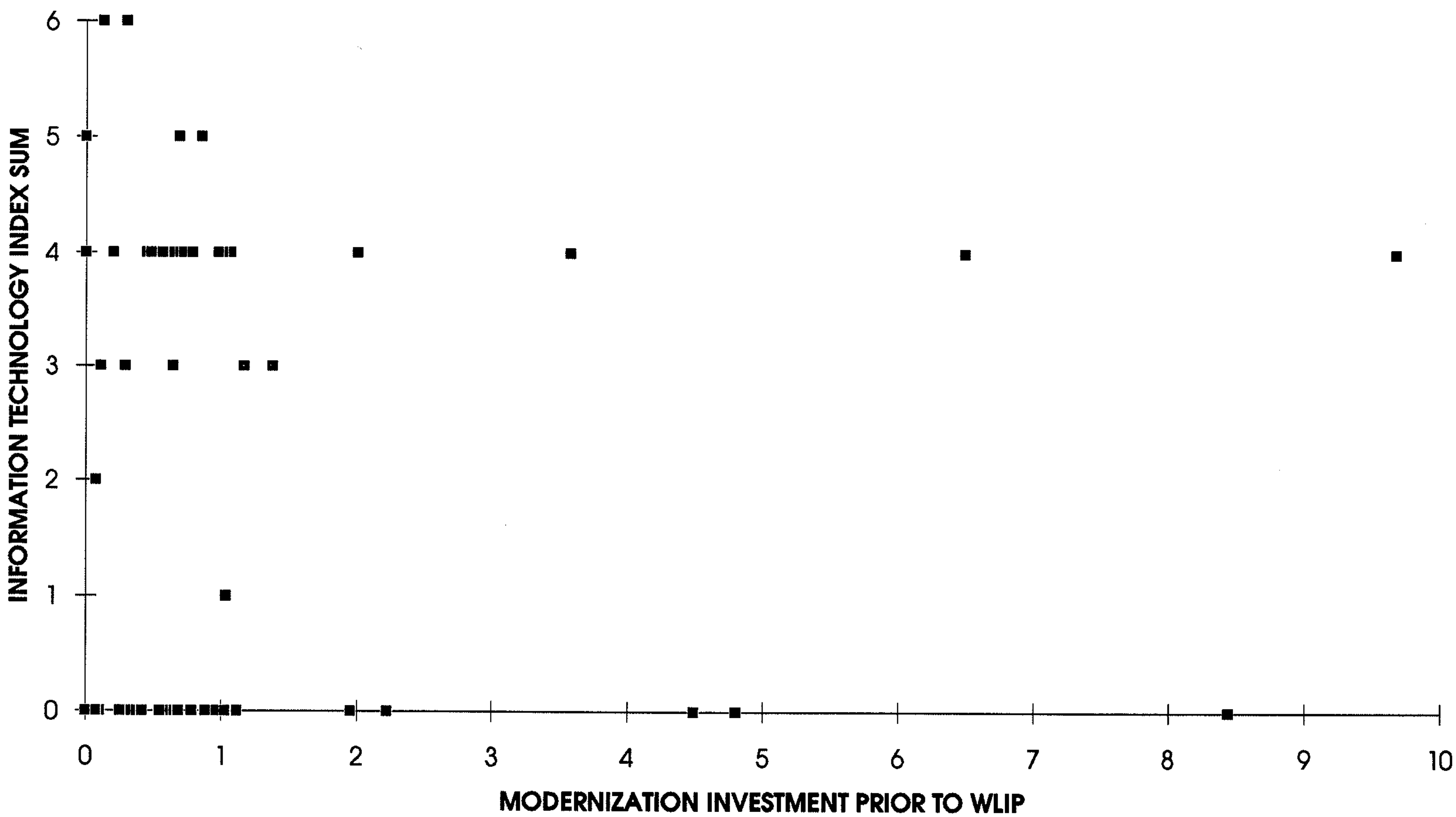

Figure A5.9 Investment vs. Information Technology Index

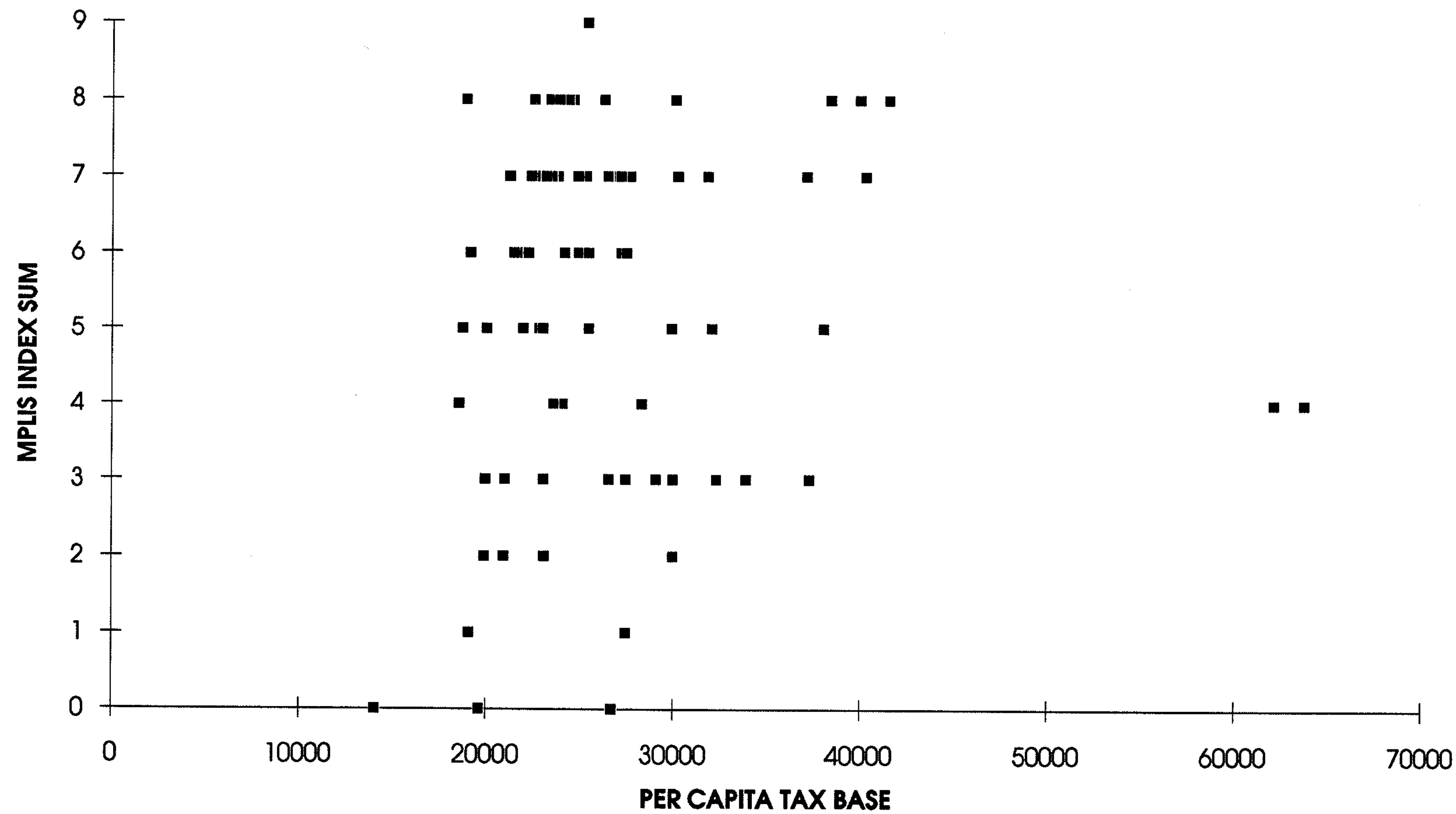

Figure A5.10 Tax Base vs. MPLIS Index

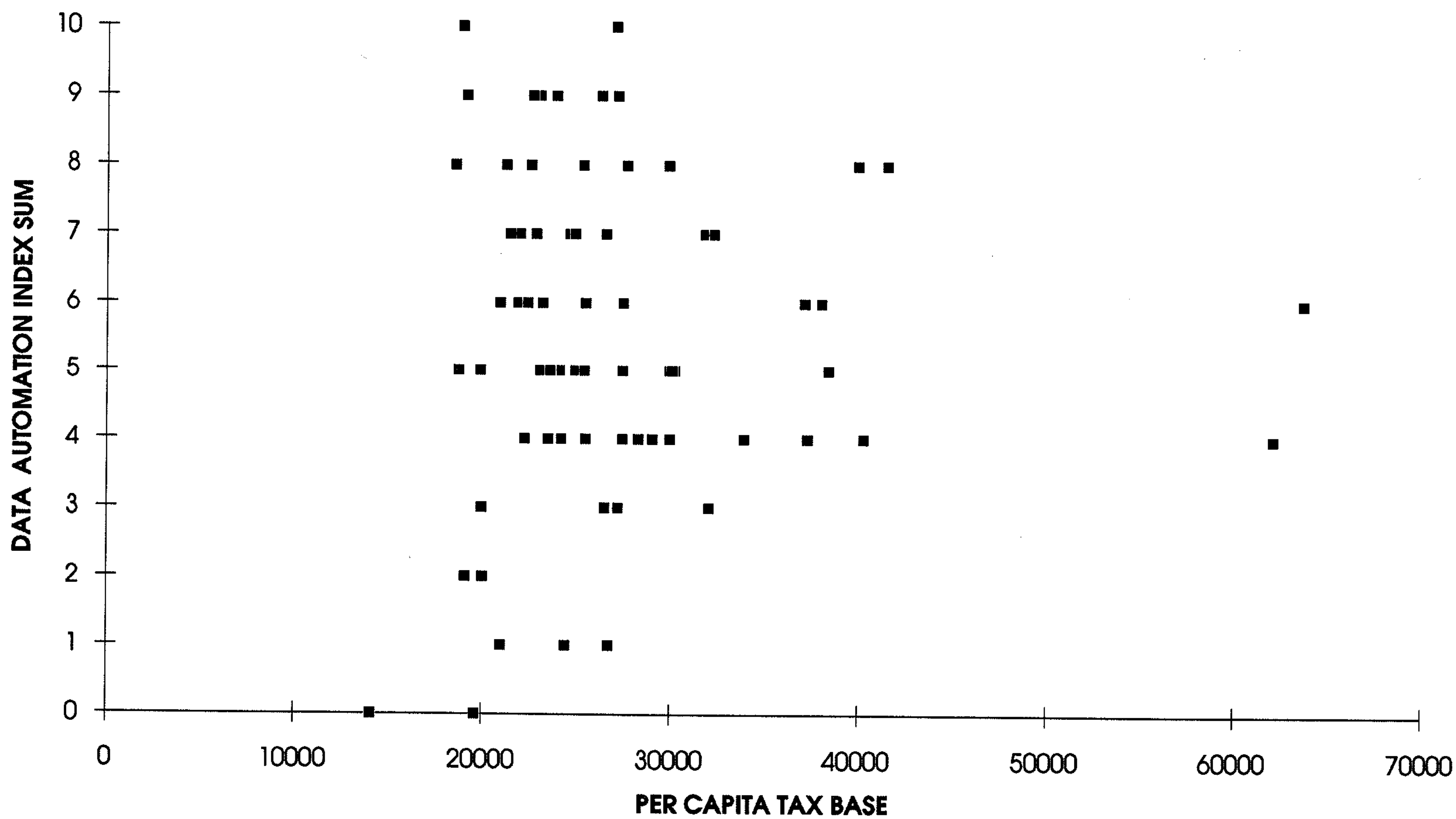

Figure A5.11 Tax Base vs. Data Automation Index

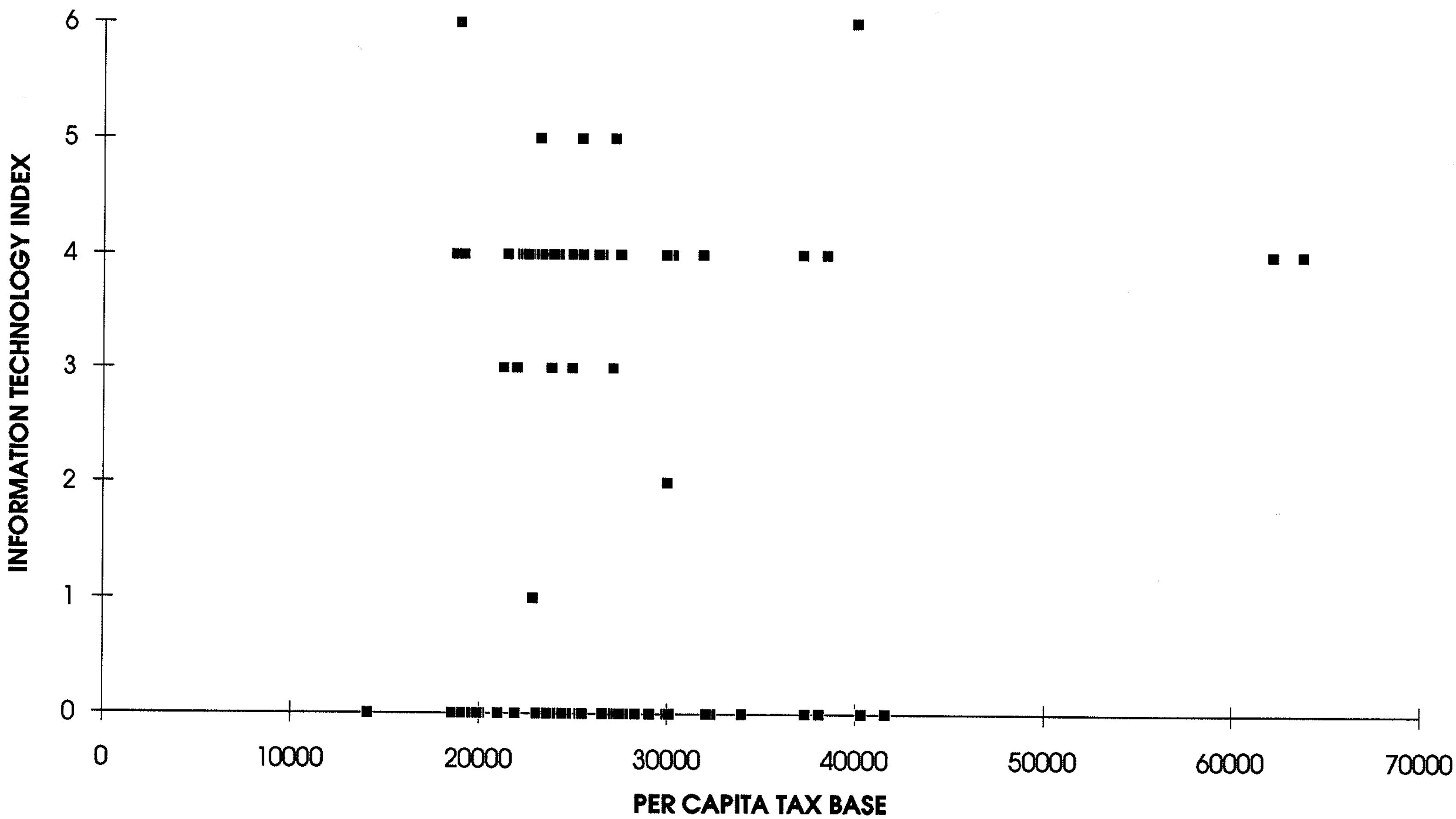

Figure A5.12 Tax Base vs. Information Technology Index

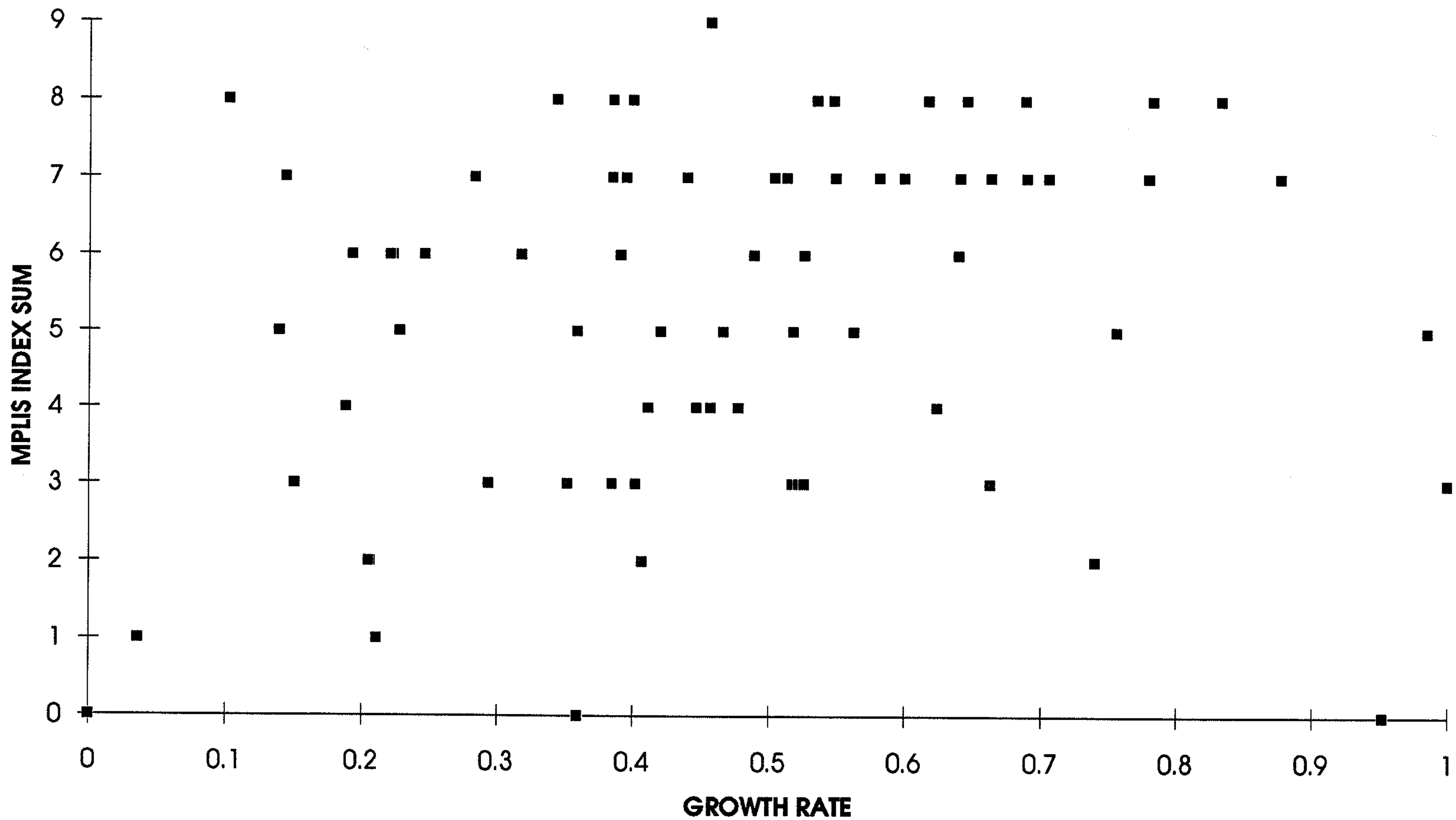

Figure A5.13 Growth Rate vs. MPLIS Index

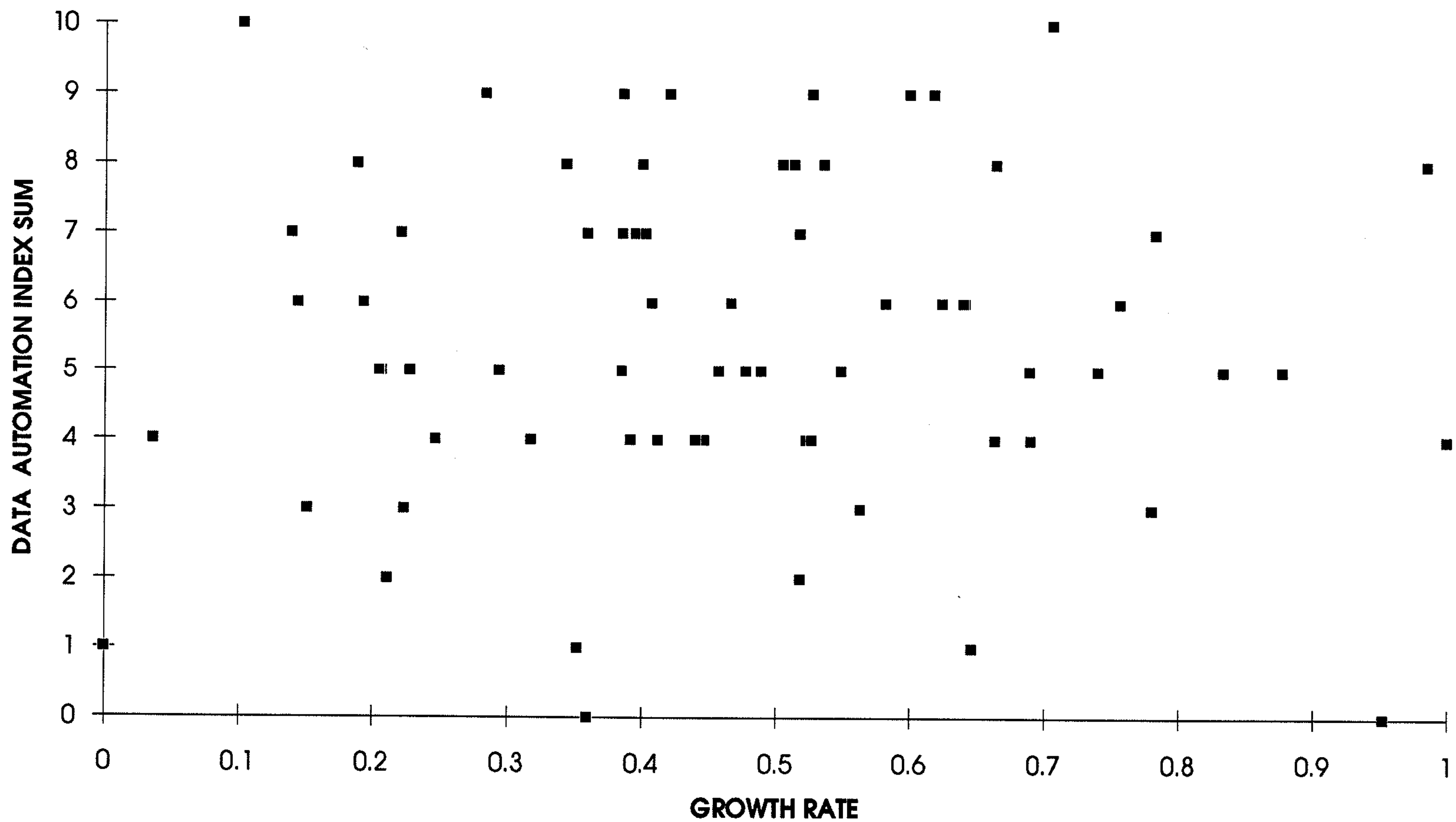

Figure A5.14 Growth Rate vs. Data Automation Index

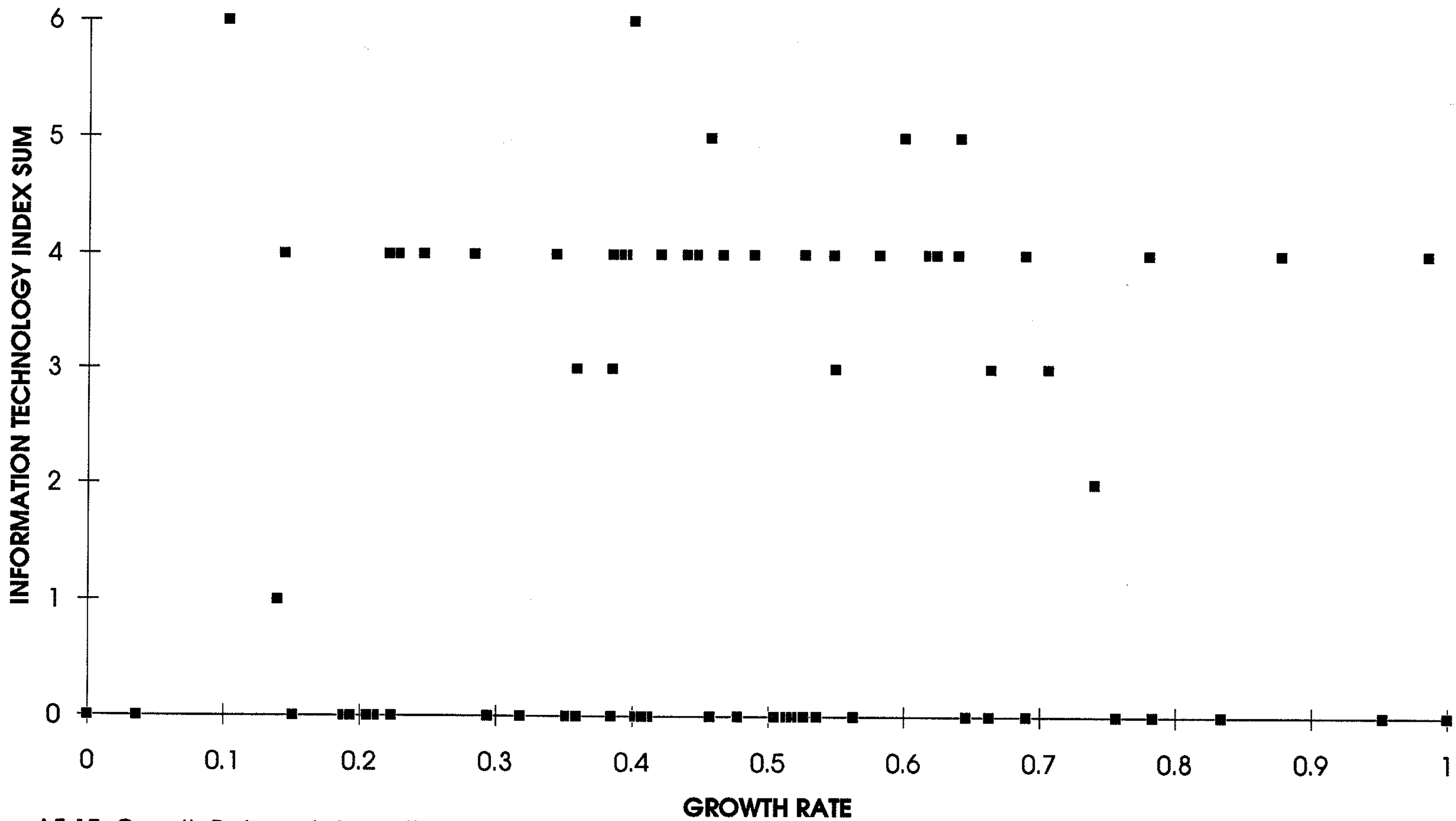

Figure A5.15 Growth Rate vs. Information Index

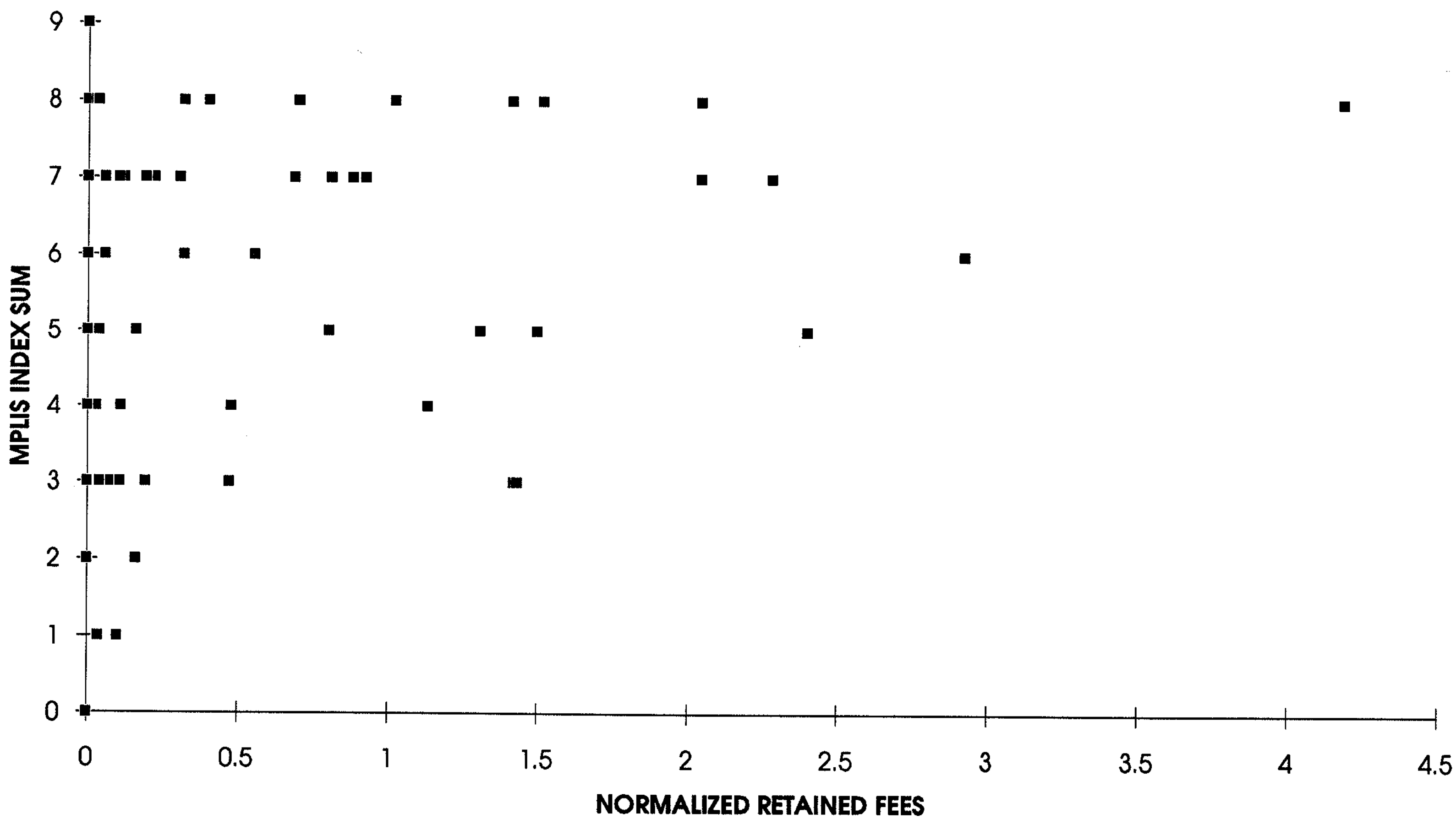

Figure A5.16 Retained Fees vs. MPLIS Index Sum

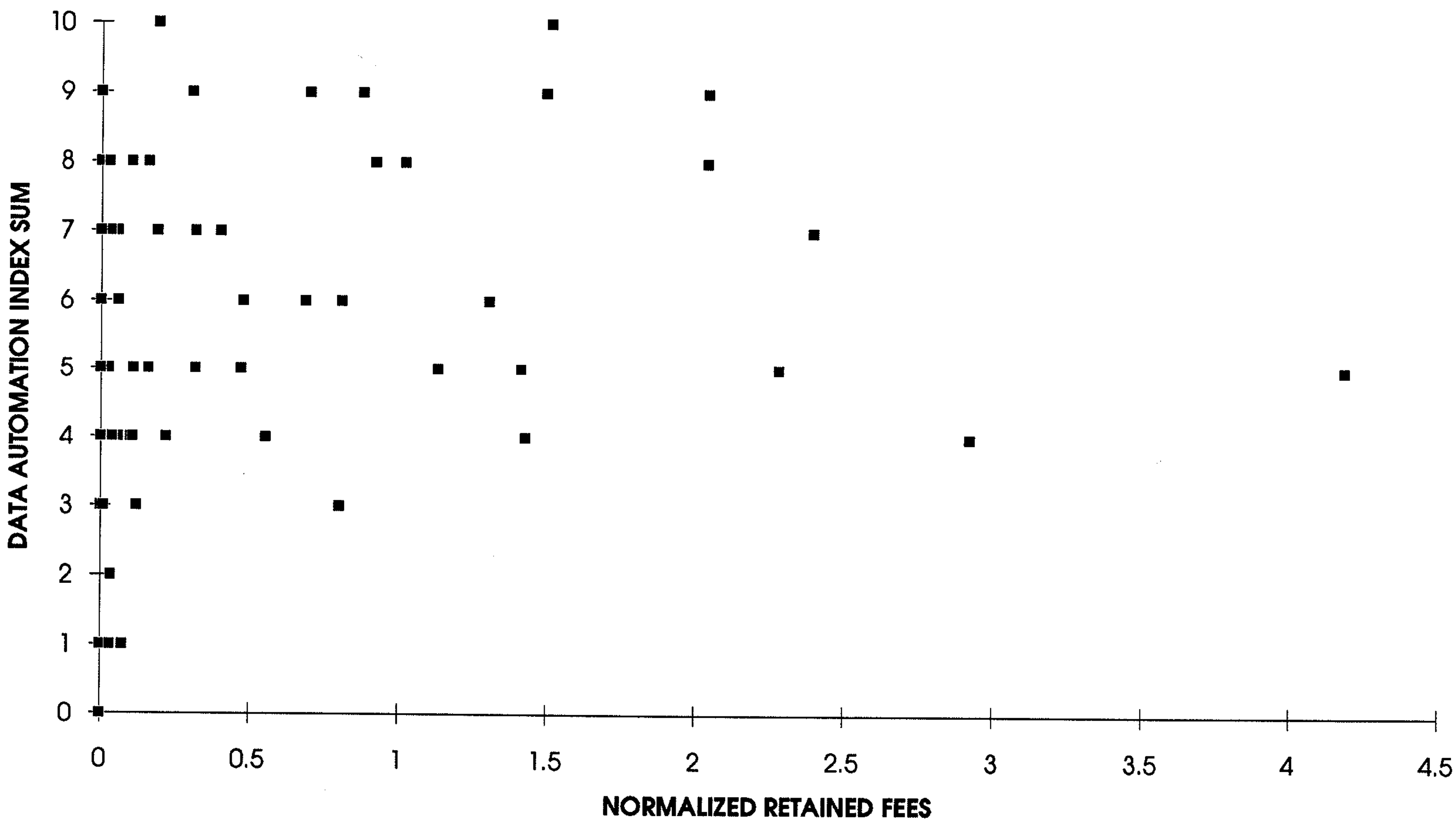

Figure A5.17 Retained Fees vs. Data Automation Index

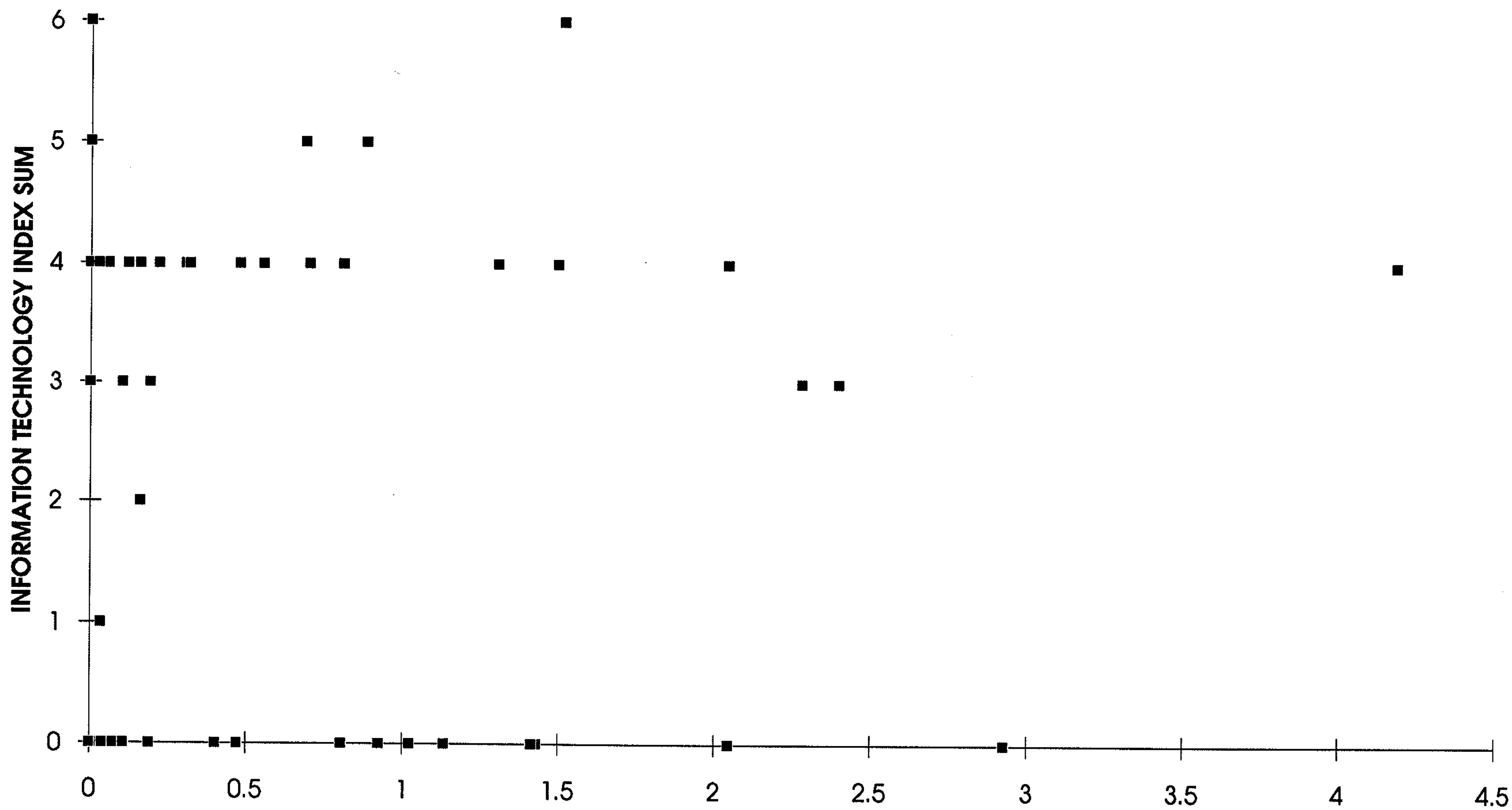

Figure A5.18 Retained Fees vs. Information Technology Index

Appendix 6:
Results of Regression Analyses

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CATMOD PROCEDURE

Response: COORDS Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	65.64674	0.3330	-0.4621	-0.2387	-0.0280	0.0100	0.0000466	-1.3961	-0.4751
2	0	60.905326	0.0722	-0.4002	-0.5159	-0.0326	0.006213	0.0000567	-1.5483	-0.9491
3	0	57.766486	0.0515	-0.3846	-0.9033	-0.0220	-0.0880	0.0000607	-1.1982	-1.3412
4	0	56.602575	0.0201	-0.3562	-1.3339	-0.0128	-0.1838	0.0000662	-1.0312	-1.5424
5	0	56.521384	0.001434	-0.3545	-1.5049	-0.0113	-0.2059	0.0000696	-1.0654	-1.5809
6	0	56.520836	9.6972E-6	-0.3548	-1.5211	-0.0112	-0.2075	0.0000699	-1.0697	-1.5833
7	0	56.520836	4.929E-10	-0.3548	-1.5212	-0.0112	-0.2075	0.0000699	-1.0698	-1.5833

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.11	0.7431
AVEINVES	1	3.51	0.0610
INSTARRA	1	0.14	0.7094
WLIANUM	1	1.51	0.2185
TAX_BASE	1	3.68	0.0552
GROWTHNO	1	0.50	0.4785
RETAINRA	1	3.21	0.0731
LIKELIHOOD RATI	64	56.52	0.7354

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	-0.3548	1.0826	0.11	0.7431
AVEINVES	2	-1.5212	0.8120	3.51	0.0610
INSTARRA	3	-0.0112	0.0300	0.14	0.7094
WLIANUM	4	-0.2075	0.1686	1.51	0.2185
TAX_BASE	5	0.00007	0.000036	3.68	0.0552
GROWTHNO	6	-1.0698	1.5096	0.50	0.4785
RETAINRA	7	-1.5833	0.8835	3.21	0.0731

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CATMOD PROCEDURE

Response: DATUM Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

	Sub	-2 Log	Convergence	Parameter Estimates						
Iteration	Iteration	Likelihood	Criterion	1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	75.445542	0.2335	-0.0328	-0.1926	-0.0358	-0.0179	0.000021	0.5534	-0.5738
2	0	71.161499	0.0568	0.0402	-0.2732	-0.0388	-0.0817	0.0000231	1.0403	-1.0003
3	0	67.923722	0.0455	0.0156	-0.3673	-0.0261	-0.2529	0.000024	1.7875	-1.3691
4	0	67.63164	0.004300	0.003723	-0.4502	-0.0227	-0.3091	0.0000262	1.9843	-1.5342
5	0	67.627507	0.0000611	0.004457	-0.4656	-0.0224	-0.3155	0.0000266	2.0006	-1.5517
6	0	67.627505	1.8078E-8	0.004495	-0.4659	-0.0224	-0.3156	0.0000266	2.0008	-1.5519
7	0	67.627505	2.311E-15	0.004495	-0.4659	-0.0224	-0.3156	0.0000266	2.0008	-1.5519

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.00	0.9966
AVEINVES	1	1.51	0.2188
INSTARRA	1	0.64	0.4225
WLIANUM	1	4.65	0.0311
TAX_BASE	1	0.61	0.4344
GROWTHNO	1	1.74	0.1870
RETAINRA	1	4.56	0.0328
LIKELIHOOD RATIO	64	67.63	0.3544

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	0.00449	1.0565	0.00	0.9966
AVEINVES	2	-0.4659	0.3789	1.51	0.2188
INSTARRA	3	-0.0224	0.0279	0.64	0.4225
WLIANUM	4	-0.3156	0.1464	4.65	0.0311
TAX_BASE	5	0.000027	0.000034	0.61	0.4344
GROWTHNO	6	2.0008	1.5163	1.74	0.1870
RETAINRA	7	-1.5519	0.7270	4.56	0.0328

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CATMOD PROCEDURE

Response: GEOCODEP Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	74.13615	0.2468	1.2938	-0.0345	0.006992	-0.0344	6.4427E-6	-0.9240	0.0375
2	0	73.525156	0.008242	1.5459	-0.0469	0.0100	-0.0501	7.7987E-6	-1.2482	0.0486
3	0	73.480251	0.000611	1.5730	-0.0485	0.0110	-0.0613	7.763E-6	-1.2483	0.0500
4	0	73.478314	0.0000264	1.5748	-0.0487	0.0112	-0.0644	7.7605E-6	-1.2397	0.0505
5	0	73.47831	4.6418E-8	1.5748	-0.0487	0.0112	-0.0646	7.7606E-6	-1.2393	0.0505
6	0	73.47831	1.342E-13	1.5748	-0.0487	0.0112	-0.0646	7.7606E-6	-1.2393	0.0505

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	1.86	0.1721
AVEINVES	1	0.07	0.7964
INSTARRA	1	0.19	0.6595
WLIANUM	1	0.68	0.4087
TAX_BASE	1	0.05	0.8310
GROWTHNO	1	0.77	0.3804
RETAINRA	1	0.02	0.8945
LIKELIHOOD RATIO	64	73.48	0.1955

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.5748	1.1532	1.86	0.1721
AVEINVES	2	-0.0487	0.1889	0.07	0.7964
INSTARRA	3	0.0112	0.0255	0.19	0.6595
WLIANUM	4	-0.0646	0.0781	0.68	0.4087
TAX_BASE	5	7.761E-6	0.000036	0.05	0.8310
GROWTHNO	6	-1.2393	1.4128	0.77	0.3804
RETAINRA	7	0.0505	0.3809	0.02	0.8945

CATMOD PROCEDURE

Response: UNIQUEID Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	80.308446	0.1841	1.1777	0.0540	-0.0299	0.0297	-0.000041	-0.7706	0.1772
2	0	79.269652	0.0129	1.9901	0.0760	-0.0372	0.0346	-0.000072	-0.8468	0.2456
3	0	79.19638	0.000924	2.2907	0.0827	-0.0382	0.0351	-0.000085	-0.8223	0.2648
4	0	79.195832	6.9233E-6	2.3194	0.0833	-0.0383	0.0351	-0.000086	-0.8193	0.2665
5	0	79.195832	3.966E-10	2.3196	0.0833	-0.0383	0.0351	-0.000086	-0.8193	0.2665

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.56	0.1096
AVEINVES	1	0.20	0.6550
INSTARRA	1	2.48	0.1153
WLIANUM	1	0.74	0.3899
TAX_BASE	1	2.25	0.1339
GROWTHNO	1	0.35	0.5534
RETAINRA	1	0.53	0.4660
LIKELIHOOD RATIO	64	79.20	0.0955

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	2.3196	1.4498	2.56	0.1096
AVEINVES	2	0.0833	0.1865	0.20	0.6550
INSTARRA	3	-0.0383	0.0243	2.48	0.1153
WLIANUM	4	0.0351	0.0409	0.74	0.3899
TAX_BASE	5	-0.00009	0.000058	2.25	0.1339
GROWTHNO	6	-0.8193	1.3823	0.35	0.5534
RETAINRA	7	0.2665	0.3656	0.53	0.4660

CATMOD PROCEDURE

Response: ACCSTAND Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	81.037347	0.1767	1.1541	-0.1931	-0.0268	-0.0123	-5.918E-6	-0.2147	-0.6890
2	0	78.686984	0.0290	1.3758	-0.2483	-0.0259	-0.0505	-9.003E-6	-0.0317	-1.0896
3	0	77.554356	0.0144	1.3692	-0.2786	-0.0192	-0.1390	-8.78E-6	0.3528	-1.2948
4	0	77.484942	0.000895	1.3729	-0.2982	-0.0173	-0.1655	-8.596E-6	0.4555	-1.3608
5	0	77.48478	2.0821E-6	1.3736	-0.3002	-0.0172	-0.1666	-8.581E-6	0.4589	-1.3643
6	0	77.48478	2.231E-11	1.3736	-0.3002	-0.0172	-0.1666	-8.581E-6	0.4589	-1.3643

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	1.73	0.1886
AVEINVES	1	1.17	0.2796
INSTARRA	1	0.47	0.4915
WLIANUM	1	1.97	0.1605
TAX_BASE	1	0.07	0.7940
GROWTHNO	1	0.11	0.7420
RETAINRA	1	5.10	0.0240
LIKELIHOOD RATIO	64	77.48	0.1200

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.3736	1.0447	1.73	0.1886
AVEINVES	2	-0.3002	0.2777	1.17	0.2796
INSTARRA	3	-0.0172	0.0250	0.47	0.4915
WLIANUM	4	-0.1666	0.1187	1.97	0.1605
TAX_BASE	5	-8.58E-6	0.000033	0.07	0.7940
GROWTHNO	6	0.4589	1.3942	0.11	0.7420
RETAINRA	7	-1.3643	0.6044	5.10	0.0240

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CATMOD PROCEDURE

Response: PROCEDST Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	76.272569	0.2251	2.0241	0.1370	-0.0419	-0.0183	8.8276E-6	-0.7427	-0.4988
2	0	75.260543	0.0133	2.7169	0.1804	-0.0564	-0.0223	0.0000128	-1.3260	-0.5825
3	0	75.235386	0.000334	2.8507	0.1875	-0.0591	-0.0228	0.0000139	-1.4634	-0.5942
4	0	75.235362	3.2782E-7	2.8550	0.1877	-0.0592	-0.0228	0.0000139	-1.4680	-0.5945
5	0	75.235362	3.481E-13	2.8550	0.1877	-0.0592	-0.0228	0.0000139	-1.4680	-0.5945

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	5.00	0.0254
AVEINVES	1	0.60	0.4368
INSTARRA	1	5.17	0.0229
WLIANUM	1	0.32	0.5746
TAX_BASE	1	0.13	0.7169
GROWTHNO	1	0.94	0.3324
RETAINRA	1	2.53	0.1118
LIKELIHOOD RATIO	64	75.24	0.1590

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	2.8550	1.2774	5.00	0.0254
AVEINVES	2	0.1877	0.2414	0.60	0.4368
INSTARRA	3	-0.0592	0.0260	5.17	0.0229
WLIANUM	4	-0.0228	0.0406	0.32	0.5746
TAX_BASE	5	0.000014	0.000038	0.13	0.7169
GROWTHNO	6	-1.4680	1.5144	0.94	0.3324
RETAINRA	7	-0.5945	0.3738	2.53	0.1118

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CATMOD PROCEDURE

Response: PARCELAT Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	72.702607	0.2614	0.2461	-0.2001	-0.0166	0.0209	-9.852E-6	-1.1866	0.1170
2	0	70.830798	0.0257	0.5765	-0.4313	-0.0210	0.0400	-0.000015	-1.5543	0.1452
3	0	70.384791	0.006297	0.6422	-0.6558	-0.0199	0.0522	-0.000016	-1.5729	0.1268
4	0	70.314811	0.000994	0.6523	-0.7637	-0.0188	0.0496	-0.000016	-1.5421	0.1204
5	0	70.310301	0.0000641	0.6543	-0.7893	-0.0183	0.0460	-0.000016	-1.5260	0.1197
6	0	70.310282	2.7966E-7	0.6544	-0.7909	-0.0183	0.0458	-0.000016	-1.5249	0.1196
7	0	70.310282	4.255E-12	0.6544	-0.7910	-0.0183	0.0458	-0.000016	-1.5249	0.1196

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.31	0.5771
AVEINVES	1	1.76	0.1846
INSTARRA	1	0.49	0.4820
WLIANUM	1	0.21	0.6464
TAX_BASE	1	0.14	0.7123
GROWTHNO	1	1.09	0.2974
RETAINRA	1	0.10	0.7489
LIKELIHOOD RATIO	64	70.31	0.2746

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	0.6544	1.1735	0.31	0.5771
AVEINVES	2	-0.7910	0.5962	1.76	0.1846
INSTARRA	3	-0.0183	0.0260	0.49	0.4820
WLIANUM	4	0.0458	0.0997	0.21	0.6464
TAX_BASE	5	-0.00002	0.000042	0.14	0.7123
GROWTHNO	6	-1.5249	1.4633	1.09	0.2974
RETAINRA	7	0.1196	0.3737	0.10	0.7489

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CATMOD PROCEDURE

Response: REMONWI Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	85.146799	0.1349	0.9736	-0.1856	-0.0177	-0.0238	0.000023	-1.3928	-0.4756
2	0	79.765411	0.0632	1.1054	-0.2376	-0.0124	-0.1368	0.0000253	-1.1585	-0.5624
3	0	76.736812	0.0380	1.0995	-0.3040	-0.001870	-0.2962	0.0000279	-0.6458	-0.6903
4	0	76.500989	0.003073	1.0913	-0.3542	0.001784	-0.3480	0.0000305	-0.5404	-0.7819
5	0	76.498428	0.0000335	1.0926	-0.3633	0.002198	-0.3532	0.0000308	-0.5331	-0.7918
6	0	76.498427	6.2282E-9	1.0926	-0.3635	0.002203	-0.3533	0.0000308	-0.5330	-0.7919

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	1.03	0.3099
AVEINVES	1	1.39	0.2391
INSTARRA	1	0.01	0.9271
WLIANUM	1	6.64	0.0100
TAX_BASE	1	0.83	0.3627
GROWTHNO	1	0.14	0.7046
RETAINRA	1	3.21	0.0730
LIKELIHOOD RATIO	64	76.50	0.1361

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.0926	1.0760	1.03	0.3099
AVEINVES	2	-0.3635	0.3087	1.39	0.2391
INSTARRA	3	0.00220	0.0241	0.01	0.9271
WLIANUM	4	-0.3533	0.1371	6.64	0.0100
TAX_BASE	5	0.000031	0.000034	0.83	0.3627
GROWTHNO	6	-0.5330	1.4059	0.14	0.7046
RETAINRA	7	-0.7919	0.4417	3.21	0.0730

CATMOD PROCEDURE

Response: REMONWO Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

	Sub	-2 Log	Convergence	Parameter Estimates						
Iteration	Iteration	Likelihood	Criterion	1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	78.385711	0.2036	0.0991	-0.1853	-0.0249	0.007538	-0.000031	1.3003	0.0519
2	0	77.563215	0.0105	0.4084	-0.2991	-0.0316	0.0154	-0.000044	1.5815	0.0766
3	0	77.528063	0.000453	0.4805	-0.3429	-0.0320	0.0186	-0.000047	1.6201	0.0769
4	0	77.527864	2.5654E-6	0.4833	-0.3469	-0.0320	0.0189	-0.000047	1.6214	0.0766
5	0	77.527864	1.305E-10	0.4833	-0.3470	-0.0320	0.0189	-0.000047	1.6214	0.0766

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.16	0.6904
AVEINVES	1	1.16	0.2807
INSTARRA	1	1.57	0.2109
WLIANUM	1	0.11	0.7367
TAX_BASE	1	1.07	0.3010
GROWTHNO	1	1.42	0.2336
RETAINRA	1	0.05	0.8310
LIKELIHOOD RATIO	64	77.53	0.1193

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	0.4833	1.2134	0.16	0.6904
AVEINVES	2	-0.3470	0.3217	1.16	0.2807
INSTARRA	3	-0.0320	0.0255	1.57	0.2109
WLIANUM	4	0.0189	0.0562	0.11	0.7367
TAX_BASE	5	-0.00005	0.000046	1.07	0.3010
GROWTHNO	6	1.6214	1.3611	1.42	0.2336
RETAINRA	7	0.0766	0.3587	0.05	0.8310

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CATMOD PROCEDURE

Response: GISSCORE Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	90.911876	0.0764	1.4275	0.1097	-0.0323	-0.0479	-0.000011	-0.3325	-0.1371
2	0	90.234718	0.007449	1.5312	0.1125	-0.0330	-0.0808	-0.000011	-0.2602	-0.1494
3	0	89.955608	0.003093	1.5388	0.1104	-0.0310	-0.1192	-0.000011	-0.1297	-0.1558
4	0	89.945559	0.000112	1.5412	0.1110	-0.0306	-0.1282	-0.000011	-0.0989	-0.1602
5	0	89.945556	2.8485E-8	1.5412	0.1111	-0.0306	-0.1283	-0.000011	-0.0984	-0.1604
6	0	89.945556	2.528E-15	1.5412	0.1111	-0.0306	-0.1283	-0.000011	-0.0984	-0.1604

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.40	0.1213
AVEINVES	1	0.37	0.5421
INSTARRA	1	1.84	0.1745
WLIANUM	1	1.85	0.1738
TAX_BASE	1	0.13	0.7212
GROWTHNO	1	0.01	0.9398
RETAINRA	1	0.22	0.6418
LIKELIHOOD RATIO	64	89.95	0.0180

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.5412	0.9947	2.40	0.1213
AVEINVES	2	0.1111	0.1822	0.37	0.5421
INSTARRA	3	-0.0306	0.0225	1.84	0.1745
WLIANUM	4	-0.1283	0.0944	1.85	0.1738
TAX_BASE	5	-0.00001	0.000031	0.13	0.7212
GROWTHNO	6	-0.0984	1.3038	0.01	0.9398
RETAINRA	7	-0.1604	0.3448	0.22	0.6418

CATMOD PROCEDURE

Response: PARTGISS Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	86.294221	0.1233	1.8694	-0.0262	-0.0402	0.0210	-0.000032	0.8714	0.0634
2	0	85.996087	0.003455	2.1097	-0.0354	-0.0476	0.0318	-0.000037	1.1190	0.0748
3	0	85.987787	0.000097	2.1200	-0.0357	-0.0482	0.0360	-0.000037	1.1229	0.0757
4	0	85.987721	7.7128E-7	2.1200	-0.0357	-0.0482	0.0364	-0.000037	1.1215	0.0758
5	0	85.987721	6.382E-11	2.1200	-0.0357	-0.0482	0.0364	-0.000037	1.1214	0.0758

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	4.22	0.0400
AVEINVES	1	0.04	0.8441
INSTARRA	1	4.18	0.0410
WLIANUM	1	0.38	0.5389
TAX_BASE	1	1.31	0.2526
GROWTHNO	1	0.64	0.4239
RETAINRA	1	0.05	0.8202
LIKELIHOOD RATIO	64	85.99	0.0348

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	2.1200	1.0324	4.22	0.0400
AVEINVES	2	-0.0357	0.1814	0.04	0.8441
INSTARRA	3	-0.0482	0.0236	4.18	0.0410
WLIANUM	4	0.0364	0.0593	0.38	0.5389
TAX_BASE	5	-0.00004	0.000033	1.31	0.2526
GROWTHNO	6	1.1214	1.4023	0.64	0.4239
RETAINRA	7	0.0758	0.3333	0.05	0.8202

CATMOD PROCEDURE

Response: INPUT Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	89.769067	0.0880	1.6363	0.0947	-0.0336	-0.0533	-0.000022	0.2778	-0.0510
2	0	88.720884	0.0117	1.7740	0.0958	-0.0348	-0.0961	-0.000024	0.4582	-0.0473
3	0	88.244045	0.005375	1.7980	0.0917	-0.0323	-0.1503	-0.000024	0.6635	-0.0527
4	0	88.236365	0.000087	1.8034	0.0929	-0.0320	-0.1584	-0.000024	0.6985	-0.0579
5	0	88.236364	1.0662E-8	1.8034	0.0929	-0.0320	-0.1584	-0.000024	0.6989	-0.0580
6	0	88.236364	6.442E-16	1.8034	0.0929	-0.0320	-0.1584	-0.000024	0.6989	-0.0580

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	3.16	0.0755
AVEINVES	1	0.25	0.6163
INSTARRA	1	1.94	0.1640
WLIANUM	1	2.78	0.0952
TAX_BASE	1	0.55	0.4580
GROWTHNO	1	0.26	0.6072
RETAINRA	1	0.03	0.8641
LIKELIHOOD RATIO	64	88.24	0.0240

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.8034	1.0146	3.16	0.0755
AVEINVES	2	0.0929	0.1854	0.25	0.6163
INSTARRA	3	-0.0320	0.0230	1.94	0.1640
WLIANUM	4	-0.1584	0.0950	2.78	0.0952
TAX_BASE	5	-0.00002	0.000032	0.55	0.4580
GROWTHNO	6	0.6989	1.3596	0.26	0.6072
RETAINRA	7	-0.0580	0.3392	0.03	0.8641

CATMOD PROCEDURE

Response: OUTPUT Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	90.911876	0.0764	1.4275	0.1097	-0.0323	-0.0479	-0.000011	-0.3325	-0.1371
2	0	90.234718	0.007449	1.5312	0.1125	-0.0330	-0.0808	-0.000011	-0.2602	-0.1494
3	0	89.955608	0.003093	1.5388	0.1104	-0.0310	-0.1192	-0.000011	-0.1297	-0.1558
4	0	89.945559	0.000112	1.5412	0.1110	-0.0306	-0.1282	-0.000011	-0.0989	-0.1602
5	0	89.945556	2.8485E-8	1.5412	0.1111	-0.0306	-0.1283	-0.000011	-0.0984	-0.1604
6	0	89.945556	2.528E-15	1.5412	0.1111	-0.0306	-0.1283	-0.000011	-0.0984	-0.1604

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.40	0.1213
AVEINVES	1	0.37	0.5421
INSTARRA	1	1.84	0.1745
WLIANUM	1	1.85	0.1738
TAX_BASE	1	0.13	0.7212
GROWTHNO	1	0.01	0.9398
RETAINRA	1	0.22	0.6418
LIKELIHOOD RATIO	64	89.95	0.0180

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.5412	0.9947	2.40	0.1213
AVEINVES	2	0.1111	0.1822	0.37	0.5421
INSTARRA	3	-0.0306	0.0225	1.84	0.1745
WLIANUM	4	-0.1283	0.0944	1.85	0.1738
TAX_BASE	5	-0.00001	0.000031	0.13	0.7212
GROWTHNO	6	-0.0984	1.3038	0.01	0.9398
RETAINRA	7	-0.1604	0.3448	0.22	0.6418

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CATMOD PROCEDURE

Response: MICROCOM Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	42.06413	0.5726	1.8239	0.0812	-0.008395	-0.0660	4.3731E-6	0.2797	-0.1337
2	0	36.853715	0.1239	2.6391	0.1985	-0.0216	-0.1157	0.0000103	0.4490	-0.2170
3	0	35.873341	0.0266	3.0819	0.3241	-0.0324	-0.1735	0.0000168	0.5053	-0.2157
4	0	35.743004	0.003633	3.2306	0.3412	-0.0350	-0.2128	0.00002	0.5943	-0.2000
5	0	35.741773	0.0000345	3.2424	0.3388	-0.0353	-0.2166	0.0000203	0.6176	-0.1984
6	0	35.741773	3.1021E-9	3.2424	0.3389	-0.0353	-0.2166	0.0000203	0.6179	-0.1984

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.51	0.1129
AVEINVES	1	0.39	0.5345
INSTARRA	1	0.85	0.3556
WLIANUM	1	2.71	0.0998
TAX_BASE	1	0.08	0.7711
GROWTHNO	1	0.06	0.8116
RETAINRA	1	0.17	0.6816
LIKELIHOOD RATIO	64	35.74	0.9984

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	3.2424	2.0451	2.51	0.1129
AVEINVES	2	0.3389	0.5455	0.39	0.5345
INSTARRA	3	-0.0353	0.0382	0.85	0.3556
WLIANUM	4	-0.2166	0.1316	2.71	0.0998
TAX_BASE	5	0.00002	0.00007	0.08	0.7711
GROWTHNO	6	0.6179	2.5914	0.06	0.8116
RETAINRA	7	-0.1984	0.4835	0.17	0.6816

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CATMOD PROCEDURE

Response: LINKS Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	41.235563	0.5811	1.8177	0.1509	-0.0246	-0.0201	3.5011E-6	0.4779	0.0994
2	0	33.962694	0.1764	2.6637	0.4864	-0.0534	-0.0634	6.0917E-6	1.0118	0.2589
3	0	30.261272	0.1090	3.1319	1.2994	-0.0784	-0.1598	0.0000127	1.1720	0.4747
4	0	28.833289	0.0472	3.3401	2.1598	-0.0976	-0.2495	0.0000306	0.8827	0.6667
5	0	28.51903	0.0109	3.4098	2.6191	-0.1089	-0.2634	0.0000461	0.3798	0.7378
6	0	28.395741	0.004323	3.4777	3.0188	-0.1166	-0.2442	0.0000531	-0.1528	0.7394
7	0	28.393211	0.0000891	3.4981	3.0872	-0.1179	-0.2429	0.0000539	-0.2088	0.7405
8	0	28.39321	3.7272E-8	3.4987	3.0886	-0.1179	-0.2429	0.0000539	-0.2099	0.7406
9	0	28.39321	8.133E-15	3.4987	3.0886	-0.1179	-0.2429	0.0000539	-0.2099	0.7406

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.00	0.1576
AVEINVES	1	3.48	0.0623
INSTARRA	1	4.74	0.0295
WLIANUM	1	2.35	0.1250
TAX_BASE	1	0.27	0.6023
GROWTHNO	1	0.00	0.9482
RETAINRA	1	1.27	0.2595
LIKELIHOOD RATIO	64	28.39	1.0000

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	3.4987	2.4755	2.00	0.1576
AVEINVES	2	3.0886	1.6569	3.48	0.0623
INSTARRA	3	-0.1179	0.0542	4.74	0.0295
WLIANUM	4	-0.2429	0.1583	2.35	0.1250
TAX_BASE	5	0.000054	0.000103	0.27	0.6023
GROWTHNO	6	-0.2099	3.2308	0.00	0.9482
RETAINRA	7	0.7406	0.6567	1.27	0.2595

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CATMOD PROCEDURE

Response: PARDIG Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	76.899275	0.2187	2.2332	0.1755	-0.0593	-0.0474	-0.000025	-0.7493	-0.1880
2	0	75.133683	0.0230	2.8662	0.2054	-0.0746	-0.0848	-0.000034	-0.7098	-0.2955
3	0	74.560243	0.007632	2.9712	0.2106	-0.0739	-0.1460	-0.000036	-0.4799	-0.3382
4	0	74.518881	0.000555	2.9931	0.2151	-0.0731	-0.1680	-0.000037	-0.4084	-0.3574
5	0	74.51883	6.9643E-7	2.9948	0.2155	-0.0731	-0.1688	-0.000037	-0.4067	-0.3587
6	0	74.51883	1.657E-12	2.9948	0.2155	-0.0731	-0.1688	-0.000037	-0.4067	-0.3587

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	5.90	0.0152
AVEINVES	1	1.25	0.2636
INSTARRA	1	6.37	0.0116
WLIANUM	1	2.12	0.1452
TAX_BASE	1	0.84	0.3580
GROWTHNO	1	0.07	0.7853
RETAINRA	1	0.61	0.4342
LIKELIHOOD RATIO	64	74.52	0.1733

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	2.9948	1.2332	5.90	0.0152
AVEINVES	2	0.2155	0.1928	1.25	0.2636
INSTARRA	3	-0.0731	0.0290	6.37	0.0116
WLIANUM	4	-0.1688	0.1159	2.12	0.1452
TAX_BASE	5	-0.00004	0.00004	0.84	0.3580
GROWTHNO	6	-0.4067	1.4932	0.07	0.7853
RETAINRA	7	-0.3587	0.4587	0.61	0.4342

CATMOD PROCEDURE

Response: PARHARD Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	49.023458	0.5019	-0.9612	0.003131	-0.0268	-0.0202	-0.000027	1.8060	0.1959
2	0	43.6019	0.1106	-0.7614	0.0377	-0.0516	-0.0495	-0.000058	3.1473	0.3988
3	0	42.337776	0.0290	-0.1995	0.0615	-0.0618	-0.1074	-0.000091	4.0205	0.5098
4	0	42.017617	0.007562	0.2220	0.0656	-0.0609	-0.1786	-0.000113	4.5407	0.5277
5	0	42.006971	0.000253	0.2990	0.0671	-0.0609	-0.1940	-0.000117	4.6513	0.5246
6	0	42.006955	3.8273E-7	0.3017	0.0672	-0.0609	-0.1946	-0.000117	4.6552	0.5243
7	0	42.006955	9.985E-13	0.3017	0.0672	-0.0609	-0.1946	-0.000117	4.6552	0.5243

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.02	0.8878
AVEINVES	1	0.06	0.8097
INSTARRA	1	2.19	0.1388
WLIANUM	1	1.21	0.2718
TAX_BASE	1	1.51	0.2196
GROWTHNO	1	4.15	0.0415
RETAINRA	1	1.17	0.2803
LIKELIHOOD RATIO	64	42.01	0.9848

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	0.3017	2.1380	0.02	0.8878
AVEINVES	2	0.0672	0.2790	0.06	0.8097
INSTARRA	3	-0.0609	0.0411	2.19	0.1388
WLIANUM	4	-0.1946	0.1771	1.21	0.2718
TAX_BASE	5	-0.00012	0.000095	1.51	0.2196
GROWTHNO	6	4.6552	2.2838	4.15	0.0415
RETAINRA	7	0.5243	0.4856	1.17	0.2803

CATMOD PROCEDURE

Response: UPDATEP Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	92.092781	0.0644	1.2170	-0.0612	-0.0100	-0.0153	-4.515E-6	-1.3723	0.3450
2	0	91.884501	0.002262	1.2783	-0.0655	-0.0098	-0.0305	-4.488E-6	-1.4036	0.3766
3	0	91.857473	0.000294	1.2808	-0.0665	-0.009351	-0.0393	-4.439E-6	-1.3761	0.3776
4	0	91.856813	7.1895E-6	1.2813	-0.0667	-0.009260	-0.0410	-4.43E-6	-1.3711	0.3778
5	0	91.856812	4.0382E-9	1.2813	-0.0667	-0.009258	-0.0410	-4.429E-6	-1.3710	0.3778

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	1.74	0.1872
AVEINVES	1	0.14	0.7040
INSTARRA	1	0.19	0.6610
WLIANUM	1	0.34	0.5600
TAX_BASE	1	0.02	0.8846
GROWTHNO	1	1.18	0.2776
RETAINRA	1	1.19	0.2748
LIKELIHOOD RATIO	64	91.86	0.0128

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.2813	0.9715	1.74	0.1872
AVEINVES	2	-0.0667	0.1756	0.14	0.7040
INSTARRA	3	-0.00926	0.0211	0.19	0.6610
WLIANUM	4	-0.0410	0.0704	0.34	0.5600
TAX_BASE	5	-4.43E-6	0.000031	0.02	0.8846
GROWTHNO	6	-1.3710	1.2626	1.18	0.2776
RETAINRA	7	0.3778	0.3460	1.19	0.2748

CATMOD PROCEDURE

Response: ADM6 Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	71.850796	0.2700	1.0664	-0.1401	-0.0417	0.0153	-0.000041	-0.0689	0.5989
2	0	69.390047	0.0342	2.1232	-0.2223	-0.0580	0.0240	-0.000079	0.0373	0.7862
3	0	69.099808	0.004183	2.7363	-0.2568	-0.0621	0.0277	-0.000105	0.1498	0.8520
4	0	69.093412	0.0000926	2.8480	-0.2616	-0.0627	0.0282	-0.000110	0.1748	0.8629
5	0	69.093408	4.5128E-8	2.8505	-0.2616	-0.0628	0.0282	-0.000110	0.1754	0.8632
6	0	69.093408	1.07E-14	2.8505	-0.2616	-0.0628	0.0282	-0.000110	0.1754	0.8632

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.87	0.0905
AVEINVES	1	0.66	0.4181
INSTARRA	1	4.83	0.0279
WLIANUM	1	0.23	0.6308
TAX_BASE	1	2.55	0.1105
GROWTHNO	1	0.01	0.9083
RETAINRA	1	5.09	0.0241
LIKELIHOOD RATIO	64	69.09	0.3095

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	2.8505	1.6840	2.87	0.0905
AVEINVES	2	-0.2616	0.3231	0.66	0.4181
INSTARRA	3	-0.0628	0.0286	4.83	0.0279
WLIANUM	4	0.0282	0.0587	0.23	0.6308
TAX_BASE	5	-0.00011	0.000069	2.55	0.1105
GROWTHNO	6	0.1754	1.5229	0.01	0.9083
RETAINRA	7	0.8632	0.3826	5.09	0.0241

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CATMOD PROCEDURE

Response: MAPSTAN Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	82.509294	0.1617	1.4669	-0.0579	-0.0193	-0.000388	-0.000023	1.2747	-0.7310
2	0	82.091821	0.005060	1.7351	-0.0754	-0.0229	-0.001808	-0.000031	1.7130	-0.8961
3	0	82.089213	0.0000318	1.7495	-0.0768	-0.0231	-0.002080	-0.000032	1.7595	-0.9114
4	0	82.089212	1.8167E-9	1.7496	-0.0768	-0.0231	-0.002082	-0.000032	1.7599	-0.9115

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.77	0.0957
AVEINVES	1	0.18	0.6752
INSTARRA	1	1.08	0.2996
WLIANUM	1	0.00	0.9557
TAX_BASE	1	0.93	0.3342
GROWTHNO	1	1.40	0.2368
RETAINRA	1	5.13	0.0235
LIKELIHOOD RATIO	64	82.09	0.0634

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.7496	1.0503	2.77	0.0957
AVEINVES	2	-0.0768	0.1833	0.18	0.6752
INSTARRA	3	-0.0231	0.0223	1.08	0.2996
WLIANUM	4	-0.00208	0.0375	0.00	0.9557
TAX_BASE	5	-0.00003	0.000033	0.93	0.3342
GROWTHNO	6	1.7599	1.4876	1.40	0.2368
RETAINRA	7	-0.9115	0.4024	5.13	0.0235

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CATMOD PROCEDURE

Response: ZONEDIG Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	58.111377	0.4096	1.4932	0.1690	-0.0301	-0.0196	0.0000309	-0.5962	-0.1720
2	0	53.35947	0.0818	1.7240	0.3948	-0.0545	-0.0451	0.0000743	-1.5488	-0.2120
3	0	51.982793	0.0258	1.6085	0.6923	-0.0710	-0.0794	0.000114	-2.3336	-0.2146
4	0	51.787227	0.003762	1.5918	0.8975	-0.0783	-0.1031	0.000129	-2.6008	-0.2096
5	0	51.783071	0.0000802	1.5976	0.9342	-0.0794	-0.1071	0.000131	-2.6393	-0.2085
6	0	51.783069	3.4933E-8	1.5979	0.9350	-0.0794	-0.1072	0.000131	-2.6401	-0.2085
7	0	51.783069	7.272E-15	1.5979	0.9350	-0.0794	-0.1072	0.000131	-2.6401	-0.2085

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.80	0.3699
AVEINVES	1	2.02	0.1556
INSTARRA	1	5.21	0.0225
WLIANUM	1	1.58	0.2090
TAX_BASE	1	2.95	0.0856
GROWTHNO	1	1.87	0.1714
RETAINRA	1	0.29	0.5909
LIKELIHOOD RATIO	64	51.78	0.8638

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.5979	1.7822	0.80	0.3699
AVEINVES	2	0.9350	0.6584	2.02	0.1556
INSTARRA	3	-0.0794	0.0348	5.21	0.0225
WLIANUM	4	-0.1072	0.0853	1.58	0.2090
TAX_BASE	5	0.000131	0.000076	2.95	0.0856
GROWTHNO	6	-2.6401	1.9303	1.87	0.1714
RETAINRA	7	-0.2085	0.3878	0.29	0.5909

CATMOD PROCEDURE

Response: ZONEHARD Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	76.53995	0.2224	-0.4555	-0.001807	-0.0453	0.0423	0.0000321	-0.3164	-0.1978
2	0	75.093809	0.0189	-0.4359	0.009382	-0.0633	0.0665	0.0000386	-0.2431	-0.3109
3	0	74.859803	0.003116	-0.4373	0.0138	-0.0685	0.0952	0.00004	-0.2968	-0.3561
4	0	74.837268	0.000301	-0.4404	0.0146	-0.0700	0.1087	0.0000404	-0.3389	-0.3671
5	0	74.837232	4.8785E-7	-0.4406	0.0147	-0.0701	0.1093	0.0000405	-0.3406	-0.3679
6	0	74.837232	7.753E-13	-0.4406	0.0147	-0.0701	0.1093	0.0000405	-0.3406	-0.3679

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.18	0.6732
AVEINVES	1	0.01	0.9379
INSTARRA	1	5.93	0.0149
WLIANUM	1	1.25	0.2644
TAX_BASE	1	1.34	0.2476
GROWTHNO	1	0.06	0.8027
RETAINRA	1	0.65	0.4202
LIKELIHOOD RATIO	64	74.84	0.1668

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	-0.4406	1.0447	0.18	0.6732
AVEINVES	2	0.0147	0.1886	0.01	0.9379
INSTARRA	3	-0.0701	0.0288	5.93	0.0149
WLIANUM	4	0.1093	0.0979	1.25	0.2644
TAX_BASE	5	0.00004	0.000035	1.34	0.2476
GROWTHNO	6	-0.3406	1.3631	0.06	0.8027
RETAINRA	7	-0.3679	0.4564	0.65	0.4202

CATMOD PROCEDURE

Response: ZONEUPDA Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	75.058824	0.2374	1.4853	-0.2223	-0.0392	0.0317	0.0000103	0.1686	0.2754
2	0	74.234744	0.0110	1.8165	-0.2586	-0.0535	0.0371	0.0000139	0.2730	0.4103
3	0	74.222584	0.000164	1.8505	-0.2624	-0.0555	0.0376	0.0000146	0.2894	0.4379
4	0	74.222579	7.1368E-8	1.8508	-0.2625	-0.0555	0.0376	0.0000146	0.2897	0.4386
5	0	74.222579	2.317E-14	1.8508	-0.2625	-0.0555	0.0376	0.0000146	0.2897	0.4386

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	2.41	0.1208
AVEINVES	1	2.06	0.1508
INSTARRA	1	4.66	0.0309
WLIANUM	1	0.84	0.3597
TAX_BASE	1	0.13	0.7170
GROWTHNO	1	0.03	0.8523
RETAINRA	1	0.97	0.3242
LIKELIHOOD RATIO	64	74.22	0.1794

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	1.8508	1.1929	2.41	0.1208
AVEINVES	2	-0.2625	0.1827	2.06	0.1508
INSTARRA	3	-0.0555	0.0257	4.66	0.0309
WLIANUM	4	0.0376	0.0410	0.84	0.3597
TAX_BASE	5	0.000015	0.00004	0.13	0.7170
GROWTHNO	6	0.2897	1.5559	0.03	0.8523
RETAINRA	7	0.4386	0.4449	0.97	0.3242

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CATMOD PROCEDURE

Response: WETDIG Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	33.433136	0.6603	1.6764	0.0519	-0.0142	-0.0098	0.0000146	0.3450	-0.2458
2	0	24.710537	0.2609	2.1044	0.1322	-0.0353	-0.0248	0.0000472	0.6843	-0.4869
3	0	21.28675	0.1386	1.5516	0.2770	-0.0604	-0.0486	0.000128	0.3020	-0.7022
4	0	19.478294	0.0850	0.2290	0.5400	-0.0835	-0.0842	0.000261	-1.4472	-0.9371
5	0	18.84137	0.0327	-0.5887	0.7615	-0.1078	-0.1182	0.000376	-2.9144	-1.1760
6	0	18.753782	0.004649	-0.7440	0.8302	-0.1217	-0.1326	0.000427	-3.5654	-1.3095
7	0	18.751308	0.000132	-0.7707	0.8365	-0.1244	-0.1347	0.000437	-3.6992	-1.3398
8	0	18.751305	1.3727E-7	-0.7717	0.8365	-0.1245	-0.1348	0.000437	-3.7036	-1.3409
9	0	18.751305	1.62E-13	-0.7717	0.8365	-0.1245	-0.1348	0.000437	-3.7036	-1.3409

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.04	0.8422
AVEINVES	1	0.40	0.5284
INSTARRA	1	2.92	0.0874
WLIANUM	1	0.73	0.3922
TAX_BASE	1	2.77	0.0958
GROWTHNO	1	0.75	0.3853
RETAINRA	1	1.99	0.1583
LIKELIHOOD RATIO	64	18.75	1.0000

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	-0.7717	3.8758	0.04	0.8422
AVEINVES	2	0.8365	1.3269	0.40	0.5284
INSTARRA	3	-0.1245	0.0728	2.92	0.0874
WLIANUM	4	-0.1348	0.1575	0.73	0.3922
TAX_BASE	5	0.000437	0.000262	2.77	0.0958
GROWTHNO	6	-3.7036	4.2660	0.75	0.3853
RETAINRA	7	-1.3409	0.9504	1.99	0.1583

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CATMOD PROCEDURE

Response: WETHARD Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	89.765637	0.0880	-0.8023	0.0530	-0.0239	0.0146	0.0000229	0.9265	-0.3002
2	0	89.611867	0.001713	-0.8463	0.0590	-0.0276	0.0210	0.0000249	1.0180	-0.3622
3	0	89.610099	0.0000197	-0.8469	0.0593	-0.0278	0.0226	0.000025	1.0165	-0.3663
4	0	89.610097	2.245E-8	-0.8470	0.0593	-0.0278	0.0227	0.000025	1.0163	-0.3663
5	0	89.610097	4.171E-14	-0.8470	0.0593	-0.0278	0.0227	0.000025	1.0163	-0.3663

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	0.75	0.3858
AVEINVES	1	0.12	0.7336
INSTARRA	1	1.55	0.2135
WLIANUM	1	0.22	0.6425
TAX_BASE	1	0.60	0.4374
GROWTHNO	1	0.66	0.4180
RETAINRA	1	0.96	0.3261
LIKELIHOOD RATIO	64	89.61	0.0190

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	-0.8470	0.9765	0.75	0.3858
AVEINVES	2	0.0593	0.1743	0.12	0.7336
INSTARRA	3	-0.0278	0.0224	1.55	0.2135
WLIANUM	4	0.0227	0.0489	0.22	0.6425
TAX_BASE	5	0.000025	0.000032	0.60	0.4374
GROWTHNO	6	1.0163	1.2549	0.66	0.4180
RETAINRA	7	-0.3663	0.3730	0.96	0.3261

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CATMOD PROCEDURE

Response: SOILDIG		Response Levels (R)=	2
Weight Variable: None		Populations (S)=	71
Data Set: STEP1		Total Frequency (N)=	71
		Observations (Obs)=	71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	47.944804	0.5129	2.2313	0.0429	0.003538	-0.0536	-0.00001	-0.2806	-0.4428
2	0	43.984489	0.0826	3.4412	0.0784	0.002666	-0.0772	-0.000019	-0.8410	-0.6586
3	0	43.625941	0.008152	4.0602	0.0967	0.000348	-0.0889	-0.000022	-1.2890	-0.7260
4	0	43.617459	0.000194	4.1735	0.0984	-0.000218	-0.0921	-0.000023	-1.3787	-0.7346
5	0	43.617443	3.6529E-7	4.1768	0.0983	-0.000225	-0.0923	-0.000023	-1.3808	-0.7348
6	0	43.617443	7.653E-12	4.1768	0.0983	-0.000224	-0.0923	-0.000023	-1.3808	-0.7348

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	5.78	0.0162
AVEINVES	1	0.09	0.7662
INSTARRA	1	0.00	0.9948
WLIANUM	1	1.37	0.2418
TAX_BASE	1	0.27	0.6019
GROWTHNO	1	0.44	0.5048
RETAINRA	1	3.26	0.0711
LIKELIHOOD RATIO	64	43.62	0.9760

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	4.1768	1.7367	5.78	0.0162
AVEINVES	2	0.0983	0.3305	0.09	0.7662
INSTARRA	3	-0.00022	0.0346	0.00	0.9948
WLIANUM	4	-0.0923	0.0789	1.37	0.2418
TAX_BASE	5	-0.00002	0.000043	0.27	0.6019
GROWTHNO	6	-1.3808	2.0700	0.44	0.5048
RETAINRA	7	-0.7348	0.4071	3.26	0.0711

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CATMOD PROCEDURE

Response: SOILHARD Response Levels (R)= 2
Weight Variable: None Populations (S)= 71
Data Set: STEP1 Total Frequency (N)= 71
Observations (Obs)= 71

MAXIMUM LIKELIHOOD ANALYSIS

Iteration	Sub Iteration	-2 Log Likelihood	Convergence Criterion	Parameter Estimates 1	2	3	4	5	6	7
0	0	98.4269	1.0000	0	0	0	0	0	0	0
1	0	90.72539	0.0782	-1.1002	0.0937	-0.0174	0.0195	0.00002	0.8145	-0.009299
2	0	90.486921	0.002628	-1.1623	0.0995	-0.0204	0.0357	0.0000213	0.8512	-0.008485
3	0	90.454491	0.000358	-1.1667	0.1008	-0.0211	0.0454	0.0000214	0.8235	-0.008862
4	0	90.453634	9.4759E-6	-1.1675	0.1011	-0.0212	0.0473	0.0000214	0.8179	-0.009008
5	0	90.453633	5.7686E-9	-1.1675	0.1011	-0.0212	0.0474	0.0000214	0.8177	-0.009013

MAXIMUM LIKELIHOOD ANALYSIS OF VARIANCE TABLE

Source	DF	Chi-Square	Prob
INTERCEPT	1	1.45	0.2287
AVEINVES	1	0.33	0.5658
INSTARRA	1	0.92	0.3382
WLIANUM	1	0.44	0.5061
TAX_BASE	1	0.47	0.4928
GROWTHNO	1	0.43	0.5136
RETAINRA	1	0.00	0.9780
LIKELIHOOD RATIO	64	90.45	0.0164

ANALYSIS OF MAXIMUM LIKELIHOOD ESTIMATES

Effect	Parameter	Estimate	Standard Error	Chi-Square	Prob
INTERCEPT	1	-1.1675	0.9700	1.45	0.2287
AVEINVES	2	0.1011	0.1761	0.33	0.5658
INSTARRA	3	-0.0212	0.0221	0.92	0.3382
WLIANUM	4	0.0474	0.0712	0.44	0.5061
TAX_BASE	5	0.000021	0.000031	0.47	0.4928
GROWTHNO	6	0.8177	1.2516	0.43	0.5136
RETAINRA	7	-0.00901	0.3269	0.00	0.9780

APPROVED *Stephen J. Ventura* Date 8/17/94

Stephen J. Ventura, Assistant Professor
Environmental Studies and Soil Science