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PATTERNS OF INFORMATION SYSTEM GROWTH IN  
COMMUNITY MENTAL HEALTH CENTERS

by

LINDA J. BELLERBY

A dissertation submitted in partial fulfillment of the  
requirements for the degree of

DOCTOR OF PHILOSOPHY  
in  
SYSTEMS SCIENCE


Portland State University

1980

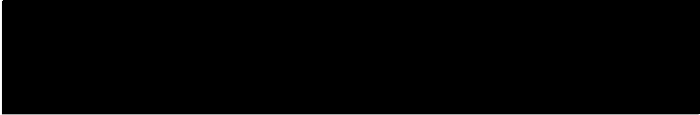
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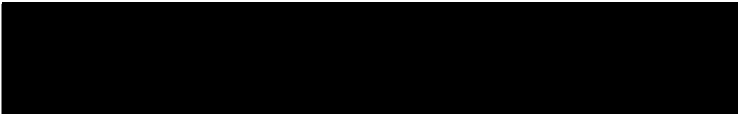
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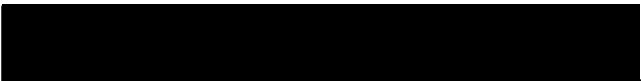
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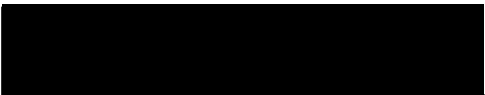
  
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AN ABSTRACT OF THE DISSERTATION of Linda J. Bellerby for the Doctor of  
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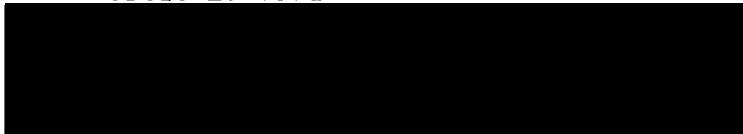
Title: Patterns of Information System Growth in Community Mental Health  
Centers.

APPROVED BY MEMBERS OF THE DISSERTATION COMMITTEE:

  
Lewis N. Goslin, Chairman

  
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Robert E. Good

  
Richard B. Halley

  
Nancy M. Koroloff

This research was undertaken to determine whether the growth of  
computer-supported information systems in community mental health  
centers can be characterized by distinct stages of development. Data  
collection and analysis were designed to answer the following two  
questions:

- Can distinct stages of information system growth be characterized by common profiles of computer-supported applications?
- Are there characteristic groups of enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) consistent among community mental health centers at any given stage of growth?

This study draws upon earlier work by Nolan who identified distinct stages which characterize the pattern of information system growth in business organizations. A model reflecting the unique characteristics of community mental health centers was formulated to describe the aspects of information system growth addressed by this study. The components of the model were used to develop three scenarios describing the hypothesized characteristics of mental health information systems at three different stages of growth.

Data for this study were obtained through a two-phase survey. The preliminary survey identified which community mental health centers are using computer-supported applications. The second survey collected detailed data about each model component using a stratified random sample of centers using computer-supported information systems.

Responses to the preliminary survey showed that seventy-nine per cent of the centers are using computer-supported information systems. In addition, the majority of centers with manual systems have plans to automate within one year. By contrast, a 1974 survey reported that only one-fourth of the centers were using computerized information systems. The number of centers using computers has therefore increased dramatically during the last five years.

The analysis of computer-supported applications showed that a refinement of the hypothesized applications profile for each stage would be more representative of the state of the art of computerized applications in community mental health centers. The original model depicting three stages of applications development was extended to four stages. The predominant types of applications being developed are those supporting administrative and clinical recordkeeping functions. These findings indicate that the development of computer-supported applications in centers parallels applications development in other mental health programs.

The analysis of characteristics of enabling factors revealed distinct differences among centers in each stage of development. The study results clearly showed that centers which are developing the most comprehensive sets of computerized applications are implementing formal planning and control techniques and user involvement strategies. These centers also reported the most favorable staff attitudes toward the usefulness of the information system and the most interest in developing new applications. While distinct characteristics of data processing organization variables were identified, these characteristics did not reflect a progression toward increased formalization of the data processing function.

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## CHAPTER I

### INTRODUCTION

Chapter I discusses the research questions investigated and the significance of this study. It also discusses the emergence of community-based mental health care and the establishment of community mental health centers as a mechanism for service delivery. Public accountability and funding provisions are also discussed in terms of their influence on mental health information system development.

### RESEARCH PROBLEM ADDRESSED

This research was undertaken to determine whether the growth of computer-supported information systems in community mental health centers can be characterized by distinct stages of development. The questions addressed are:

- Can distinct stages of information system growth be characterized by common profiles of computerized applications?
- Are there characteristic groups of enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) consistent among community mental health centers at any given stage of growth?

The research was designed to synthesize the experiences of community mental health centers in developing information systems. This synthesis was done by examining how the structure of these systems are

evolving and the processes underlying their growth. The data collected through this study are analyzed to determine whether sufficient differentiation exists among stages to establish a stage theory formulation.

Throughout this study an information system is defined as an integrated network of people, procedures, and equipment that systematically collects, stores, and analyzes data, and presents them in a form that facilitates decision making at all levels of the organization. A mental health information system provides support for making decisions about service delivery to individual clients, planning and evaluating programs, and carrying out administrative functions needed to operate mental health programs. Although the concept of an information system does not necessarily imply the use of computers, this study is concerned only with the development of computer-supported information systems for mental health service delivery.

#### SIGNIFICANCE OF RESEARCH

Important breakthroughs in information technology during the past three decades (1950-1980) have resulted in greatly increased computing capability and computing performance at decreased costs. As hardware and software technologies have expanded, the range of potential applications to aid management decision making has increased dramatically. Yet, at the same time, many organizations have been disappointed with the results gained from their information system development efforts (see, e.g., Soden, 1975; Canning, 1977; Nolan, 1979). Among these are many mental health organizations (see, e.g., Hedlund et al, 1977; Knesper et

al, 1978).

It is increasingly apparent that new insights about management of the computer resource in mental health organizations are needed. In spite of this need, Nolan (1973) cautions against premature attempts to formulate a normative theory for effective management of the computer resource. He suggests, "Research must first support a formative period" to identify those variables and those interrelationships that best describe current management practices.

The research conducted for this dissertation establishes a plausible starting point based on the strategy suggested by Nolan. Although the literature documents individual lessons learned during many system development efforts, no systematic study to date has been undertaken to examine the patterns underlying these lessons. This study formulates a descriptive model of information system growth in community mental health centers which in turn allows an examination of the changes that occur as these centers progress to more sophisticated uses of information systems.

A model describing the characteristics of information system growth offers multiple uses to the community mental health profession. First, it provides valuable baseline data about centers in varying stages of information system development. Such descriptive data have never been collected on a nationwide sample of centers. From these data, managers can assess the desirability of current computer uses and related management practices, and from that assessment derive improved system development strategies. Second, since the data focus on technical, organizational and managerial aspects, the study encourages

an integrated look at information system development and increases managerial awareness of the interrelationships that exist. Finally, where the relationships between enabling factors and effective computer use have been identified, the study directly facilitates the realization of desired change.

At the operational level, the data allow center management to compare the status of their information system applications and system support activities to those of other centers. The commonality of community mental health center mandates and environmental constraints increases the usefulness of such a comparison and the ability of one center to directly benefit from the experiences of another. The study identifies alternative development strategies already in existence, and helps managers evaluate possible directions for change within their centers.

If a normative stage theory formulation emerges from this and subsequent research, the progression to more sophisticated computer-supported applications can be related in concrete terms to the characteristics of those enabling factors which are needed to support system development and operation. An information system is more likely to be successful if it is compatible with users' ability and desire to use the system and if it is undertaken with adequate control over system development activities and resources. A prescriptive model which helps managers identify what stage their system is in can also help them assess their centers' readiness and ability to move to the next stage.

A second audience is served by the study: federal, state, and local managers who are providing resources and technical assistance for

mental health information system development. The study makes a valuable contribution toward establishing a new focus for dissemination of information system technology appropriate to community mental health settings. Of particular importance to this endeavor is the model's emphasis on the enabling factors which support information system growth. Typically, too much attention is paid to desired technical capability without adequate consideration of the underlying support processes. These processes ultimately determine how well computer technology will be integrated into, and controlled by, the organization. The model developed through this study provides a framework for assessing how support processes change. Thus, the results of this study will allow funders to determine: (1) whether current technical assistance strategies are targeted at the problem areas identified by the study and viewed by mental health professionals as being barriers to successful system implementation at different stages of growth; and (2) whether available resources are adequate to meet these needs.

#### MENTAL HEALTH CARE ENVIRONMENT

##### Emergence of Community Mental Health Care

The passage of the Community Mental Health Centers Act (Public Law 88-164) in 1963 established a new direction in mental health service delivery. The Act shifted the focus from almost complete reliance on state hospital care to community-based mental health programs with a much broader range of mandated services. In little more than a decade, the conditions under which mental health care is provided, and the techniques for providing service, have changed dramatically. Elpers and

Chapman (1972) noted this orientation has been characterized by the following changes:

- The level of funding at the federal, state, and local levels has been greatly increased;
- Locally developed programs are much more visible than remote state hospitals and are under closer scrutiny by representatives of the community;
- A much wider array of personnel are being used, including non-professionals and volunteers;
- The role of the mental health professional has been broadened from a primary orientation as a therapist to include training, consulting, and managing;
- A broader range of mental health services is more accessible to the community-at-large than formerly possible; and
- Most mental health organizations are obtaining funds from multiple sources, including federal, state, and local governments, patients, and third-party payers.

Community mental health centers are a vital component of community mental health care. A primary distinction between centers and other community-based programs is the federal funding provided by the Community Mental Health Centers Act for facility construction and staffing. These centers are also mandated to provide a comprehensive set of services including inpatient care, outpatient care, partial hospitalization, emergency services, consultation and education, specialized services for children and the elderly, assistance to courts and to other community agencies, follow-up care, and special programs to

deal with alcoholism and other drug abuses.

#### Accountability Requirements

The changes in mental health service delivery cited above have created concern among both the program funders and the public. Elpers and Chapman (Smith et al, 1974) quote the nature of these concerns:

The growing community mental health programs are no longer represented by easily identifiable massive buildings nor clearly delineated medical programs. The diversity of personnel staffing makes placing trust in a few prestigious professionals much more difficult for the public. The diversity of programs with their multiple purposes and complex interrelationships with other human services causes the goals and objectives of community mental health programs to seem vague, obscure and ill defined. There is rising concern about the goals and effectiveness of community mental health programs and whether they are invading the purviews of welfare, public health, criminal justice systems and education. Regardless of whether this invasion is taking place, there is concern about mental health effectiveness, efficiency and how it interfaces with the other providers of human services.

These concerns have resulted in mandated requirements for federally funded centers to provide information about the operation, costs and outcomes of mental health programs. The Community Mental Health Centers Amendments of 1975 (Public Law 94-63) include the following program evaluation provisions:

1. Community Mental Health Centers must establish "an ongoing quality assurance program respecting the center's services."
2. Grant applications shall contain assurances that the center will provide:

an effective procedure for developing, compiling, evaluating, and reporting to the Secretary statistics and other information relating to (I) the cost of the center's operation, (II) the patterns of utilization of its services, (III) the availability of its services, (IV) the impact of its services upon the mental health of the residents of its catchment area.

3. In each year the "center shall obligate for a program of continuing evaluation of the effectiveness of its programs . . . not less than an amount equal to 2 per centum of the amount obligated by the center in the preceding year for its operating expenses."

These requirements, together with internally recognized needs, have made it imperative that community mental health centers systematically collect and analyze operational information. They have also provided the impetus for centers to develop computer-supported information systems as an efficient way to obtain needed information.

#### Funding Provisions

Efforts to develop and operate mental health information systems have been hampered by limited funding and lack of stable long term support (Lindberg, 1978). This is due, in part, to their funding provisions. Eight years of gradually decreasing staffing support is provided. Each year increasing amounts of staff time and funds must be diverted to find alternative sources of funding to replace diminishing federal support (Bloom, 1977). Thus, at the time when the center's information system should be evolving toward higher level uses, development efforts must compete for scarce organizational resources.

The Community Mental Health Centers Amendments cited in the preceding section obligate two per cent of operating costs to program evaluation. This statutory provision has been interpreted to include the development or upgrading of computer systems during the initial community mental health center grant period (Hedlund et al, 1979). In subsequent years, however, money from the operating budget must be used

for maintenance of these systems. Yet most centers do not have surplus funds for investment in information system improvement and equipment because their funding base is decreasing.

Another avenue of support is also provided under the terms of the Community Mental Health Centers Amendments. Two per cent of all Community Mental Health Center appropriations may be retained by the National Institute of Mental Health (NIMH) for technical assistance to improve center management and administration. This provision is used by NIMH to help centers evaluate information system requirements and to develop a standardized minicomputer-based information system (Hedlund et al, 1979). This system, which is still under development, is being designed to satisfy basic documentation, reporting and program evaluation needs. While this system development effort will provide some direction, "broader orchestration within and between the Federal and mental health communities . . . will be necessary if there is to be a more coherent, effective development and diffusion of mental health information systems technology" (Hedlund et al, 1979).

#### SUMMARY

This chapter discussed the stage theory research and reviewed the background of community mental health centers. This research will examine the growth of computer-supported information systems in community mental health centers and whether that growth can be characterized by distinct stages of development. The study is based on an analysis of how the profiles of computer-supported applications are evolving and of the processes underlying this growth. The descriptive

model developed through the study is classified as a stage theory formulation. This model provides a valuable state-of-the-art overview of mental health information systems as well as a useful framework for developing improved system development strategies.

The emergence of community mental health centers as a vital service delivery mechanism has been accompanied by demands for increased accountability. These demands have provided the impetus for many centers to develop computer-supported information systems. However, these development efforts have been hampered by limited funding and lack of stable long term support.

## CHAPTER II

### REVIEW OF THE LITERATURE

Chapter II summarizes the literature relevant to the research problem under study. The chapter includes a discussion of theories and concepts supporting this research and of research conducted in related areas. The chapter is organized around three themes: (1) stage theory formulations, (2) recent research on mental health information systems, and (3) use of computers in mental health.

### STAGE THEORY FORMULATIONS

The descriptive model developed through this study can be classified as a stage theory formulation. Nolan (1973) noted that stage theories are particularly useful for developing knowledge in diverse fields during their formative periods.

#### Requirements of a Stage Theory Formulation

The following minimal requirements of a stage theory formulation were defined by Kuznets (1965):

1. Each stage must display empirically testable characteristics;
2. The characteristics of each stage must be distinct (they are unique to that stage either singly or in combination); and
3. The analytical relation to the preceding and succeeding stages must be defined (this requires specifying what must happen in the preceding stage to allow the given stage to emerge and

identifying what brings a given stage to an end).

Thus, the major dimensions of a stage theory formulation are: (1) the identification of the elements; and (2) the conception of the elements' growth over time.

#### Research on Stage Theory Formulations

Nolan's research on stage theory formulations (1973, 1974, 1979) identified distinct stages which characterize the pattern of data processing growth in business organizations. These distinctive stages were derived from research which showed that computer budgets form an S-shaped curve when plotted over time. The inflection points represent major transitions in the life cycle of the computer resource and provide the basis for Nolan's original four-stage growth hypothesis. His original model (1973) was expanded (1979) to include the following six stages of growth which take into account recent (1970-1978) developments in information technology:

##### Stage 1: Initiation

The introduction of computer technology into the organization is characterized by a conservative learning process and the conversion of basic manual operational procedures to automated procedures. The utility of the computer in supporting operational activities is established.

##### Stage 2: Contagion

This stage is a period of rapid, unplanned growth as computer applications are introduced into all facets of the organizations' operation. The budget for the data processing effort grows rapidly.

##### Stage 3: Control

During stage 3 the status of the data processing activity is upgraded. Initial attempts are made to establish user accountability for data processing expenditures incurred. At some point during this stage, a basic shift in orientation occurs with the introduction of data base technology. The new focus is on

managing the organization's data resources rather than managing the computer.

#### Stage 4: Integration

The computer utility is established and data base technology is used to support key application areas. Data processing growth rates increase rapidly as in stage 2.

#### Stage 5: Data Administration

Data base and data communications processing increase and balance is established between centralized shared-data applications and decentralized user-controlled applications.

#### Stage 6: Maturity

As the organization emerges from stage 5, it has the sophistication to pursue a balanced program of efficient and effective data resource management. Primary emphasis is on integrated systems which are aligned with the information flows in the organization. Minicomputer and microcomputer processing support a significant proportion of the applications.

The conceptual foundation underlying these six stages is shown in Figure 1. This formulation uses the data processing budget as a surrogate for the collective effects of multiple situational variables. The elements associated with managing the computer resource are closely aligned with the growth of the computer budget. The situational variables, together with a given set of elements and their attributes, result in the applications portfolio for the organization. He noted (1973) that further research was needed to document the direct effect of situational variables on the elements and the recursive effects of existing computer-based applications.

#### Data Processing Growth Predictions for Human Services

Schoech and Schkade (1980) drew upon Nolan's findings in predicting that "the pattern of growth of computerized data processing in the human services will roughly parallel the previously recorded

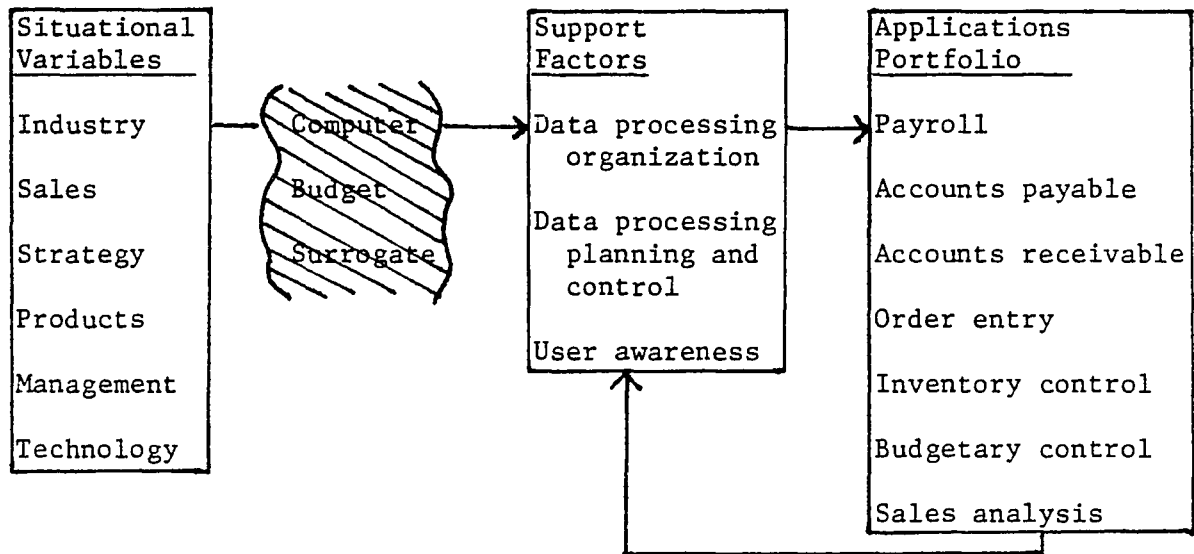


Figure 1. Conceptual foundation of Nolan's stage theory formulation of data processing growth in business organizations.\*

\* Adapted from Nolan (1973 and 1979).

growth in business." They also forecasted a period of rapid data processing growth in human service organizations during the next five to ten years which will exceed the rate of growth experienced by business organizations. These predictions are supported by the increased demands for accountability being placed on human service organizations, the rapid decline in computer costs, improvements in data management technology, and increased availability of packaged systems.

Schoech and Schkade cited three factors which tend to slow down the rate of development. First, it is difficult to develop standardized measurable units of service. Second, it is extremely difficult to collect service data across agency boundaries because of the political and territorial nature of the diversified and fragmented service delivery system at the community level. Finally, while human service agencies can buy technologies to move the organization quickly through the first three stages of Nolan's model, the movement from stage 4 (Integration) to stage 6 (Maturity) is an evolutionary process which requires considerable organizational learning and adoption on the part of the agency.

#### RECENT RESEARCH ON MENTAL HEALTH INFORMATION SYSTEMS

Recent national surveys indicate community mental health centers are beginning to utilize computer technology to meet the demand for improved accountability. A 1974 survey by Johnson, Giannetti, and Nelson (1976) reported that one-fourth of the centers surveyed had developed some computer applications. The study revealed that structural data

gathering, the foundation of technological applications, was reported by more than half of the centers responding.

The findings of a 1978 survey of community mental health centers showed that computer applications are being developed primarily in support of administrative functions such as accounting and external reporting requirements rather than clinical functions (Giannetti, Johnson and Williams, 1978). The study also indicated that center directors perceive the greatest need for improvement in administrative applications. This appears to be a response to external pressures for better cost accounting, evaluation of program effectiveness, and other reports to accountability sources. The pressure to meet external reporting requirements has discouraged the design of systems with the capability to provide the information needed to support internal planning and decision making. This trend was identified earlier as a major obstacle to the development of information systems that have an impact on clinical care (Pollack, Windle, and Wurster, 1974).

In a 1976 survey of forty state departments of mental health, Hedlund and Hickman (1977) found that thirty-five departments used computers for some administrative and clinical functions. Of the five departments with no current operational computer use, three reported active planning for computer support in the near future. These findings are important because community mental health centers often interface directly with state computer systems. The systems are usually oriented toward state reporting requirements but can also include applications needed to support the internal information needs of the centers.

## USE OF COMPUTERS IN MENTAL HEALTH

The mental health literature provides useful insights into the types of applications being automated by mental health organizations. Johnson (1978) described three research and development trends in the application of computers to mental health care. These include:

1. The development of automated patient data systems to provide objective reporting of traditional clinical functions, patient statistics, and other recordkeeping functions (see, e.g., Laska, 1972; Sletten, Ulett, and Hedlund, 1973; Morgan, 1972);
2. The development of automated clinical techniques such as the automation of the Minnesota Multiphasic Personality Inventory (MMPI) and Rorschach interpretive systems, patient diagnosis from structured interview protocols, and automated nursing notes (see, e.g., Pearson, Swenson, Rome, Mataya, and Brannick, 1965; Spitzer and Endicott, 1974; Rosenberg, Glueck, and Stroebel, 1967); and
3. The development of interventionally relevant systems which are characterized by efforts to predict the assignment of psychiatric medications, to produce recommendations automatically for individualized treatment programs for delinquents, and to develop an on-line psychiatric assessment system (see, e.g., Altman, Evenson, Sletten, and Cho, 1974; Johnson, Giannetti, and Williams, 1975).

Simulation, game theory, and computerized predictions are identified as areas in which computer capability will be applied in the future.

Johnson noted that significant progress has been made in the use of automated patient data systems. However, the use of automated

clinical techniques is not as widespread, even though such techniques have been in existence since the middle 1960's. Work in the area of interventionally relevant systems is still very recent and additional research is needed before any significant impact is realized.

Crawford (1974) reviewed the utilization of computer technology in terms of administrative, clinical, and research applications. Automated procedures which support administrative functions are again cited as having the most significant impact in mental health settings. The clinical applications discussed are generally the same as those discussed above by Johnson (1978). Crawford noted that the development of computer-based clinical instruments is still a very new area. However, he predicted that behavioral checklist-type instruments emphasizing quantification will proliferate in coming years. Research applications include statistical analysis, computerized diagnosis, interview simulation, and content analysis.

A recent state-of-the-art report (Hedlund et al, 1979) highlighted other areas where computerized applications are being developed. These include systems which support monitoring of individual patient care and program evaluation and planning. The first category includes computer processing of patient assessment and progress reports, medication treatment, and treatment plans. These systems also provide integrated data about patient problems, treatment objectives, the specific treatment provided, and patient progress. Program evaluation applications utilize the systematic documentation of individual patient data to assess program effectiveness. Outcome evaluation and cost-effectiveness studies are also being supported by computer data

bases.

The computer-supported applications discussed above are representative of mental health information systems in general. It is important to note that community mental health centers are a specialized mental health setting and have information requirements which differ from psychiatric hospitals, mental retardation/developmental centers, or state and county departments of mental health. Hedlund et al (1979) articulated the distinctions between community mental health center information systems and other mental health programs:

By and large, the data collection and processing applications for these systems are somewhat more limited than for the larger general MHISs already described, and they tend to be defined predominantly in terms of special program reporting needs. They tend to stress simple (minimal) data, collecting procedures, few direct clinical applications, and economical hardware/software configurations.

A review of documentation specific to community mental health center information systems (Wilson, 1974; Paton and Maberry, 1978; Elpers, 1975; Hansen, Johnson, and Williams, 1977) and discussions with mental health professionals indicate that applications which support both administrative and clinical accountability are predominant. Sophisticated research applications and applications which are still in the developmental stage are not likely to be operational or under development in community mental health centers.

A consensus about the current use of computer technology in mental health exists. Hedlund et al (1979) concisely summarize this view:

. . . emphasis has been placed on computer applications having to do with patient census and statistics, documentation of services provided, administrative functions (especially patient and third-party billing), and program evaluation.

More clinically oriented computer applications (i.e., those having to do with monitoring of individual patient care, clinical decision making and clinical predictions) are clearly taking a back seat in operational settings, with only rather weak interest.

#### SUMMARY

This chapter discussed the conceptual background supporting this research and research conducted in related areas. Little research has been directed toward developing stage theory formulations of information system growth. The most comprehensive research in this area was conducted by Nolan. His research identified distinct stages which characterize the pattern of information system growth in business organizations.

Recent literature on mental health information systems reveals that one-fourth of the community mental health centers had developed some computer applications in 1974. Another survey reports these centers are developing applications primarily in support of administrative functions such as accounting and external reporting requirements instead of clinical functions. The pressure to meet external reporting requirements has been identified as a major obstacle to the development of information systems that have an impact on clinical care. State departments of mental health are using computers more extensively than centers, predominantly for administrative and clinical accountability functions.

## CHAPTER III

### RESEARCH METHODS

Chapter III presents an overview of the research methods used in conducting this study. The methods discussed in this chapter are the model underlying this research, the hypothesized stages of mental health information system growth, and the methods employed for data collection. Data analysis procedures are discussed in Chapter IV, Analysis of Findings.

#### OVERVIEW OF RESEARCH METHODS

The following sequence of methods was utilized in this stage theory research:

1. A model was formulated to describe the aspects of information system growth addressed by this study.
2. Using the framework provided by the model, three scenarios were developed which describe the hypothesized characteristics of mental health information systems at different stages of development.
3. A preliminary survey of community mental health centers was conducted to identify those using computer-supported information systems.
4. Data about each model component were collected using a stratified random sample of community mental health centers with

computer-supported information systems.

5. The data collected on computer-supported applications were analyzed to determine whether the pattern exhibited by the data was the same as the pattern projected in the hypothesized scenarios. Based on the survey findings, the profile of computer-supported applications in each stage was modified. Cluster analysis was then used to further refine the classification scheme for computer-supported applications.
6. Discriminant analysis was used to determine whether the characteristics of the enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) were significantly different for each stage of applications development.

#### MODEL UNDERLYING THIS RESEARCH

The model underlying this research is shown in Figure 2. The model has four major components: situational factors, enabling factors, profile of computer-supported applications, and impact factors.

Situational factors such as federal reporting requirements, available technology, and service delivery requirements influence the enabling factors supporting information system development and the resulting profile of applications. These factors are generally constant and apply in the same way to all community mental health centers.

Organization of data processing activities, management planning and control techniques, and user involvement are important enabling factors which directly influence the applications developed. It is

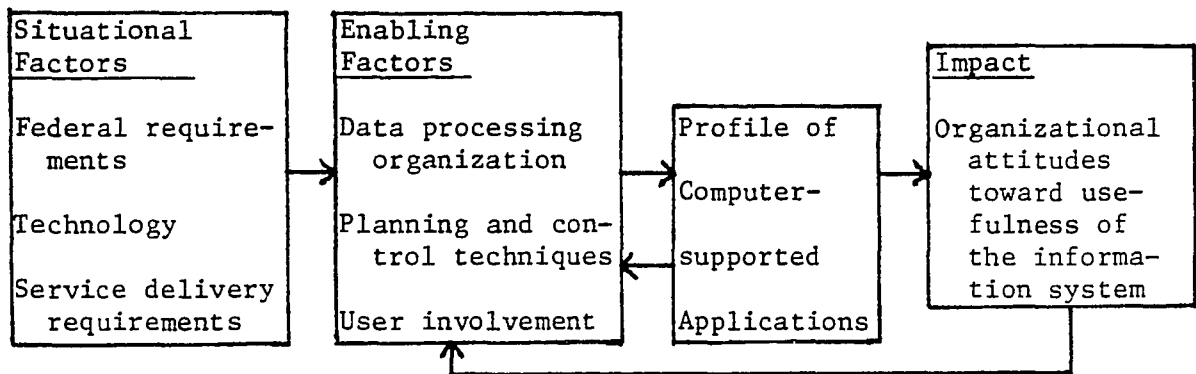


Figure 2. Conceptual model underlying a stage theory formulation of information system growth in community mental health centers.

hypothesized that enabling factors become increasingly formalized as centers progress through each stage of development.

The outcome of the system development process is the profile of computer-supported applications. Each successive stage is characterized by a more comprehensive set of applications.

Organizational attitudes toward the usefulness of the information system are a measure of the impact the system has on the organization. The impact of the information system influences the direction of future system development efforts.

Conceptualizing the relationships in this way is generally supported by Nolan's work. The primary difference between the two models is the treatment of data processing expenditures. In Nolan's model, the inflection points in the data processing expenditure curve, indicating changes in the rate of growth, are used to identify the transition between stages. The model which has been developed to support a stage theory formulation for mental health information systems treats data processing budgets as one aspect of data processing planning and control. This modification reflects the nature of funding available to community mental health centers for information system development efforts. As noted in Chapter I, Introduction, many of these centers do not have the funds available in their annual operating budgets to undertake a major upgrading of their existing systems. Consequently, they often rely on federal funds. Such funds are usually available only on a one-time basis and do not reflect a continuing level of data processing support. In other cases, resources for information system development are provided by state or county departments of mental health

at little or no cost to the centers. Such arrangements encourage or require centers to participate in standardized systems. The result is that data processing expenditures for many centers can not be clearly delineated.

The impact of information systems on the organization is incorporated as an explicit component of the model. This aspect of information system development is not included in Nolan's model. It has been included here because organizational attitudes are important determinants of a psychological climate with respect to system development. This climate influences both the organizational support for, and direction of, future development efforts. The inclusion of this component makes the model representative of the managerial, organizational, and technical dimensions of information system development.

#### DESCRIPTION OF HYPOTHESIZED STAGES

The following three scenarios describe the hypothesized characteristics of mental health information systems at three different stages of development. Each scenario incorporates the characteristics of computer-supported applications, organization of data processing activities, management planning and control techniques, user involvement, and impact. The data collected through this study are compared to the characteristics described in each of these three scenarios to determine whether each scenario accurately represents stages of information system growth in community mental health centers. Only the first three stages of development are described. Review of the

literature and documentation of a number of operational systems indicate that mental health information system development has probably not progressed beyond stage 3.

### Stage 1 Scenario

General Characteristics. The introduction of computer technology into community mental health centers is usually justified by the need to increase the efficiency of processing large numbers of transactions to meet external reporting requirements. Most centers utilize the computer facilities of other organizations such as state mental health departments or service bureaus. Relatively few centers purchase or lease their own computer.

Computer-supported Applications. Initial applications focus on administrative bookkeeping and statistical reports required by external funding sources. Patient census and demographic characteristics, billing, accounting, payroll, staff activity, intake, and direct and indirect services are application areas likely to be automated during stage 1. The pressure to meet mandated reporting requirements creates an environment which discourages the development of clinical applications.

Organization of Data Processing Activities. Staff responsibility for information system development is frequently assigned to the business manager because fiscal applications are among the first to be automated. Program evaluators also assume this responsibility in many centers because evaluation is closely associated with systematic data collection. Data processing activities are carried out informally or are combined with the activities of another organizational unit. Very few centers have in-house programmers.

Management Planning and Control Techniques. Effective management planning and control techniques are rarely initiated. Since external computer facilities are used, management usually lacks control over programming staff and computer costs. The data processing budget is part of a larger budget item or included in the budget of another organization. Minimal documentation is prepared for computer programs or information handling procedures. No organizational responsibility is assigned for establishing long range direction of the information system. System development priorities are set on a first come, first served basis.

User Involvement. The impact of introducing computer technology into the center is underestimated by management. User involvement strategies designed to obtain user inputs during system development are rarely implemented.

Impact. Administrators have the most favorable attitudes toward the system because of the system's capability to generate reports for external funding sources. Other users are less enthusiastic about the usefulness of the system because of initial difficulties in designing responsive information systems.

## Stage 2 Scenario

General Characteristics. Some centers acquire an in-house computer as they develop more computerized applications. Low-priced minicomputers make in-house computers economically justifiable for centers having difficulty developing responsive systems at external facilities.

Computer-supported Applications. Stage 2 is characterized by efforts to encourage more clinical applications. New applications are

likely to be developed for patient diagnostic data, individual treatment plans, medication treatment, follow-up, mental status examination, utilization review, and psychological screening. The expanded data base allows cost-outcome applications to be developed.

Organization of Data Processing Activities. Data processing activities continue to be included in the activities of organizational units such as accounting, administrative services, or program evaluation. Staff responsibility for the information system moves to a higher level in the center. The Director of Administrative Services or the Director of Research and Evaluation frequently assume this responsibility. A few centers begin to acquire in-house programmers so applications more responsive to user needs can be developed.

Management Planning and Control Techniques. Emphasis on management planning and control is still not prevalent. System development costs and computer costs are absorbed through a central budget. Management participates more in setting system development priorities but informal criteria are still used. When new applications are being considered, little planning documentation is prepared.

User Involvement. In stage 2, users are consulted periodically during system development. One person within the center serves as the primary advocate of information system development. This person serves as a liaison between users and technical design staff to ensure user inputs are considered.

Impact. More favorable attitudes toward the usefulness of the system are developed. Clinicians, researchers, and evaluators find the system more useful because additional clinical applications have been

developed. Users occasionally express interest in developing new applications.

### Stage 3 Scenario

General Characteristics. An increase in the number of in-house computers is apparent in stage 3. Direct control over computer resources allows centers to develop systems that meet their specific information requirements.

Computer-supported Applications. New applications are likely to be developed to support inventory systems for property, special symptom or problem scales, goal achievement monitoring, clinical progress notes, development and social history, and computerized predictions. Several of these applications reflect increased use of behavioral checklist instruments.

Organization of Data Processing Activities. Separate data processing units are established and assume more status within the center. The head of the unit reports directly to the administrator. More programmers are hired and are specialized in different areas of application programming. Activities related to data entry and computer operations are performed in-house. Professional staff are more involved in routine data processing activities as applications having an impact on clinical care are developed.

Management Planning and Control Techniques. Increased emphasis on planning and control occurs during stage 3 as management sees the need to improve the efficiency and effectiveness of data processing activities. This is made evident by the initiation of formal project management and charge-out for computer services used. The data

processing budget is well-defined and includes specific breakdowns for data processing personnel, computer costs, and system development costs. System and programming documentation is required for each application. A high level information system steering committee is established to develop a long range information system plan and to set priorities for new applications.

User Involvement. Users assume more responsibility during system development and participate as members of the design team. Formal training sessions are conducted to familiarize users with new forms, procedures and reports. Demonstration projects are carried out to obtain user feedback prior to full system implementation. Formal procedures exist which allow users to suggest modifications to make the system more responsive to their needs.

Impact. Users in this stage have more favorable attitudes and express more interest in developing new applications than users in earlier stages. The system has a more positive impact because applications are tailored to meet user needs and the operation of the system has become an integral part of the center's operations.

These scenarios and their interrelationships are reflected in Table I.

## STUDY DESIGN

### Definition of Population

This study is based upon a review of information system development in community mental health centers receiving federal support under the Community Mental Health Centers Act of 1963 through the

TABLE I  
CHARACTERISTICS OF MENTAL HEALTH INFORMATION SYSTEMS  
AT THREE STAGES OF DEVELOPMENT

	Stage 1 Characteristics	Stage 2 Characteristics	Stage 3 Characteristics
General Characteristics	Use computer facilities of other organizations	Centers begin to acquire an in-house computer	Numbers of in-house computers increases
Computer-supported Applications	Patient census and demographic characteristics Billing Accounting Payroll Staff activity Intake Direct services Indirect services	Cost outcome data Individual treatment plan Diagnostic data Medication treatment Follow-up Mental status examination Utilization review Psychological screening	Inventory system for property Special symptom or problem scales Goal achievement monitoring Clinical progress notes Development and social history Computerized predictions
Organization of Data Processing Activities	Staff responsibility for system assigned to business manager or program evaluator Data processing activities carried out informally or combined with activities of another organizational unit Very few centers have in-house technical staff	Staff responsibility for system moves to higher level in the center Data processing activities continue to be included in the activities of other organizational units A few centers acquire in-house programmers	Separate data processing units are established The head of the unit reports directly to the administrator More programmers are hired and specialized in different application areas Professional staff are more routinely involved in data processing activities

TABLE I (continued)

	Stage 1 Characteristics	Stage 2 Characteristics	Stage 3 Characteristics
Management Planning and Control Techniques	<p>Planning and control techniques rarely initiated</p> <p>No specific data processing budget exists</p> <p>Minimal system documentation is prepared</p> <p>System development priorities set on a first come, first served basis</p>	<p>Emphasis on planning and control techniques still not prevalent</p> <p>General data processing budget exists</p> <p>Little system or planning documentation is prepared</p> <p>Management sets system development priorities using informal criteria</p>	<p>Formal project management and charge-out for computer services are used</p> <p>Data processing budget is well-defined</p> <p>System and planning documentation is required</p> <p>Information system steering committee is established</p>
User Involvement	<p>Very few opportunities are provided for user input and feedback</p>	<p>Users consulted periodically during system development</p> <p>One person serves as advocate for system development</p>	<p>Users actively involved during system development</p> <p>More opportunities exist for user input and feedback</p>
Impact	<p>Staff feel the automated system is somewhat useful</p>	<p>More favorable attitudes about the usefulness of the system are developed</p> <p>Users occasionally express interest in developing new applications</p>	<p>An increased number of staff feel the system is useful and express more interest in developing new applications</p>

National Institute of Mental Health. During 1979 NIMH funded 637 centers in all 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands.

#### Data to be Collected

The model shown in Figure 2 (see page 23 ) established the framework around which data collection was organized. The data items contained in the survey instruments were designed to provide insights into the enabling factors, profiles of computer-supported applications, and impact of mental health information systems. The attributes which define each of these components in a mental health setting were derived from a review of the literature and discussions with mental health professionals. The data for this study were collected through a two-phase survey.

#### Limitations of Study Design

The data collected during this study do not provide comparative historical data which would adequately test the causal relationships implied by the model. The data reflect only the characteristics of centers at the time of the survey. The chronological sequence of how these characteristics have changed over time is not documented. This study addresses only the first two requirements of a stage theory formulation as defined by Kuznets (1965) (see Chapter II, Review of the Literature). These are:

1. Each stage must display empirically testable characteristics; and
2. The characteristics of each stage must be distinct.

While observations can be made about the analytical relationship of a

given stage to the preceding and succeeding stages, the data collected are not sufficient to derive these relationships empirically.

The study findings can not be generalized to smaller, single-service delivery, or privately funded programs. Certain characteristics of community mental health centers are not representative of mental health programs in general. The centers are mandated to provide twelve types of services and to dedicate a portion of their budget to program evaluation and information collection activities. Consequently, they are more comprehensive in scope and more likely to be supporting ongoing information system activities. The study results are probably applicable to the large, more sophisticated mental health programs which are not designated as comprehensive mental health programs.

#### Preliminary Survey

The purpose of the preliminary survey was to determine the extent to which manual or automated systems were being developed and the type of computer facility used. The preliminary questionnaire was composed of nine items; five of these items were applicable only to centers using computer-supported information systems. The questionnaire is included as Appendix A.

The questionnaire was pre-tested at five mental health sites. Minor modifications identified by the pre-test were incorporated into the final survey instrument. Centers participating in the pre-test were not included in the universe for the survey.

Questionnaires were mailed to 633 community mental health centers receiving federal support at the time the survey was conducted (1979).

Three weeks after the questionnaires were mailed, a follow-up letter was sent to those centers which had not yet responded.

In view of the large number of centers (fifty-one per cent) which did not respond, a random sample of non-respondents was selected. The purpose of the non-response survey was to determine whether the preliminary survey provided a true representation of the number of centers using computer-supported information systems. Thirty centers, representing ten per cent of the non-response population, were included in the non-response survey. These centers were contacted by telephone to ascertain whether manual or automated information systems were being used and to obtain estimates of the centers' size.

#### Second-phase Survey

The second-phase survey was designed to explore issues specifically related to computer-supported information systems. The detailed questionnaire addressed four topics: (1) the types of computer-supported applications being developed; (2) organization of information system activities; (3) planning and control techniques; and (4) user involvement. This questionnaire is included as Appendix B.

NIMH staff and other mental health professionals knowledgeable in information systems were asked to review this questionnaire. It was then pre-tested at five mental health sites and modified using the feedback received. Again, the centers participating in the pre-test were not included in the survey.

The questionnaire was distributed to a random sample of centers using computer-supported information systems. The sample was stratified

using the number of full-time staff employed by the center (see Table II on page 37). A stratified random sample was used to guarantee the data represented centers of all sizes. The centers responding to the preliminary survey were clustered on the variable representing staff size using a K-Means clustering algorithm. Seven centers were excluded from the second survey because they did not report the number of full-time staff employed by the center. Four useful strata were obtained from the cluster analysis. Independent random samples were drawn from each of the four strata.

The number of centers in each stratum and associated sample sizes are presented in Table II. An approximate sample size needed to estimate center attributes was computed using the formula (Mendenhall, Ott and Scheaffer, 1971):

$$n = \frac{Npq}{(N - 1) D + pq}$$

where,

n = Sample size

N = Population size

p = proportion of the population with a given attribute

q = 1-p

D =  $B^2/4$

B = bound on the error of estimation.

Since a variety of attributes are measured, with no prior information available about their distribution, p = .5 was used so a conservative sample size would be obtained. A bound on the error of estimation was specified as .10. Thus,

TABLE II  
STRATA SIZE AND SAMPLE SIZE USED  
FOR SECOND SURVEY

<u>Stratum</u>	<u>Number of Full- time Staff</u>	<u>Number of Centers in Each Stratum</u>	<u>Number of Centers in Sample Size</u>
1	5 - 70	97	20
2	71 - 140	93	20
3	142 - 284	35	20
4	311 - 700	<u>9</u>	<u>9</u>
TOTAL		234	69

$$n = \frac{(234) (.5) (.5)}{(233) (.0025) + (.5) (.5)} = 70.$$

Using this figure as a guide, twenty centers in the first three strata, representing at least twenty percent of the stratum size, and all centers in stratum 4 were selected as the basis of the sample.

A follow-up letter was mailed one week after the questionnaire mailing date. A second follow-up letter was sent to centers which had not yet responded five weeks after the original mailing. A second copy of the questionnaire was enclosed with the follow-up letter.

#### SUMMARY

This chapter presented an overview of the research methods used in conducting the study. A model was formulated based on Nolan's earlier work on stage theory formulations. The components of this model were used to develop three stage theory scenarios describing the hypothesized characteristics of mental health information systems at different stages of development. A two-phase survey design was then developed to obtain data about the aspects of information system growth under study.

## CHAPTER IV

### ANALYSIS OF FINDINGS

In Chapter IV, responses to the preliminary survey and the two research questions addressed by the study are analyzed. The questions are:

- Can distinct stages of information system growth be characterized by common profiles of computerized applications?
- Are there characteristic groups of enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) consistent among community mental health centers at any given stage of growth?

The chapter is divided into three main sections for discussion. These are: (1) analysis of preliminary survey, (2) analysis of computer-supported applications, and (3) analysis of factors underlying information system growth.

### ANALYSIS OF PRELIMINARY SURVEY

Responses to the preliminary survey were received from 307 centers representing forty-nine per cent of the questionnaires mailed. All of these responses were usable for this study. The Honeywell 60/27 computer at Portland State University was used to aid in the statistical analysis of the research data. Frequency scores and cross-tabulations were computed. These statistics were provided by a resident frequency

analysis program, TALLY, and the SPSS<sup>1</sup> X-TABS program.

### Sampling Error

The estimates of population attributes obtained through this study are subject to error due to sampling. A measure of the magnitude of this error can be derived through a worst case example. The maximum value of the standard error occurs when the proportion of the population conforming and not conforming to an attribute are equal; that is, when  $p = .5$ . The formula for computing the standard error of an estimated proportion is (Mendenhall, Ott, and Scheaffer, 1971):

$$S_p = \left[ \frac{pq}{n-1} (1-n/N) \right]^{1/2}$$

where,

$s$  = standard error of an estimated proportion

$N$  = population size

$n$  = sample size

$p$  = proportion of the population conforming to the attribute

$q = 1 - p$ .

The maximum standard error an an estimated proportion in the preliminary survey is:

$$S_p = \left[ \frac{(.5)(.5)}{307} (1-307/633) \right]^{1/2} = .02$$

At the ninety-five per cent confidence level, one can reasonably expect that the range defined by a given point estimate  $\pm .04$  will include the true population proportion.

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<sup>1</sup> SPSS (Statistical Package for the Social Sciences) is a set of computer programs designed to provide statistical procedures and data management facilities tailored to the needs of empirical social researchers; see Nie et al, 1975.

### General Characteristics of the Population Under Study

Table III summarizes the number of centers with computer-supported or manual information systems and the size of the centers responding to the preliminary survey. Responses show that:

- Seventy-nine per cent of the centers responding are using computer-supported information systems; the remaining twenty-one per cent use completely manual systems.
- Of the sixty-six centers with manual information systems, thirty-five are planning to automate within one year (this represents eleven per cent of the responses).
- As the size of the center increases, a greater proportion of centers is likely to use computer-supported information systems.

These findings indicate increased use of computers in community mental health centers. A survey cited earlier (Johnson, Giannetti, and Nelson, 1976) showed that only one-fourth of the community mental health centers were using computer support in 1974. However, the same survey also reported that more than one-half of the centers were systematically collecting a structured data set. Since structured data are a prerequisite for automation, the transition to automated systems is following a predictable pattern.

The characteristics of centers with computer-supported information systems are summarized in Table IV. Of particular interest are the type of computer facility and system development options used. Thirty-two per cent of the centers own or lease an in-house computer. No comparative historical data are available to determine whether an increased number of centers are now acquiring their own computers instead of relying on

TABLE III

CHARACTERISTICS OF CENTERS RESPONDING  
TO PRELIMINARY SURVEY

Computer-supported vs. Manual Information Systems

	<u>Number of Centers</u>	<u>Per Cent</u>
Centers with computer-supported systems	241	79
Centers with completely manual systems	66	21
Centers planning to automate manual systems within one year	35	11*

Size of Centers Responding

Number of full-time staff

	<u>Number of Centers</u>	<u>Per Cent</u>	<u>Computer- supported Information Systems</u>	<u>Manual Informa- tion Systems</u>
5-70	138	45	97	42
71-140	113	37	93	20
141-284	37	12	35	2
285-700	9	3	9	0
No response	10	3	0	0

Total annual expenditures

	<u>Number of Centers</u>	<u>Per Cent</u>
Less than \$1,000,000	75	24
\$1,000,001 - \$1,500,000	67	22
\$1,500,001 - \$2,000,000	51	17
\$2,000,001 - \$3,000,000	53	17
Greater than \$3,000,001	47	15
No response	14	5

\* Per cent of total sample.

TABLE IV  
CHARACTERISTICS OF CENTERS USING COMPUTER-  
SUPPORTED INFORMATION SYSTEMS

Type of Computer Facilities Used	<u>Number of Centers</u>	<u>Per Cent</u>
Own/lease in-house computer	77	32
Computer owned by another organization	170	71
Other arrangements:		
Computer owned by multiple Centers	1	0
Information System Development Options*		
Purchased a packaged system from another organization	66	27
Participate in a state-wide system	97	40
Developed the system in-house	133	55
Developed the system under contract with an external organization	75	31
Other:		
Modified a system purchased from another organization; modified/adopted a hospital or county system	18	7
Number of Years a Computer Has Been Used		
1 year	48	20
2 years	46	19
3-4 years	58	24
5-6 years	47	20
7 or more years	35	15
No response	7	3
Size of Data Processing Budget		
\$1,000-10,000	54	22
\$10,001-20,000	36	15
\$20,001-40,000	46	19
\$40,001-100,000	31	13
\$100,001 or more	8	3
No response	66**	27

TABLE IV (continued)

	<u>Number of Centers</u>	<u>Per Cent</u>
Use of Timesharing Terminals		
Do not use timesharing terminals	176	73
Use timesharing terminals	64	27
No response	1	0
Number of terminals used:		
1 terminal	29	12
2 terminals	15	6
3-5 terminals	14	6
6 or more terminals	5	2
No response	1	0

\* Some centers have used more than one system development option.

\*\*The data processing budget of some centers is included in the budget of another organization.

facilities owned by another organization.

Respondents also indicated that developing the information system in-house is the most widely used option. This finding is somewhat questionable because other questionnaire items indicate very few centers have in-house staff such as programmers, with the technical expertise to carry out detailed system design activities. It is possible some of these respondents are referring to participation of in-house staff in planning desired system capabilities and design of forms, reports, and procedures instead of design tasks such as programming.

#### Non-response Survey

Twenty-seven of the thirty centers selected for the non-response survey were contacted. Data concerning center size and computer usage are presented in Table V. The data show that similar distributions of responses were obtained for both respondents and non-respondents. Of primary importance is the fact that the number of centers responding to the preliminary survey is not biased in favor of computer-supported information systems.

### ANALYSIS OF COMPUTER-SUPPORTED APPLICATIONS

The analysis discussed in this section addresses the first question under study: Can distinct stages of information system growth be characterized by common profiles of computer-supported applications? The analysis is based on data obtained from fifty-three centers. These centers represent seventy-seven per cent of the centers included in the second survey. Table VI shows the number and percentage of respondents by stratum.

TABLE V  
CHARACTERISTICS OF CENTERS IN NON-RESPONSE SURVEY

	<u>Number of Centers</u>	<u>Per Cent</u>
Computer-supported vs. Manual Information Systems		
Centers with computer-supported systems	23	85
Centers with completely manual systems	4	15
Type of Computer Facility Used		
Own/lease in-house computer	5	22
Computer owned by another organization	18	78
Number of Full Time Staff		
1-70	11	41
71-140	7	26
141-284	1	4
285-700	2	7
No response	6	22

TABLE VI  
NUMBER OF CENTERS RESPONDING  
TO SECOND SURVEY

<u>Stratum</u>	<u>Number of Centers in Each Stratum</u>	<u>Number of Centers Responding</u>	<u>Response Rate (per cent)</u>
1	97	18	19
2	93	13	14
3	35	16	46
4	9	6	67

The second-phase survey contained a list of twenty-three applications appropriate to mental health settings. Eight of these are classified as administrative applications (those dealing with patient statistics and administrative functions such as accounting) and fifteen as clinical applications (those dealing with clinical decision making and monitoring of individual care). A list of these applications is contained in Appendix B as Part I of the questionnaire. Respondents were asked to indicate the current status of each application area using a five-point scale, coded as follows:

- 1 - Computer support operational
- 2 - Computer support in development
- 3 - Detailed plans in progress
- 4 - Long-term planning only
- 5 - No specific plans for computer support.

Appendix C shows the frequency distribution of each coded value for the twenty-three applications. Respondents were asked to specify other administrative or clinical applications but no significant number of responses were obtained for any application not already included on the questionnaire.

#### Sampling Error

A measure of the magnitude of sampling error in the second survey can be derived through a worst case example. As shown in Table VI, stratum 2 has the lowest response rate. Since this stratum is subject to the greatest sampling error, it will be used to calculate the amount of this error. The proportion of the population conforming to an attribute (p) is assigned a value of .5. Using the formula shown on page 40, the

maximum standard error for an estimated proportion is:

$$S_p = \left[ \frac{(.5)(.5)}{12} (1-13/93) \right]^{1/2} = .13.$$

At the ninety-five per cent confidence level, one can reasonably expect that the range defined by a given point estimate  $\pm .26$  will include the true population proportion.

### Validation of Hypothesized Application Profiles

It was hypothesized that mental health information systems can be characterized by three distinct stages of development. The applications associated with each of the three stages are presented below:

#### Stage 1 Applications

- Application 1 - Patient census/demographic characteristics
- Application 2 - Third-party billing
- Application 3 - Direct patient billing
- Application 4 - Financial/accounting
- Application 5 - Payroll
- Application 7 - Staff activity data
- Application 9 - Intake data
- Application 11 - Direct service data
- Application 13 - Indirect service data

#### Stage 2 Applications

- Application 8 - Cost outcome data
- Application 10 - Individual treatment plan
- Application 12 - Diagnostic data
- Application 14 - Medication treatment data
- Application 15 - Follow-up data
- Application 16 - Mental status examination
- Application 17 - Utilization review
- Application 22 - Psychological screening

#### Stage 3 Applications

- Application 6 - Inventory system for property
- Application 18 - Special symptom or problem scales
- Application 19 - Goal achievement data
- Application 20 - Clinical progress notes
- Application 21 - Development and social history
- Application 23 - Computerized predictions

Two criteria were selected for defining membership in a given stage of applications development: (1) a center must have computer support operational or under development for at least sixty per cent of the applications defined above for the specified stage; and (2) computer support must be operational or under development for at least sixty per cent of the applications defined for all preceding stages of development. The second criteria reflects the evolutionary structure of the hypothesized model. It is assumed that a center will progress sequentially through stage 1 to stage 2 and then to stage 3.

Because this study represents exploratory analysis in an area of mental health information systems where no research has been done, a sixty per cent level of acceptance was chosen to permit as full an investigation as possible of applications with computer support operational or under development. This level is also considered to be high enough to include a sufficient number of applications in each stage for identifying common patterns among centers.

The data contained in the first two columns of Appendix C were analyzed to determine how many of the applications in each of the three stages were currently computerized or under development. These results are presented in Table VII. Forty-three centers, representing eighty-one per cent of the sample, meet the criteria for classification in stage 1. Six of the forty-three centers also meet the criteria for stage 2 of development. One of the six centers classified in stage 2 meets the criteria for inclusion in stage 3. Thus, thirty-seven centers are classified in stage 1, five centers in stage 2, and one center in stage 3. Ten centers do not meet the criteria for classification in any stage.

TABLE VII

SUMMARY OF APPLICATIONS WITH COMPUTER SUPPORT  
OPERATIONAL OR UNDER DEVELOPMENT

Number of Stage 1 Applications  
with Computer Support Operational  
or Under Development

Number of Centers

9 applications	-- -- 11 -- --	43 centers have computer support operational or under development for at least 60% of the stage 1 applications
8 applications	9	
7 applications	12	
6 applications	-- -- 11 -- --	
5 applications	5	
4 applications	5	
3 applications	0	
2 applications	0	
1 application	0	
0 applications	0	

Number of Stage 2 Applications  
with Computer Support Operational  
or Under Development

Number of Centers

8 applications	-- -- 0 -- --	6 centers have computer support operational or under development for at least 60% of the stage 2 applications
7 applications	1	
6 applications	1	
5 applications	-- -- 4 -- --	
4 applications	5	
3 applications	6	
2 applications	7	
1 application	20	
0 applications	9	

Number of Stage 3 Applications  
with Computer Support Operational  
or Under Development

Number of Centers

6 applications	-- -- 0 -- --	1 center has com- puter support operational or under development for at least 60% of the stage 3 applications
5 applications	0	
4 applications	-- -- 1 -- --	
3 applications	3	
2 applications	4	
1 application	23	
0 applications	22	

To determine whether the hypothesized classification scheme best represents the data, the frequency of responses was computed for all fifty-three centers in the sample. This frequency is based on the number of centers which indicated that computer support for each application was either operational or under development. The frequency tabulations are presented in Table VIII. Each of the applications in stage 1 has a high response rate. Application 12 in stage 2 appears to belong more appropriately with the stage 1 applications. Its frequency of response is significantly higher than the other applications in stage 2 and is closer to the range of response rates represented by the stage 1 applications. Applications 10, 16, and 22 in stage 2 fit better with the response rates of the stage 3 applications. Likewise, applications 6 and 18 are better classified as stage 2 applications rather than stage 3 applications. The modified grouping of applications by stage is shown below:

#### Stage 1 Applications

- Application 1 - Patient census/demographic characteristics
- Application 2 - Third-party billing
- Application 3 - Direct patient billing
- Application 4 - Financial/accounting
- Application 5 - Payroll
- Application 7 - Staff activity data
- Application 9 - Intake data
- Application 11 - Direct service data
- \* Application 12 - Diagnostic data
- Application 13 - Indirect service data

#### Stage 2 Applications

- \* Application 6 - Inventory system for property
- Application 8 - Cost outcome data
- Application 14 - Medication treatment data
- Application 15 - Follow-up data
- Application 17 - Utilization review
- \* Application 18 - Special symptom or problem scales

TABLE VIII  
RESPONSE FREQUENCY OF APPLICATIONS WITH COMPUTER  
SUPPORT OPERATIONAL OR UNDER DEVELOPMENT

	<u>Percentage of Centers with Computer Support Operational or Under Development</u>
Stage 1 Applications	
Application 1 - Patient census and demographic characteristics	94
Application 2 - Third-party billing	70
Application 3 - Direct patient billing	68
Application 4 - Financial/accounting	68
Application 5 - Payroll	75
Application 7 - Staff activity data	85
Application 9 - Intake data	70
Application 11- Direct service data	82
Application 13- Indirect service data	68
Stage 2 Applications	
Application 8 - Cost outcome data	26
Application 10- Individual treatment plan	12
Application 12- Diagnostic data	57
Application 14- Medication treatment data	29
Application 15- Follow-up data	20
Application 16- Mental status examination	12
Application 17- Utilization review	32
Application 22- Psychological screening	11
Stage 3 Applications	
Application 6 - Inventory system for property	34
Application 18- Special symptom or problem scales	22
Application 19- Goal achievement data	16
Application 20- Clinical progress notes	6
Application 21- Development and social history	6
Application 23- Computerized predictions	4

### Stage 3 Applications

- \* Application 10 - Individual treatment plan
- \* Application 16 - Mental status examination
- Application 19 - Goal achievement data
- Application 20 - Clinical progress notes
- Application 21 - Development and social history
- \* Application 22 - Psychological screening
- Application 23 - Computerized predictions

The applications marked by an asterisk indicate those which were reclassified.

Using the modified classification scheme, thirty-nine centers (seventy-four per cent of the sample) are included in stage 1 of development, eight centers (fifteen per cent of the sample) in stage 2, and no centers in stage 3. The number of centers in stage 1 increased by two and the number in stage 2 increased by three. The one center which was previously classified in stage 3 did not meet the modified criteria. Six centers did not meet the criteria for classification in any stage.

The modified classification scheme was adopted and will be used as the basis for further analysis. It will be referred to as the Application Profile Model throughout the remainder of the study. This model is more representative of the state of the art of computerized applications in community mental health centers and it accounts for a greater percentage of the sample population. However, given the small response rate of some of these application areas, particularly in stage 3, the classification scheme will need to be refined further as an increased number of centers develop a more comprehensive set of applications.

### Cluster Analysis

While the Application Profile Model does highlight the

distinctions among application profiles at two levels of development, it provides no insight into differences that might exist among the thirty-nine centers grouped together in stage 1. Further analysis is needed to determine how homogeneous the centers in stage 1 are. Cluster analysis was used to determine whether the community mental health centers under study could be ordered into meaningful groups based on similarities among their application profiles. The alternative perspective provided by the cluster analysis will also help determine whether the proposed classification scheme provides the best interpretation of the data.

The application profiles of the fifty-three centers in the sample were analyzed using a K-MEANS clustering algorithm. Applications with a low response frequency were eliminated to focus the clustering on those most commonly used. These were all clinical applications with twenty per cent or fewer of the responding centers indicating computer support was operational or under development. The fifteen applications used in the cluster analysis include:

1. Patient census/demographic characteristics
2. Third-party billing
3. Direct patient billing
4. Financial/accounting
5. Payroll
6. Inventory system for property
7. Staff activity data
8. Cost outcome data
9. Intake data
10. Direct service data
11. Diagnostic data
12. Indirect service data
13. Medication treatment data
14. Utilization review
15. Special symptom or problem scales

### Selection of Clusters for Further Analysis

A K-MEANS program was set up to partition the data set into an increasing number of clusters. A maximum of six clusters was formed. Each set of cluster groupings was analyzed to determine which could be most meaningfully interpreted.

A useful statistic computed by the K-MEANS program is the average distance of elements in the cluster to the cluster center. This statistic measures how tightly each of the clusters are formed. The average distances for each cluster in a grouping were averaged to derive a measure of how well the entire data set was being clustered. These data are contained in Table IX. The change in the grand mean does not become progressively smaller, indicating the tightness of the clusters does not improve significantly as the number of clusters increases. The data groupings consisting of two, three, and four clusters were therefore selected for further analysis.

### Relationships Between Clusters

To gain insight into how the different clusters were formed, the movement of centers between clusters was analyzed. Two aspects are important:

- Are there sub-clusters of centers that are always grouped together regardless of whether two, three, or four clusters are formed?
- If so, how do these sub-clusters recombine as the number of clusters increases from two to four?

The identification of sub-clusters was accomplished by a visual cross comparison of centers contained in each of the three data

TABLE IX  
AVERAGE DISTANCE OF CLUSTER ELEMENTS  
TO CLUSTER CENTER

<u>Number of Clusters</u>	<u>Average Distance of Cluster Elements to Cluster Center</u>	<u>Grand Mean</u>	<u>Change in Grand Mean</u>
1	5.5	5.5	
2	4.8 5.4	5.1	.4
3	4.3 5.0 4.9	4.7	.4
4	4.1 4.5 4.4 4.9	4.5	.2
5	3.9 3.5 4.5 4.4 5.0	4.3	.2
6	3.9 3.3 3.9 5.0 5.0 3.7	4.1	.2

groupings. Eight sub-clusters were identified. The centers in each of these sub-clusters were always grouped together regardless of whether two, three, or four clusters were formed.

Figure 3 shows how these sub-clusters combine to form clusters in each of the three data groupings. There is no strongly defined relationship between the arrangement of sub-clusters as they recombine. For example, no two sub-clusters remain grouped together in the same cluster in all three groupings. In addition, the data grouping consisting of four clusters does not show a direct relationship to the pattern exhibited by the two-cluster grouping. The most definite pattern exists between the groupings of two and three clusters. Three couplings, each consisting of two sub-clusters, occur in both data groupings.

#### Variability Among Cluster Responses

Since these findings do not provide adequate insight to interpret the data meaningfully, the median values of the development status for each application were plotted by sub-cluster. The categories of development status range from computer support operational to no specific plans for computer support. The profiles obtained for each of the three data groupings are shown in Figures 4 through 6. (The profile for cluster 4.2 is not shown because this cluster contains only one sub-cluster.) These profiles show the extent to which the majority of centers in each sub-cluster have developed computer-supported applications similar to those of other sub-clusters within that cluster. The range of standard deviations among responses within each cluster is shown in Table X.

The data grouping comprised of two clusters shows little

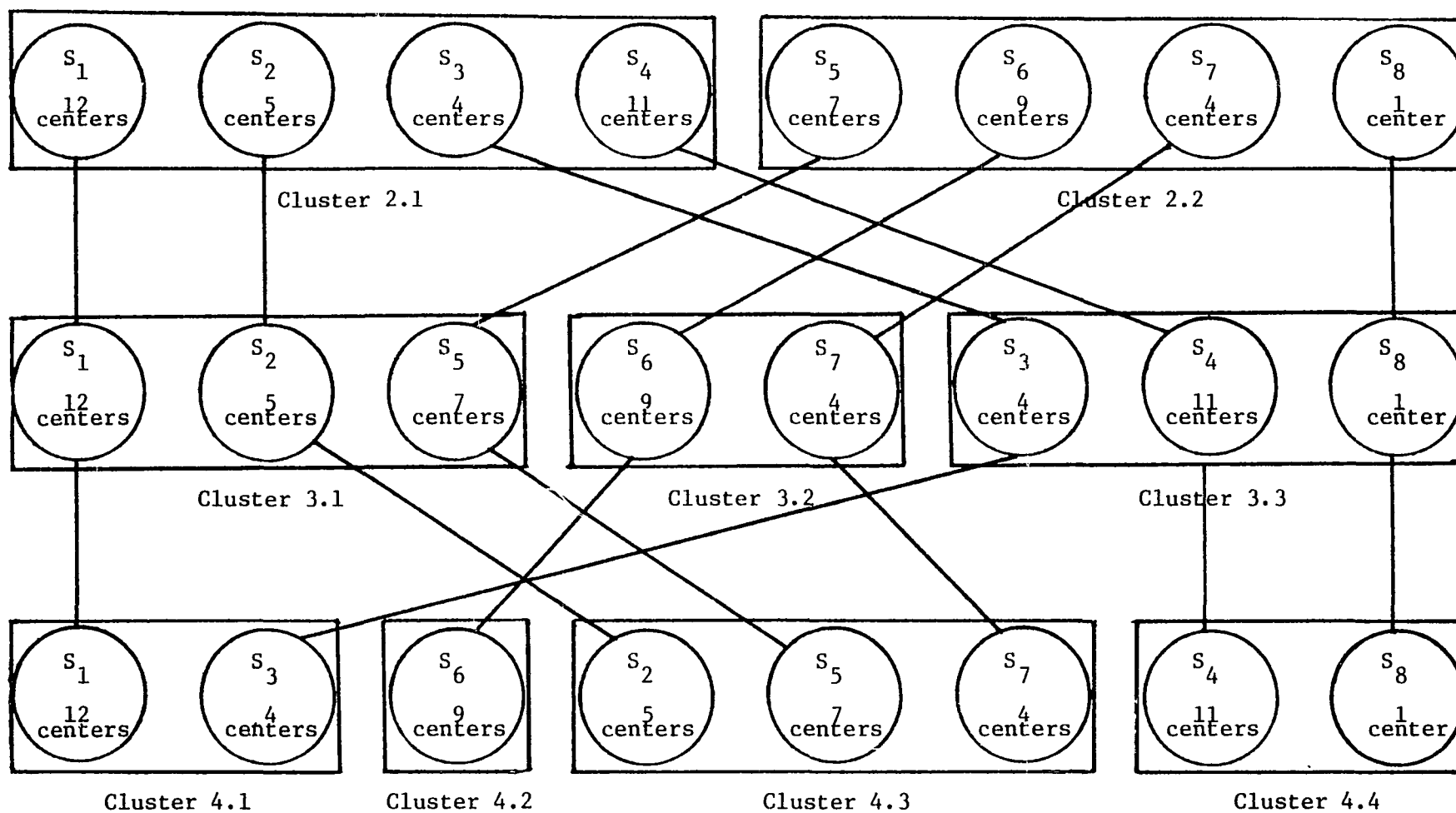
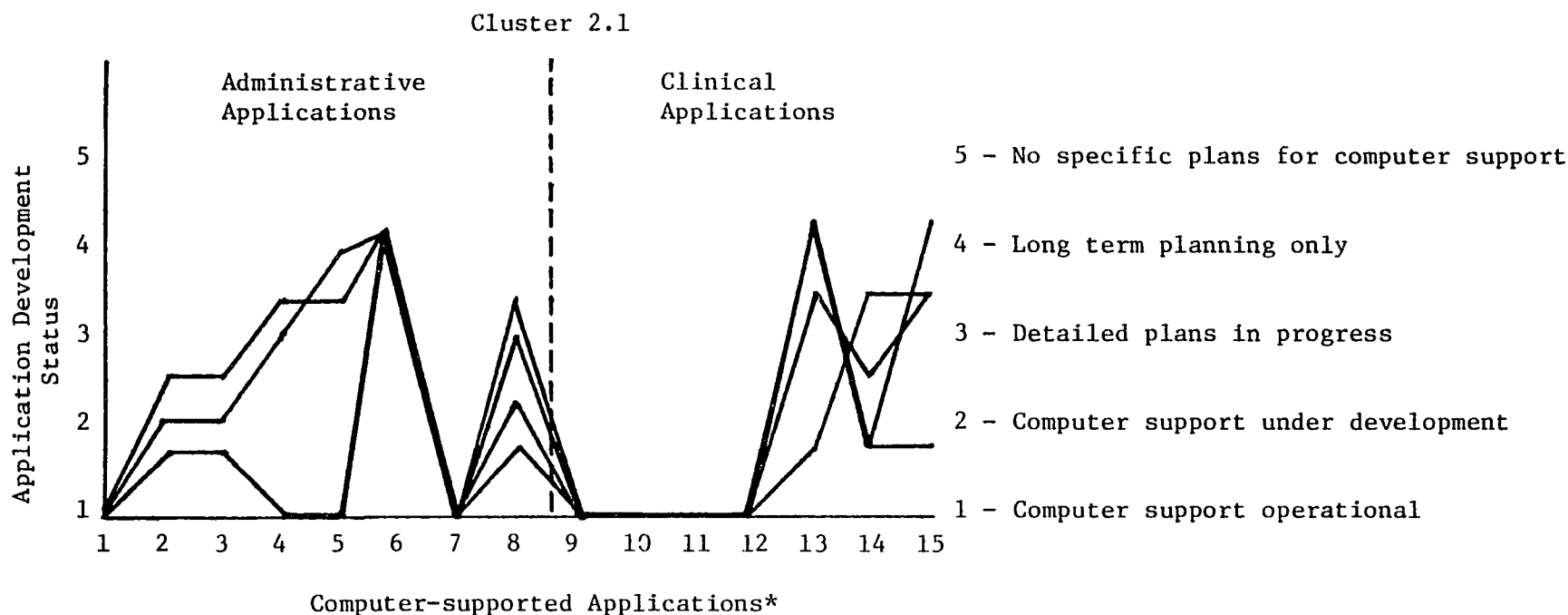


Figure 3. Combinations of sub-clusters forming clusters within the three data groupings.

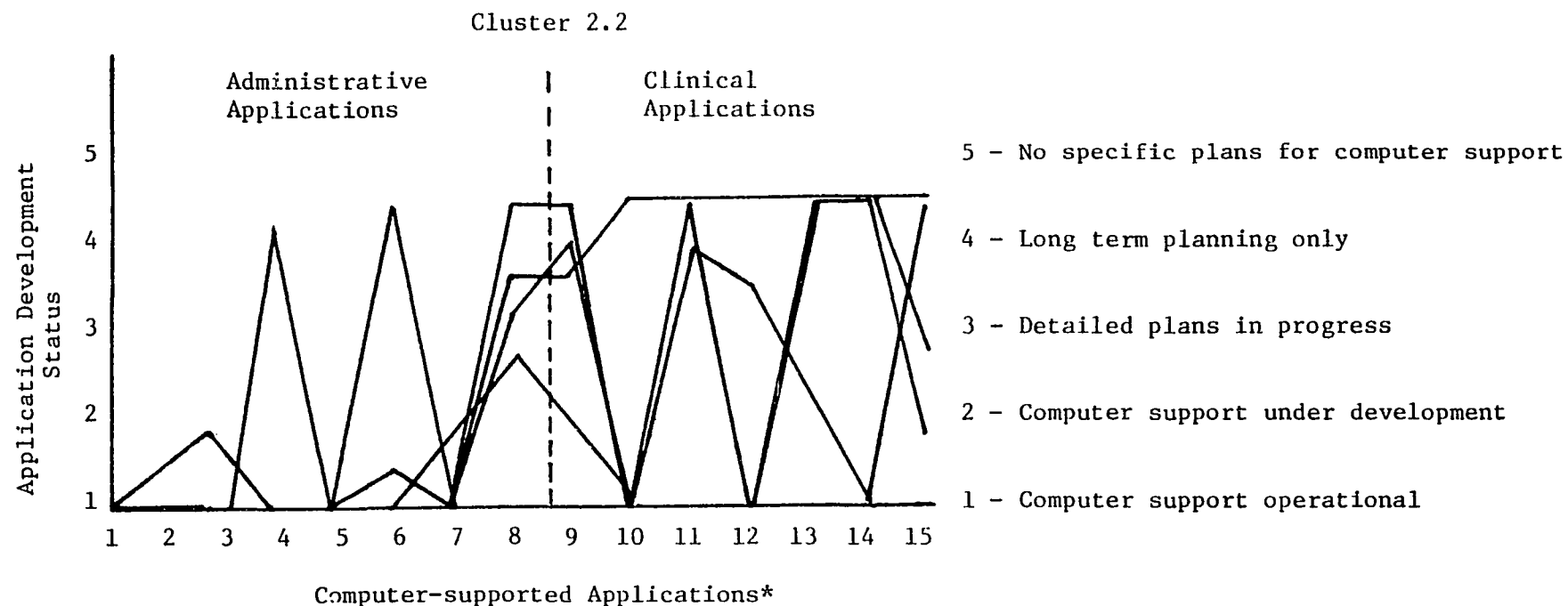


In cluster 2.1, the majority of centers in each sub-cluster have computer support operational for six application areas (patient census, staff activity, intake, individual treatment plan, and direct and indirect services). The development status of the other applications varies widely between computer support operational and no specific plans for computer support.

\* Definitions for these applications can be found on page 55 of the text.

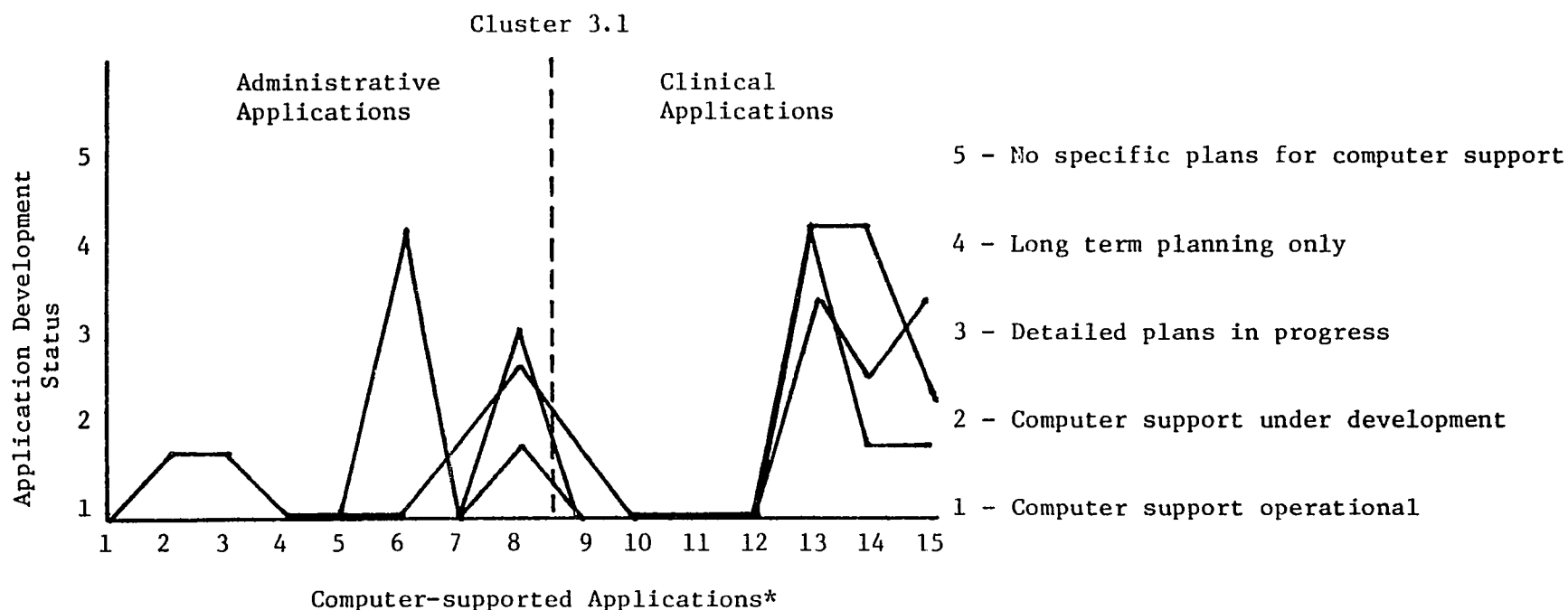
Figure 4. Median values of application development status for two-cluster data grouping.

Figure 4. (continued)



Each sub-cluster in cluster 2.2 shows a different profile of application development status. The only similarity occurs for the applications pertaining to patient census, payroll, and staff activity. The majority of centers in each sub-cluster have computer support operational for these three applications. The development status of the other application areas ranges from computer support operational to no plans for computer support.

\* Definitions for these applications can be found on page 55 of the text.

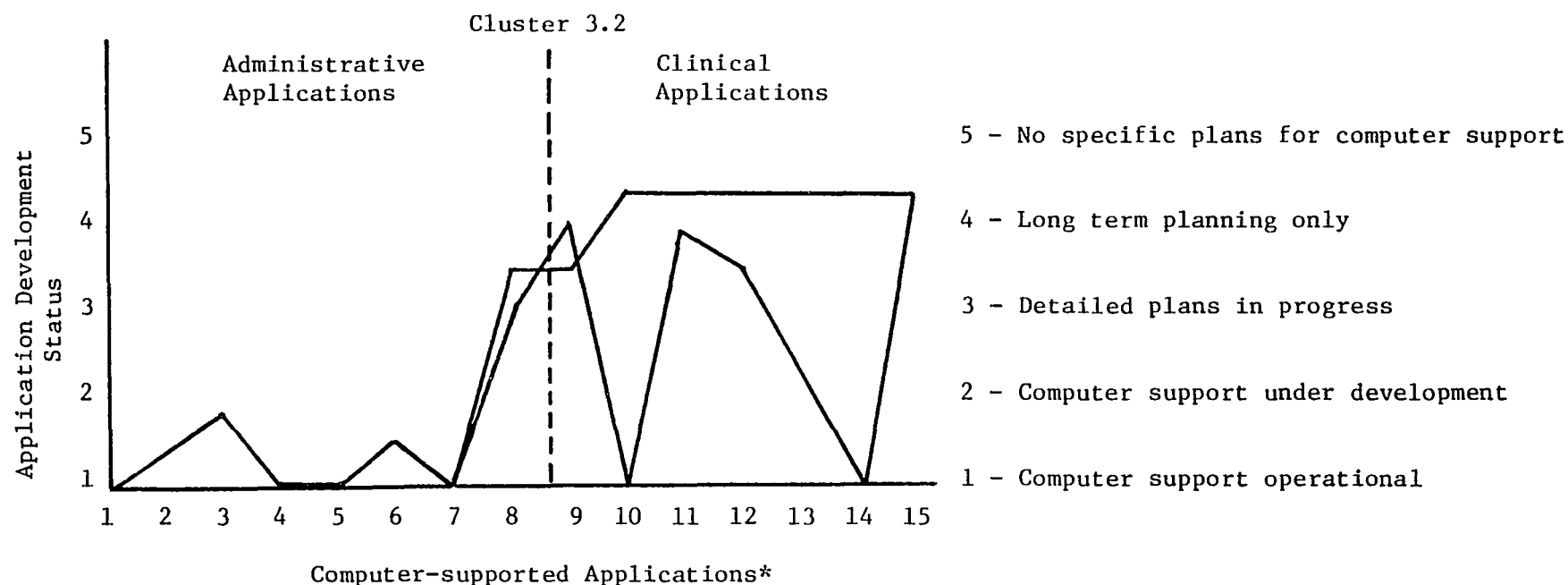


The majority of centers in each of the cluster 3.1 sub-clusters have computer support operational for six application areas (patient census, accounting, payroll, individual treatment plan, and direct and indirect services). Overall, the range of application development status values is quite small. This means that centers in this cluster have applications in about the same development status.

\* Definitions for these applications can be found on page 55 of the text.

Figure 5. Median values of application development status for three-cluster data grouping.

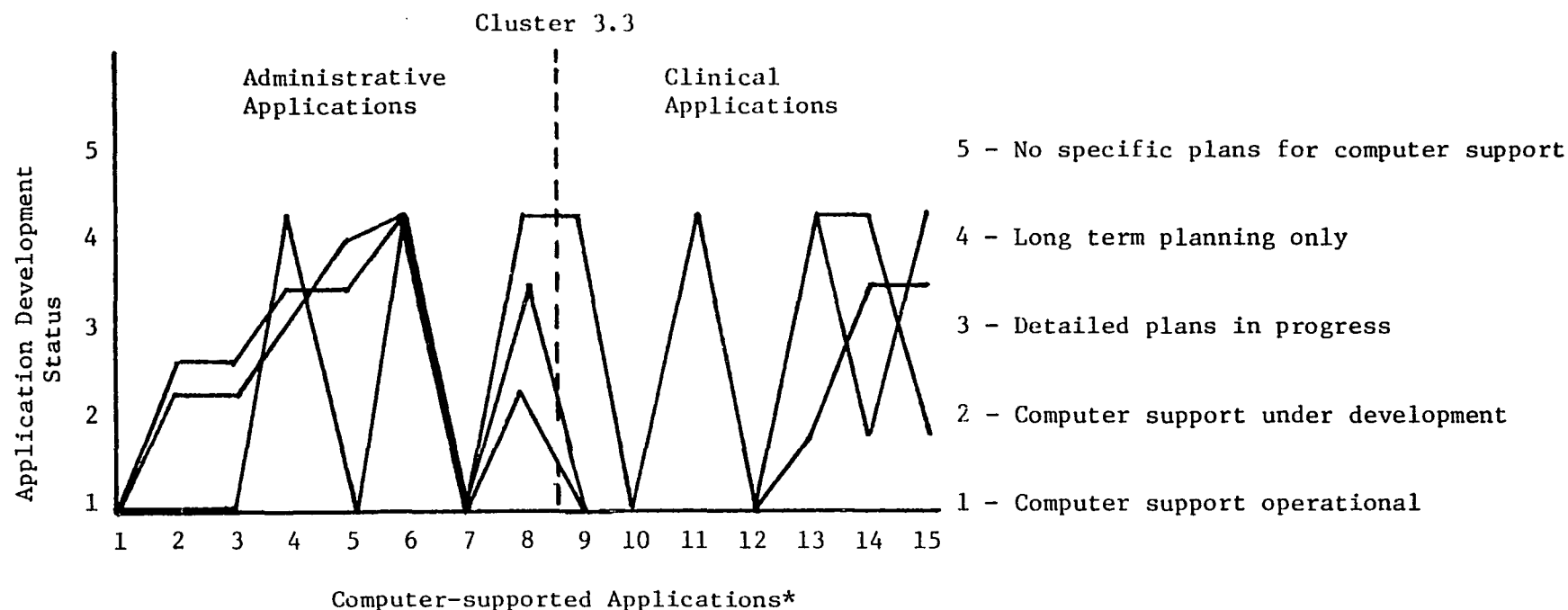
Figure 5. (continued)



The cluster 3.2 profile shows only two application areas (individual treatment plan and medication treatment) with widely differing development status. Most of the centers in one sub-cluster have computer support operational for these two applications, while centers in the other sub-cluster have no plans for computer support. The development status of all other application areas is similar in both sub-clusters.

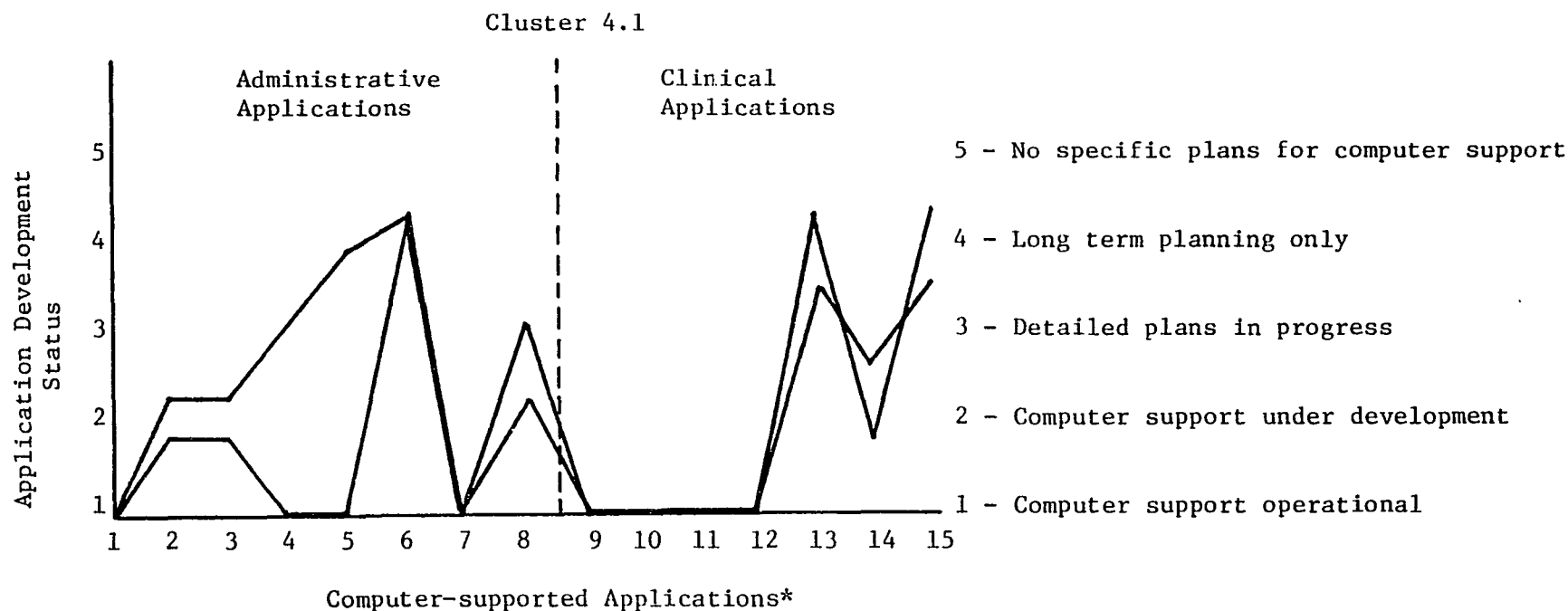
\* Definitions for these applications can be found on page 55 of the text.

Figure 5. (continued)



In cluster 3.3 the majority of centers have computer support operational for patient census, staff activity, individual treatment plan, and diagnostic data. Most of the centers in this cluster have no plans for automating inventory systems for property. There are three applications where sub-clusters show development status ranging from computer support operational to no plans for computer support. These include the payroll, intake, and direct service application areas.

\* Definitions for these applications can be found on page 55 of the text.

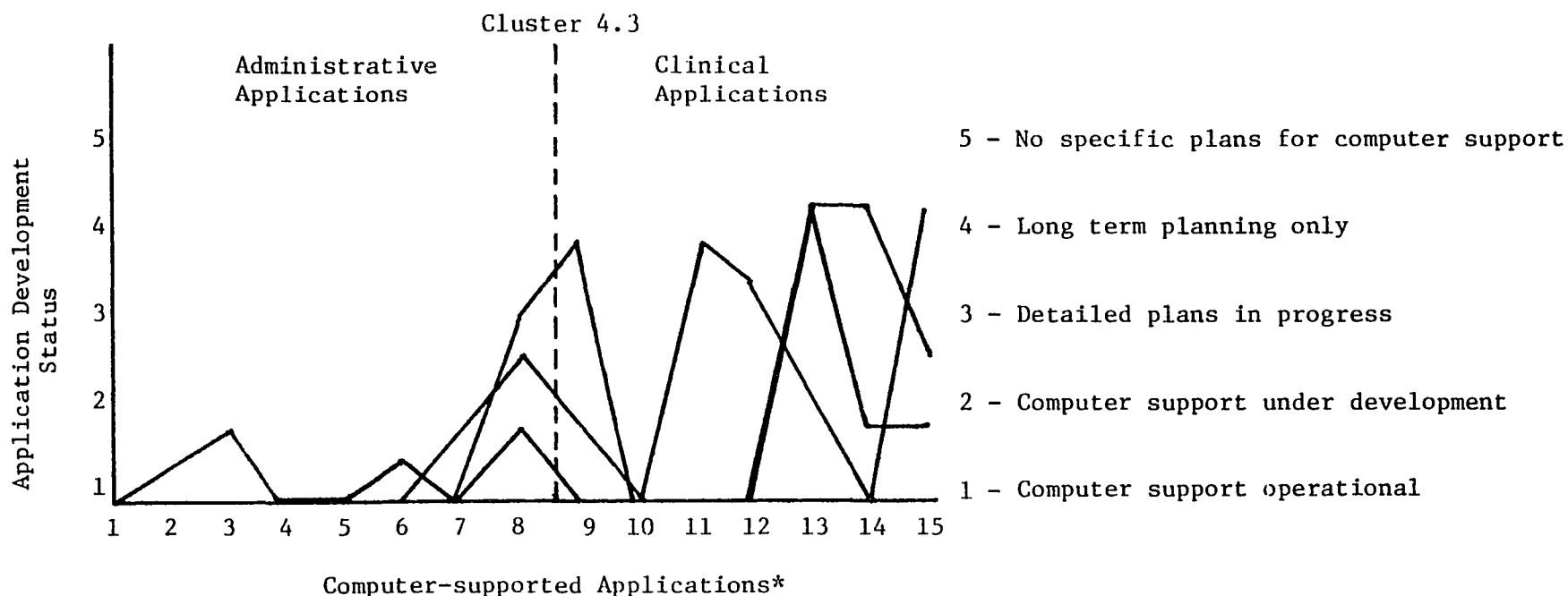


The two sub-clusters comprising cluster 4.1 have only two applications (accounting and payroll) where centers differ on development status. One sub-cluster contains centers with computer support operational and other other includes centers which have long range or no plans for computer support.

\* Definitions for these applications can be found on page 55 of the text.

Figure 6. Median values of application development status for four-cluster data grouping.

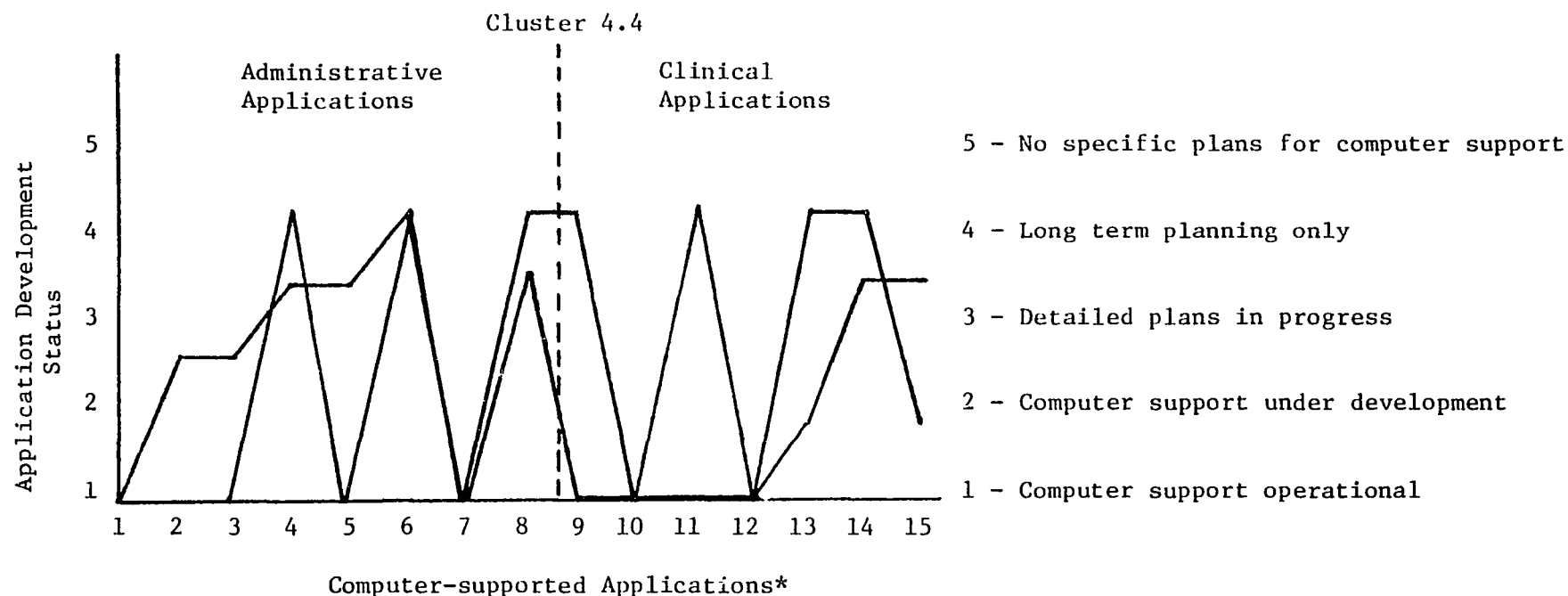
Figure 6. (continued)



Cluster 4.3 shows the majority of centers in each sub-cluster have computer support operational or under development for most of the administrative applications. The development status of four clinical applications (intake, direct service, diagnostic data, and medication treatment) ranges from operational to long term or no plans for computer support.

\* Definitions for these applications can be found on page 55 of the text.

Figure 6. (continued)



The cluster 4.4 profile shows the majority of clusters in these two sub-clusters have computer support operational for patient census, staff activity, and individual treatment plan applications. The majority of centers also report no plans for automating inventory systems for property. The development status varies widely for four application areas (payroll, intake, and direct and indirect services).

\* Definitions for these applications can be found on page 55 of the text.

TABLE X  
STANDARD DEVIATIONS OF RESPONSES PERTAINING  
TO APPLICATION DEVELOPMENT STATUS

<u>Cluster</u>	Applications with std. dev. < 1.0		Applications with ≥ 1.0 std. dev. < 1.5		Applications with std. dev. ≥ 1.5	
	<u>Number of Centers</u>	<u>Per Cent</u>	<u>Number of Centers</u>	<u>Per Cent</u>	<u>Number of Centers</u>	<u>Per Cent</u>
2.1	3	20	6	40	6	40
2.2	1	7	7	47	7	47
3.1	5	33	6	40	4	27
3.2	4	27	3	20	8	53
3.3	5	33	2	13	8	53
4.1	5	33	5	33	5	33
4.2	6	40	3	20	6	40
4.3	7	47	3	20	5	33
4.4	6	40	1	7	8	53

similarity among the profiles of application development status for each sub-cluster (see Figure 4).<sup>2</sup> The most similarity is found in cluster 2.1. The majority of centers in each sub-cluster have computer support operational for six applications. Table X indicates the standard deviations for these clusters are larger than those of clusters in other data groupings. Only four applications in both clusters have a standard deviation less than one. Consequently, this data grouping does not provide the best foundation for describing the application profiles of the centers under study.

The profiles of clusters 3.1 and 3.2 in the next data grouping show the development status values of most applications fall within a narrow range (see Figure 5). The sub-clusters in cluster 3.3 also show most applications have a similar development status, with the exception of the one sub-cluster identified earlier as being an outlier. Table X shows that the standard deviations for this set of clusters are slightly larger than for the four-cluster data grouping.

The profiles of the sub-clusters in cluster 4.1 show only two administrative applications where centers differ appreciably on development status (see Figure 6). Cluster 4.3 shows the majority of centers in each sub-cluster have computer support operational for most of the administrative applications. The range of values for the clinical

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<sup>2</sup> It should be noted that one of the sub-clusters in cluster 2.2 is characterized by only two values; either computer support is operational or there are no specific plans for computer support. These values represent the two extremes of the application development continuum and this is a very non-typical profile. Furthermore, since this sub-cluster contains only one center, it gives the appearance of more variability than actually exists. This sub-cluster is also found in clusters 3.3 and 4.4.

applications shows wider differences among development status. Cluster 4.4 contains two sub-clusters, one of these being the sub-cluster containing only one center. The two sub-cluster profiles indicate the development status varies widely in four application areas. Although Table X shows the standard deviations for these four clusters are somewhat smaller than those of the three-cluster data grouping, the differences are not significant enough to exclude this latter grouping of clusters as the basis for further analysis.

#### Interpretation of Application Profiles by Cluster

To make the final determination about which of these two groupings best represents the data, both were analyzed to determine which applications characterize each cluster. The application profile is defined by those applications where sixty per cent of the centers have computer support operational or under development. The profiles for each cluster are summarized in Table XI.

Clusters 3.1, 3.2, and 3.3 clearly reflect distinctions between the administrative and clinical applications. The first cluster is characterized by both types of applications. The second is defined exclusively by administrative applications, while the third is dominated by clinical applications. It is interesting to note that the first cluster is a composite of all applications contained in the other two clusters, with the exception of application 6 (inventory system for property). Furthermore, this set of applications is identical to those which define stage 1 of the Application Profile Model (see page 52).

The second data grouping displays the same distinctions between administrative and clinical applications. Clusters 4.1 and 4.3 have

TABLE XI

APPLICATION PROFILES FOR THE THREE-CLUSTER  
AND FOUR-CLUSTER DATA GROUPINGS

## Three-cluster Data Grouping

<u>Cluster 3.1</u>	<u>Cluster 3.2</u>	<u>Cluster 3.3</u>
<u>Administrative Applications</u>	<u>Administrative Applications</u>	<u>Administrative Applications</u>
Patient demographic characteristics	Patient demographic characteristics	Patient demographic characteristics
Third-party billing	Third-party billing	Staff activity data
Direct patient billing	Direct patient billing	
Financial/accounting	Financial/accounting	<u>Clinical Applications</u>
Payroll	Payroll	Intake data
Staff activity data	Inventory system for property	Direct service data
	Staff activity data	Diagnostic data
<u>Clinical Applications</u>		Indirect service data
Intake data		
Direct service data		
Diagnostic data		
Indirect service data		

## Four-cluster Data Grouping

<u>Cluster 4.1</u>	<u>Cluster 4.2</u>	<u>Cluster 4.3</u>
<u>Administrative Applications</u>	<u>Administrative Applications</u>	<u>Administrative Applications</u>
Patient demographic characteristics	Patient demographic characteristics	Patient demographic characteristics
Third-party billing	Third-party billing	Third-party billing
Financial/accounting	Direct patient billing	Direct patient billing
Payroll	Financial/accounting	Financial/accounting
Staff activity data	Payroll	ing
	Staff activity data	Payroll
<u>Clinical Applications</u>		Inventory system for property
Intake data		Staff activity
Direct service data		
Diagnostic data		<u>Clinical Applications</u>
Indirect service data		Intake data
		Direct service data
		Diagnostic data
		Indirect service data

TABLE XI (continued)

Cluster 4.4

Administrative

ApplicationsPatient demographic  
characteristics

Staff activity data

Clinical

Applications

Intake data

Direct service data

Indirect service data

essentially the same profile as cluster 3.1. Cluster 4.1 contains one less administrative application and cluster 4.3 contains one administrative application not included in cluster 3.1. Cluster 4.2 contains all but one of the applications included in cluster 3.2. Cluster 4.4 is also similar to cluster 3.3, with only one less clinical application. Thus, this grouping is characterized by two clusters consisting of both administrative and clinical applications, one cluster defined exclusively by administrative applications, and one cluster with a small number of both types of applications.

The major difference in this data grouping is the formation of two clusters with profiles similar to that of cluster 3.1. However, Table X shows that the variability among responses of centers included in cluster 3.1 is about the same as the variability among responses of centers included in clusters 4.1 and 4.3. A better fit of the data is therefore not obtained through the formation of these two clusters. There is also a sharper contrast between the profiles of clusters 3.2 and 3.3 than between clusters 4.2 and 4.4. Partitioning the data into four clusters does not provide a significantly improved interpretation of these data. The data grouping consisting of three clusters will therefore be used to further clarify the Application Profile Model derived earlier.

#### Extension of Application Profile Model

The results of the cluster analysis provide insights into both the stage 1 and 2 centers described by the Application Profile Model. As noted earlier, the application profiles which characterize the three clusters are a composite of the applications specified for the stage 1

centers with the exception of one application. It is therefore reasonable to extend the Application Profile Model by partitioning stage 1 into three distinct groupings of centers. This partitioning is illustrated in Figure 7. This extension allows for classification of the six centers which previously did not meet the criteria for classification in any stage. Twenty-six centers are classified in stage 1 of applications development, nineteen centers in stage 2, eight centers in stage 3, and no centers in stage 4.

The model now reflects two distinct application profiles for the initial stage of development. Centers will either develop applications which support administrative functions or applications with primary emphasis on accountability at the client level. (The designation stage 1-A will henceforth be used in referring to centers in stage 1 whose application profiles consist of administrative applications; stage 1-C will designate centers in stage 1 with primary emphasis on clinical accountability applications.) Centers with either type of application profile are classified as being in stage 1. Centers which originally developed administrative applications will next develop a set of applications which provide accountability at the client level. Likewise, centers that initially developed client accountability applications will expand computer support to include a broader set of administrative applications. Thus, centers in stage 2 will have a common application profile regardless of which set of applications were developed first.

Stage 2 of the Application Profile Model has been redefined as stage 3 and the original stage 3 redefined as stage 4. It should be noted that the application pertaining to inventory systems for property

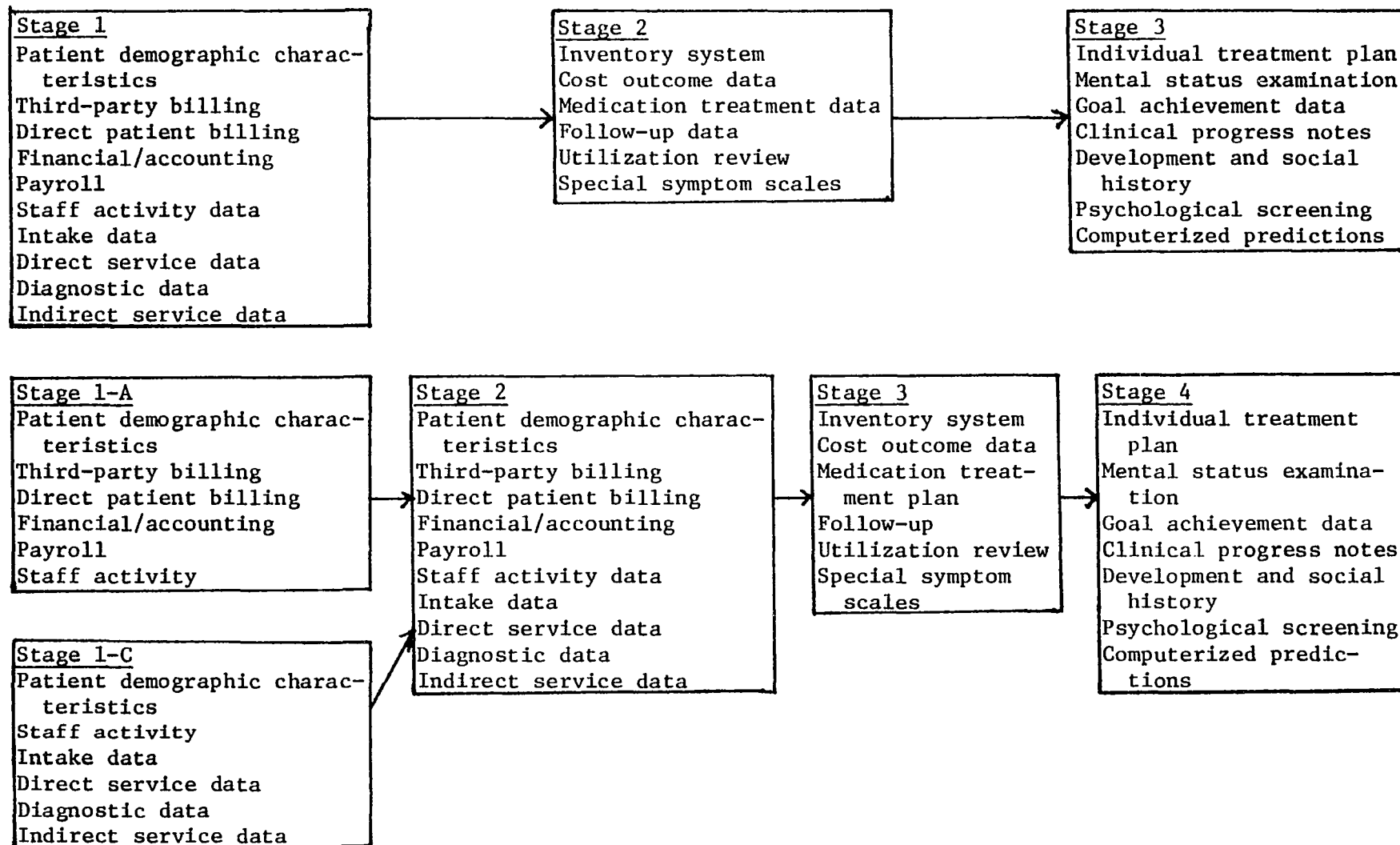


Figure 7. Comparison of the two application profile models.

is still included as part of the stage 3 profile. Even though computer support for this application is operational or under development in more than sixty per cent of the centers included in stage 1-A, it did not meet this criteria among centers contained in stage 2. In addition, the number of centers in the total sample indicating that computer support for this application was operational or under development is too low to include it in the stage 1 and 2 profiles.

The cluster analysis did not differentiate the stage 3 centers from the stage 1 and 2 centers. This is not surprising because the number of centers classified in this stage is so small. However, it is reasonable to expect these centers to be included in the cluster now designated as stage 2. A review of the cluster data revealed that five of the eight centers in stage 3 are included in this cluster. Two centers are included in the cluster now designated as stage 1-C and one center in the cluster designated as stage 1-A. An analysis of the application profile for the last three centers shows they have long-term or no specific plans for computer support of four of the fifteen applications being analyzed. Since the K-MEANS algorithm clusters on the basis of all five levels of application development status, these centers are being differentiated because of a few extreme values.

#### Distribution of Centers By Stratum

Table XII shows the distribution of centers in each stage among the four strata. These data show that centers are fairly well distributed among the strata. There is no evidence that stage membership is a function of size. For example, the large centers are not more advanced in the development of computerized applications than smaller

TABLE XII  
DISTRIBUTION OF CENTERS IN  
EACH STAGE BY STRATUM

<u>Stage</u>	Stratum 1	Stratum 2	Stratum 3	Stratum 4
	<u>50-70 Full- time Staff</u>	<u>71-140 Full- time Staff</u>	<u>142-284 Full- time Staff</u>	<u>311-700 Full- time Staff</u>
1	13 centers	5 centers	3 centers	5 centers
2	3 centers	5 centers	10 centers	1 center
3	2 centers	3 centers	3 centers	0 centers

centers. It is therefore reasonable to pool the strata estimates for this study.

A description of other general characteristics of centers in each stage of applications development is presented in Appendix D. The discussion is based primarily on data collected in the preliminary survey.

#### ANALYSIS OF FACTORS UNDERLYING INFORMATION SYSTEM GROWTH

This section addresses the second research question being investigated: Are there characteristic groups of enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) consistent among community mental health centers at any given stage of growth? The characteristics of the centers classified in the three stages of the Application Profile Model are analyzed to determine whether distinct patterns exist.

The analyses presented in this section are based on data items contained in Parts II, III, and IV of the questionnaire included as Appendix B. Responses to each data item are tabulated and discussed in Appendix E.

#### Discriminant Analysis

The discriminant analysis discussed below was used to determine whether the differences in the characteristics of the enabling factors are significant enough to distinguish among the three stages of applications development. Discriminant analysis was also used to identify significant differences among variables describing the general

characteristics of centers in each stage and information system impact. This technique provides several statistical measures for interpreting these data. It provides the Wilks' lambda (U-statistic) value showing the amount of variation explained individually and collectively by the set of variables being analyzed. The F value and associated level of significance is also calculated for each variable entered into the analysis. Thus, those variables which contribute most to differentiation among stages can be identified. Discriminant analysis also shows how many centers are classified in the correct stage by the variables being analyzed.

Five sets of analyses were run using the SPSS stepwise discriminant analysis program. A separate analysis was performed on the variables related to general characteristics of centers, organization of data processing activities, planning and control techniques, user involvement, and information system impact. Missing values were recoded using the mean value of the responses for the data item.

#### Analysis of Variables Describing General Characteristics

The results of the discriminant analysis shown in Table XIII revealed no variables related to general characteristics were significant at the .05 level. This means there are no significant differences among the characteristics of centers in the three stages with respect to variables such as size, type of computer facility used, number of years a computer has been used, or size of data processing budget.

TABLE XIII  
RESULTS OF DISCRIMINANT ANALYSIS OF  
GENERAL CHARACTERISTICS VARIABLES

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Value*</u>	<u>Significance</u>
Use computer terminals for interactive processing	.95	1.43	.25
Own/lease in-house computer	.89	1.44	.23
Number of full-time staff (classified by stratum)	.84	1.42	.22
Developed the information system in-house	.79	1.51	.16

\* F values reported are those when variable first entered the analysis.

### Analysis of Data Processing Organization Variables

Fifteen variables related to data processing organization account for significant proportions of the variation among stages. These variables are shown in Table XIV. The first variable listed in the table (percentage of time researchers routinely spend on data processing activities) accounts for eight per cent of the variation. (The amount of variation is computed by subtracting the Wilks' lambda value from 1.0.) Together, the first and second variables account for fourteen per cent of the variation. The variance accounted for by the second variable entering the analysis is that proportion of the variation which the second variable accounts for after that contributed by the first. All fifteen variables combined account for seventy-five per cent of the variation in data processing organization among stages.

The data contained in Table XIV also show the significance level begins to increase when the thirteenth variable (who the person in charge of the information system reports to) is entered into the analysis. This is due to the loss of degrees of freedom in combination with little increase in the amount of variation being accounted for by the entering variable.

Table XV shows that seventy-five per cent of the centers were correctly classified using the fifteen variables. Those centers in both stages 2 and 3 which were not properly classified were grouped with the stage 1 centers. This indicates the characteristics of stages 2 and 3 are very different from each other but have some commonalities with the stage 1 centers. About one-fourth of the stage 1 centers are classified with the stage 2 centers. Again, this indicates stage 1 centers are very

TABLE XIV  
RESULTS OF DISCRIMINANT ANALYSIS OF DATA  
PROCESSING ORGANIZATION VARIABLES

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Values*</u>	<u>Significance</u>
Percentage of time re-searchers routinely spend on data processing activities	.92	2.11	.1321
Number of computer operators routinely involved in data processing activities	.86	1.95	.1076
Percentage of time computer operators routinely spend on data processing activities	.78	2.09	.0616
Percentage of time program managers routinely spend on data processing activities	.70	2.26	.0295
Number of program managers routinely involved in data processing activities	.64	2.33	.0171
Number of clerical support staff routinely involved in data processing activities	.56	2.49	.0074
Percentage of time clerical support staff routinely spend on data processing activities	.49	2.67	.0027
Percentage of time data entry staff routinely spend on data processing activities	.45	2.63	.0022
Number of researchers routinely involved in data processing activities	.41	2.58	.0019
Percentage of time clinicians routinely spend on data processing activities	.38	2.53	.0017

TABLE XIV (continued)

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Values*</u>	<u>Significance</u>
Percentage of time programmers routinely spend on data processing activities	.35	2.51	.0015
Assignment of in-house programmers to specific user areas	.31	2.55	.0010
Who the person in charge of the information system reports to	.30	2.45	.0013
Number of clinicians routinely involved in data processing activities	.27	2.40	.0014
Percentage of time administrators routinely spend on data processing activities	.25	2.37	.0015

\* F values reported are those when the variables first entered the analysis.

TABLE XV  
CLASSIFICATION RESULTS USING DATA PROCESSING  
ORGANIZATION VARIABLES

<u>Actual Stage</u>	<u>Number of Centers</u>	<u>Predicted Stage Membership</u>		
		<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Stage 1	26	20 77%	6 23%	0 0%
Stage 2	19	4 21%	15 79%	0 0%
Stage 3	8	3 38%	0 0%	5 63%

Total per cent of centers correctly classified: 75%

distinct from those of stage 3 but have some characteristics in common with the stage 2 centers.

#### Discussion of Significant Data Processing Organization Variables

Table XVI presents a comparison of responses to data processing organization variables by stage of applications development. Many of these results are difficult to interpret. For example, the mean number of in-house computer operators increases between stages. This reflects the finding that more centers in stages 2 and 3 have in-house computers than centers in stage 1. (The distribution of responses for the data item pertaining to the type of computer facility used is contained in Appendix D on page 136 .) However, the percentage of time computer operators spend on data processing activities decreases between stages 2 and 3. Since the stage 3 centers have a larger set of applications, operators would be expected to have a heavier workload. The mean percentage of time data entry staff spend on data processing activities shows the same pattern as computer operators. Data entry staff would also be expected to have a heavier workload in stage 3 because the number of computer applications has increased.

The mean number of clerical support staff routinely involved in data processing activities decreases between stages 2 and 3. This finding is also difficult to interpret. It may be an indicator of more efficient data handling procedures in the stage 3 centers. On the other hand, this decrease is significantly large to warrant further investigation before it is accepted as a measure of improved efficiency.

The reduced number of staff and percentage of time spent on data processing activities shown in stage 3 could be the result of funding

TABLE XVI  
 RESPONSES TO DATA PROCESSING ORGANIZATION  
 VARIABLES COMPARED BY STAGE

<u>Variables</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Mean percentage of time researchers routinely spend on data processing activities	2	13	9
Mean number of computer operators routinely involved in data processing activities	.3	.4	.9
Mean percentage of time computer operators routinely spend on data processing activities	17	29	19
Mean percentage of time program managers routinely spend on data processing activities	6	3	6
Mean number of program managers routinely involved in data processing activities	2.2	4.0	7.4
Mean number of clerical support staff routinely involved in data processing activities	6.0	12.7	2.3
Mean percentage of time clerical support staff routinely spend on data processing activities	36	46	25
Mean percentage of time data entry staff routinely spend on data processing activities	32	45	42
Mean number of researchers routinely involved in data processing activities	.2	1.2	.6
Mean percentage of time clinicians routinely spend on data processing activities	2	3	2
Mean percentage of time programmers routinely spend on data processing activities	12	29	19
Assign in-house programmers to specific user areas*	8%	0%	0%

TABLE XVI (continued)

<u>Variables</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Position title of who the person in charge of the information system reports to*			
Administrator	69%	79%	63%
Director of Administrative Services	4%	11%	13%
Other positions	19%	11%	13%
Mean number of clinicians routinely involved in data processing activities	9.8	11.8	31.8
Mean percentage of time administrators routinely spend on data processing activities	7	9	18

\* Response distributions based on per cent of centers in specified category.

constraints. If these centers are in the final years of their federal staffing grant, the amount of funding support for data processing staff is greatly reduced. Consequently, these centers may be cutting back to the minimum staffing levels needed to operate and maintain the system.

The data show the number of clinicians routinely involved in data processing activities increases in each stage. On the surface, this finding is reasonable because the applications developed by centers in stages 2 and 3 are more clinical in nature and clinicians would be more likely to complete source documents and be involved in other system support functions. However, the tabulation of responses to this data item contained in Appendix E (see page 145) indicates the majority of centers in each stage report no clinicians routinely involved in data processing activities. Since clinicians in most centers should be completing forms documenting activities such as the type and frequency of services delivered, it appears this data item did not elicit the proper response.

The data also reveal the person responsible for the center's information system most often reports to the administrator in the stage 2 centers. The stage 3 centers show the lowest frequency of this person reporting to the administrator. Again, these data suggest more than one interpretation. The data may indicate that administrators in stage 3 centers feel other in-house staff have sufficient expertise to deal with information system problems. However, reporting responsibility to the administrator can also be viewed as a form of organizational commitment as it gives the information system function more visibility.

In summary, these data are too ambiguous to suggest a set of

characteristics that reflect increased formalization of data processing organization within the stage 3 centers. The data show that staffing levels generally increase between stages 1 and 2 and decrease in stage 3. The hypothesized characteristics of data processing organization variables summarized in Table I (see page 31) were not supported by the data. For example, it was hypothesized that separate organizational units responsible for data processing activities would be established in stage 3. The number of in-house programmers was also expected to increase in each stage. The data do not reveal significant differences among the characteristics of these variables at different stages of development.

#### Analysis of Planning and Control Variables

Eight planning and control variables account for significant proportions of the variation among stages. Table XVII lists these variables and the associated Wilks' lambda and F values. This set of variables combined account for fifty-three per cent of the variation among stages.

Table XVIII shows sixty-eight per cent of the centers were correctly classified using this set of variables. Stage 3 is particularly well-defined; seventy-five per cent of these centers are properly classified. The stage 3 centers are very distinct from stage 1 centers but show some similarity with stage 2 centers. The centers in stages 1 and 2 are less well-defined; about one-third of the centers in both stages are classified in other stages.

TABLE XVII  
RESULTS OF DISCRIMINANT ANALYSIS OF  
PLANNING AND CONTROL VARIABLES

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Value*</u>	<u>Significance</u>
Extent to which information handling procedures are documented	.83	5.28	.0083
Extent to which information system performance is formally evaluated	.70	4.73	.0016
Users charged for computer services	.62	4.27	.0007
Job description prepared for a system development project	.57	3.86	.0006
Use of information system steering committee	.52	3.52	.0006
System improvement priorities assigned on first come, first served basis	.49	3.16	.0009
Project milestones for system development projects are established	.47	2.89	.0013

\* F values reported are those when the variable first entered the analysis.

TABLE XVIII  
CLASSIFICATION RESULTS USING PLANNING  
AND CONTROL VARIABLES

<u>Actual Stage</u>	<u>Number of Centers</u>	<u>Predicted Stage Membership</u>		
		<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Stage 1	26	18 69%	5 19%	3 12%
Stage 2	19	4 21%	12 63%	3 16%
Stage 3	8	0 0%	2 25%	6 75%

Total per cent of centers correctly classified: 68%

### Discussion of Significant Planning and Control Variables

Table XIX presents a comparison of responses to planning and control variables by stage. Several of these variables reflect increased emphasis on planning and control as centers develop more comprehensive sets of computer applications in stages 2 and 3. These include the extent to which information handling procedures are documented, charge-out for computer services used, and less reliance on informal criteria for establishing system improvement priorities such as a first come, first served basis. Stage 3 centers also show the most frequent use of a steering committee to establish information system policy and overall direction of system development. The distinctions exhibited by these variables at each stage support the hypothesized progression toward more formalized planning and control techniques described in Table I (see page 31).

Centers in stages 2 and 3 rank lowest on two aspects of project management, preparing job descriptions for staff involved in system development projects and documenting project milestones or interim target deadlines. It is possible that respondents from centers in stage 1 interpret project management techniques in a less formal way than staff from centers with more system development experience. As staff become familiar with formal system development techniques they may rate their center's techniques from a more critical perspective. However, further investigation is needed before these data can be properly interpreted.

Stage 3 has the smallest number of centers reporting that no formal evaluation of system performance is conducted. Centers in stage 3

TABLE XIX  
RESPONSES TO PLANNING AND CONTROL  
VARIABLES COMPARED BY STAGE

<u>Variables</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Extent to which information handling procedures are documented*			
Most (Value = 1)	27%	63%	88%
Some (Value = 2)	62%	32%	13%
None (Value = 3)	8%	5%	0%
Mean of responses	1.8	1.4	1.1
Extent to which information system performance is formally evaluated*			
Formal evaluation conducted (Value = 1)	12%	37%	25%
Formal evaluation occasionally conducted (Value = 2)	50%	26%	13%
Formal evaluation not conducted (Value = 3)	38%	37%	63%
Mean of responses	2.3	2.0	2.4
Users charged for computer services*	19%	26%	50%
Job descriptions are prepared for a system development project*	23%	16%	0%
Information system steering committee is used*	42%	32%	75%
System improvement priorities assigned on first come, first served basis*	19%	5%	0%
Milestones for system development projects are documented*	15%	5%	0%

\* Response distributions based on per cent of centers in specified category.

may feel system evaluation is not needed because staff attitudes toward the system are generally favorable. Or, system evaluation may not be seen as a high priority task if centers are being forced to reduce the amount of staff time devoted to data processing activities.

In summary, the data provide support for the projection that increased planning and control occurs at each successive stage of development.

#### Analysis of User Involvement Variables

Table XX shows the four user involvement variables which are significant in this analysis. These variables account for thirty-seven per cent of the variation among stages. The large amount of variation which remains unaccounted for results in the fewest number of correctly classified centers. Table XXI shows that only fifty-eight per cent of the centers were properly classified. The poorest classification results are found in stage 2. Only thirty-seven per cent of these centers were classified in stage 2, while forty-two per cent were classified in stage 3. This means centers in stage 2 have very poorly defined characteristics. Overall, the data show that stages 2 and 3 are more like each other than either is to stage 1. Stage 1 centers exhibit a clearly defined set of characteristics, with seventy-three per cent of these centers being properly classified.

#### Discussion of Significant User Involvement Variables

Table XXII summarizes the distribution of responses for the four significant user involvement variables. Three of the four variables show that stage 3 centers more frequently use strategies which encourage user

TABLE XX  
RESULTS OF DISCRIMINANT ANALYSIS  
OF USER INVOLVEMENT VARIABLES

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Value*</u>	<u>Significance</u>
One person designated as primary advocate of informa- tion system improvement	.80	6.36	.0035
Degree to which a formal assess- ment of users' information needs is conducted	.72	4.47	.0023
Procedures established to modify system to be more responsive to user needs	.67	3.54	.0033
Demonstration project carried out prior to full system implementation	.63	3.05	.0043

\* F values reported are those when the variable first entered the analysis.

TABLE XXI  
CLASSIFICATION RESULTS USING  
USER INVOLVEMENT VARIABLES

<u>Actual Stage</u>	<u>Number of Centers</u>	<u>Predicted Stage Membership</u>		
		<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Stage 1	26	19 73%	4 15%	3 12%
Stage 2	19	4 21%	7 37%	8 42%
Stage 3	8	1 13%	2 25%	5 63%

Total percent of centers correctly classified: 58%

TABLE XXII  
RESPONSES TO USER INVOLVEMENT  
VARIABLES COMPARED BY STAGE

<u>Variables</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
One person designated as primary advocate of information system improvement*	58%	100%	88%
Degree to which a formal assessment of users' information needs is conducted*			
Formal assessment (Value = 1)	27%	63%	75%
Informal assessment (Value = 2)	62%	37%	25%
Has not been a concern (Value = 3)	4%	0%	0%
Mean of responses	1.7	1.4	1.3
Procedures established to modify system to be more responsive to user needs*			
Formal procedures established (Value = 1)	12%	32%	63%
Informal procedures established (Value = 2)	42%	47%	13%
Has not been a concern (Value = 3)	35%	21%	13%
Mean of responses	2.2	1.9	1.5
Demonstration project carried out prior to full system implementation*			
Formal demonstration project (Value = 1)	31%	32%	25%
Informal demonstration project (Value = 2)	27%	16%	25%
Has not been a concern (Value = 3)	31%	47%	38%
Mean of responses	2.0	2.2	2.1

\* Response distributions based on per cent of centers in specified category.

input and feedback. The use of an information system advocate is widespread in both stages 2 and 3. The system advocate role is seen as providing an important liaison between technical staff and users so the right people will be involved in making system design decisions. Centers in these two stages most frequently conduct a formal assessment of users' information needs, thus allowing user input to be obtained early in the design process. Stage 3 centers are also more likely to have formal procedures allowing users to request modifications which will make the system more responsive to their needs. Demonstration projects prior to full system implementation are conducted more frequently in stages 1 and 2 than in stage 3. The use of demonstration projects was expected to increase because it provides an opportunity for user feedback before the system reaches full operational status.

Although sixty-three per cent of the variation among stages remains unaccounted for, these data reflect distinct differences among user involvement strategies. Stage 3 centers provide the most opportunity for timely user involvement. Stage 2 centers also show improved user involvement strategies as compared to the stage 1 centers. These findings support the hypothesized characteristics of user involvement variables described in Table I (see page 31 ).

#### Analysis of Impact Variables

Table XXIII presents the four variables measuring information system impact which are relevant in distinguishing among stages. These variables account for forty per cent of the variation.

Table XXIV shows that sixty-six per cent of the centers were classified in the correct stage. Stage 2 centers had the most

TABLE XXIII  
RESULTS OF DISCRIMINANT ANALYSIS  
OF IMPACT VARIABLES

<u>Variables</u>	<u>Wilks' Lambda</u>	<u>F Values*</u>	<u>Significance</u>
User interest in developing new computer applications	.85	4.46	.0165
Program manager attitudes about the usefulness of the system	.76	3.64	.0082
Administrator attitudes about the usefulness of the system	.64	4.06	.0011
Researcher attitudes about the usefulness of the system	.60	3.43	.0017

\* F values reported are those when the variable first entered the analysis.

TABLE XXIV  
CLASSIFICATION RESULTS USING  
IMPACT VARIABLES

<u>Actual Stage</u>	<u>Number of Centers</u>	<u>Predicted Stage Membership</u>		
		<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
Stage 1	26	16 62%	5 19%	5 19%
Stage 2	19	2 11%	14 74%	3 16%
Stage 3	8	2 25%	1 13%	5 63%

Total per cent of centers correctly classified: 66%

well-defined characteristics, with seventy-four per cent of these centers being properly classified. More than one-third of the centers in stages 1 and 3 were classified in other stages. Those centers in stage 1 not properly classified were divided equally among stages 2 and 3. One-fourth of the stage 3 centers were classified as having characteristics in common with the stage 1 centers.

#### Discussion of Significant Impact Variables

Table XXV presents a comparison of responses to the impact variables by stage of applications development. The data show stage 3 centers consistently have the most favorable attitudes about the usefulness of the information system. These centers also have the highest number of users expressing interest in the development of new applications. Stage 2 centers have the lowest incidence of program managers reporting the system is definitely useful. The attitudes of administrators and researchers in stage 2 are more favorable. One possible interpretation of this finding is that implementation of clinical accountability applications creates disruption at the program level.

These findings clearly indicate that systems developed by centers in stage 3 are having more favorable impact. Centers in stage 2 show more favorable staff attitudes than centers in stage 1. The hypothesized characteristics reflecting more favorable staff attitudes in each successive stage (see Table I on page 31) are supported by these data.

Table XXVI summarizes the discriminant analysis results of each of the five sets of variables. Although less than fifty per cent of the variation among stages is accounted for by two sets of variables (user

TABLE XXV  
RESPONSES TO IMPACT VARIABLES  
COMPARED BY STAGE

<u>Variables</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>
User interest in developing new computer applications*			
Users expressing interest (Value = 1)	31%	63%	75%
Users occasionally expressing interest (Value = 2)	62%	37%	25%
Users not expressing interest (Value = 3)	8%	0%	0%
Mean of responses	1.8	1.4	1.3
Program manager attitudes about the usefulness of the system*			
Definitely useful (Value = 1)	35%	21%	88%
Somewhat useful (Value = 2)	35%	58%	0%
Minimally useful (Value = 3)	27%	11%	13%
Creates more problems than worth (Value = 4)	0%	11%	0%
Mean of responses	1.9	2.1	1.3
Administrator attitudes about usefulness of the system*			
Definitely useful (Value = 1)	46%	89%	88%
Somewhat useful (Value = 2)	38%	5%	13%
Minimally useful (Value = 3)	8%	5%	0%
Creates more problems than worth (Value = 4)	4%	0%	0%
Mean of responses	1.7	1.2	1.1
Researcher attitudes about usefulness of the system*			
Definitely useful (Value = 1)	50%	63%	100%
Somewhat useful (Value = 2)	12%	11%	0%
Minimally useful (Value = 3)	15%	11%	0%
Creates more problems than worth (Value = 4)	4%	5%	0%
Mean of responses	1.6	1.5	1.0

\* Response distributions based on per cent of centers in specified category.

TABLE XXVI  
SUMMARY OF DISCRIMINANT ANALYSES

	<u>General Characteristics Variables</u>	<u>Data Processing Organization Variables</u>	<u>Management Planning and Control Variables</u>	<u>User Involvement Variables</u>	<u>Information System Impact Variables</u>
Number of variables accounting for signi- ficant amounts of vari- ation	0	15	7	4	4
Total percentage of variation accounted for	--	75	53	37	40
Percentage of centers classified in the correct stage	--	75	65	58	66

involvement and impact), these analyses make an important contribution to this exploratory research. The analyses highlight significant differences among the characteristics of centers in each of the three stages of applications development.

#### SUMMARY

In this chapter the data obtained through the two surveys were analyzed. Responses to the preliminary survey showed seventy-nine per cent of the community mental health centers are using computer-supported information systems. This survey also revealed the majority of centers with manual systems were planning to automate within one year.

The results of the detailed survey were used to answer the two research questions under study. It was determined that a refinement of the hypothesized application profile for each stage of development would be more representative of the state of the art of computerized applications in community mental health centers. The modified profile also allowed for classification of a greater number of centers than the original version. The insights gained by clustering the data collected on computer applications provided for further modification. These analyses established that distinct stages of information system growth can be characterized by profiles of computer-supported applications common to each stage.

Discriminant analysis was then used to determine whether the characteristics of the enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) are sufficiently different to distinguish among the

three stages of applications development. The analysis of the data processing organization variables revealed results too ambiguous to allow for adequate interpretation. There is evidence of increased formalization of planning and control techniques among centers in stages 2 and 3. User involvement strategies which allow for timely user input and feedback are more frequently used as centers develop more comprehensive sets of computer applications. Stage 3 centers also show the most favorable attitudes toward the usefulness of the information system indicating these systems are having the most positive impact.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

Chapter V presents a summary of the study, the conclusions supported by the data, and recommendations for further research.

#### SUMMARY

##### Research Problem Addressed

This research was undertaken to determine whether the growth of computer-supported information systems in community mental health centers can be characterized by distinct stages of development. The model developed through this study describes patterns of computer use and of factors which support information system development. Such a model is classified as a stage theory formulation.

Data collection and analysis were designed to answer the following two research questions:

- Can distinct stages of information system growth be characterized by common profiles of computerized applications?
- Are there characteristic groups of enabling factors (i.e., organization of data processing activities, management planning and control techniques, and user involvement) consistent among community mental health centers at any given stage of growth?

The emergence of community mental health centers as a vital service delivery mechanism has been accompanied by demands for increased

accountability about program efficiency and effectiveness. These demands have made it imperative that centers systematically collect and analyze operational information. They have also provided the impetus for centers to develop computer-supported systems as an efficient way to obtain needed information. However, system development efforts have been hampered by limited funding and lack of stable long-term support.

### Review of the Literature

The review of the literature revealed little research directed toward developing stage theory formulations of information system growth. The most comprehensive work in this area was conducted by Nolan, who identified distinct stages which characterize the pattern of information system growth in business organizations. Schoech and Schkade predicted the pattern of growth of computerized data processing in human services will parallel the pattern of growth described by Nolan's stage theory formulation.

A research study conducted in 1974 reported that one-fourth of the community mental health centers have developed some computer applications. Another survey reported these centers are developing applications primarily in support of administrative functions such as accounting and external reporting requirements instead of clinical functions. The pressure to meet external reporting requirements has been identified as a major obstacle in the development of information systems which have an impact on clinical care.

### Research Methods

The model underlying this research was derived from Nolan's

earlier work on stage theory formulations. The components of the conceptual model were used to develop three scenarios describing the hypothesized characteristics of mental health information systems at different stages of growth.

Data for this study were obtained through a two-phase survey. The preliminary survey identified which community mental health centers were using computer-supported information systems. Detailed data about the aspects of information system growth under study were collected through a stratified random sample of centers using computer-supported information systems.

The purpose of the first stage of data analysis was to determine: (1) whether the data collected on computer applications supported the hypothesized profile of applications; (2) whether the data were better represented by a different profile of computer-supported applications; or (3) whether no common profiles of computerized applications exist. Frequency analysis and cluster analysis were used to identify patterns in the data. Given that distinct profiles of computerized applications exist, the second data analysis task was to determine whether the characteristics of the enabling factors were significantly different in each stage of applications development. Stepwise discriminant analysis was selected as the most appropriate statistical technique for making this determination.

### Research Findings

Responses to the preliminary survey showed that seventy-nine per cent of the community mental health centers are using computer-supported information systems. In addition, the majority of centers with manual

systems are planning to automate within one year. These findings indicate the number of centers using computers has increased dramatically during the last five years. The survey also revealed that thirty-two per cent of the centers own or lease an in-house computer.

The analysis of computer-supported applications showed that a refinement of the hypothesized applications profile for each stage would be more representative of the state of the art of computerized applications. The insights gained by clustering provided the basis for further modification. The results were a partitioning of stage 1 into two stages. The clustering also revealed two distinct application profiles for the initial stage of development. Thus, the original model depicting three stages of applications development was extended to four stages of development. Twenty-six centers were classified in stage 1 of applications development, nineteen centers in stage 2, eight centers in stage 3, and no centers in stage 4.

The discriminant analysis of characteristics of enabling factors revealed distinct differences among stages. There is evidence of increased formalization of planning and control techniques among centers in stage 3. User involvement strategies which allow for timely user input and feedback are more frequently used in stage 3. The analysis of data processing organization variables did not reveal a distinct set of characteristics showing increased formalization of data processing activities.

A discriminant analysis of the variables measuring information system impact showed that centers in stage 3 have the most favorable attitudes toward the usefulness of the system. This is an indication

that systems developed by the stage 3 centers are having the most positive impact.

## CONCLUSIONS

### First Research Question

The first question under study was: Can distinct stages of information system growth be characterized by common profiles of computerized applications? This study concludes that distinct stages of information system growth can be characterized by profiles of computer applications common to community mental health centers in each stage. The analysis of computer-supported applications showed that a model defined by four stages of applications development better represented the data than the original three-stage model. All of the centers under study can be classified in one of the designated stages.

The predominant types of applications being developed are those supporting administrative functions and clinical recordkeeping functions. The study also shows that few centers are developing applications with direct clinical impact; that is, applications which facilitate monitoring of individual patient care, clinical decision making, and clinical predictions. The emphasis on accountability applications and the lack of emphasis on clinical decision making applications indicate that areas of computer usage in community mental health centers parallel developments in other areas of mental health care.

Morgan and Crawford (1974) note, "The task of the mental health professional and administrator is to define what types of data bases and

computer applications would be most helpful to them for the solution of mental health care delivery problems." If mental health professionals establish that applications facilitating clinical decision making and clinical predictions are, in fact, useful in improving service delivery, then further research is needed to develop and implement such applications. Johnson (1979) classifies these types of applications as interventionally relevant systems (see Chapter II, Review of the Literature). He noted that such systems are still in the developmental stage. Given the limited funding centers have for information system research and development efforts, federal and state funders need to support new efforts to develop and test these types of applications. The potential usefulness of computerized information systems cannot be fully realized until these systems have a direct impact on the quality of care provided to clients.

#### Second Research Question

The second question investigated was: Are there characteristic groups of enabling factors consistent among community mental health centers at any given stage of growth? The study concludes that characteristic groups of enabling factors can be identified for centers at any given stage of growth.

While distinct characteristics of data processing organization variables can be identified, these characteristics do not reflect a progression toward increased formalization of the data processing function. The hypothesized characteristics of data processing variables were not supported by the data. For example, the number of centers where a formalized data processing unit has been established is no larger for

stage 3 centers than for centers in other stages. The position of MIS Director, which indicates increased formalization of data processing activities, is more prevalent among stage 2 centers than stage 3 centers. And, while the number of centers with in-house computers increases in each stage of development, there is no increase in the number of in-house programmers and other technical support staff. These findings indicate the data processing function is not developing as a distinct organizational unit with its own professional staff.

The lack of formalized data processing organization may be influenced by unstable funding for system development and operation. The decrease in the number of staff routinely involved in data processing activities shown in stage 3 may well be the result of the center's decreasing federal funding base. During the initial years of the funding period, federal staffing funds can be used to hire researchers, program evaluators, or technical data processing staff who have a particular interest or skill in developing information systems. Toward the end of the eight-year funding period, it appears that centers may be forced to reduce the number of staff directly involved in data processing activities and maintain only those staff needed to operate the existing system.

In summary, centers acquire data processing resources wherever they can—from federal staffing grants, state or county mental health departments, or special grants. These sources do not provide stable long term funding and many of these resources are not under the control of center management. In general, centers that rely on external data processing staff and equipment, without budgetary control over these

resources, would be expected to have more difficulty maintaining control over the system development process. Many mental health professionals agree these arrangements are impeding effective system development in community mental health settings (see, e.g., Weirich, 1980 and Lindberg, 1978). Yet this study shows centers are developing a wide range of computer-supported applications under these conditions and many users feel these systems are definitely useful. Thus, the critical question to be addressed is whether the lack of formalized organization of data processing activities within centers is preventing the development of more sophisticated applications. In other words, will centers be able to progress to stage 4 of applications development without formalized data processing organization?

The study provides evidence to conclude that distinct characteristics, reflecting increased formalization of planning and control techniques, can be identified for each stage of applications development. The areas where distinctions exist among stages (documentation of information handling procedures, charge-out for computer services, use of an information system steering committee, and assignment of information system priorities) are related to activities carried out within the center. The areas where no distinctions exist are those likely to involve coordination with external resources. For example, little formal planning documentation is prepared when new computerized applications are being considered and few project management techniques are being used. The use of formalized planning and project management techniques will give center management more control over the system development process.

Variables describing user involvement strategies also exhibit characteristics distinct for each stage of development. These characteristics show that centers develop more effective opportunities for user involvement in the system development process as they progress to more sophisticated uses of computer technology.

#### Other Insights

The study also provides insights about two other sets of variables related to general characteristics of information system development and impact of the system. No distinctions among stages were identified for the variables related to general characteristics. The study concludes that no patterns exist between stages regarding the use of in-house computers and computers owned by external organizations. The system development options used and the size of the data processing budget vary widely. Additionally, no significant differences exist in the number of years a computer has been used by centers in each stage of development. These findings indicate that system development strategies are probably influenced by factors that vary among centers. Typical factors that are likely to vary include type and level of funding available for system development, availability of internal and external data processing resources, and managerial preferences about system development options.

The study concludes that information systems have more favorable impact at each successive stage of development. Users tend to have more favorable attitudes about the usefulness of the system and express more interest in developing new applications as centers progress through each stage.

Guidelines for Community Mental Health Center Managers

The study results provide useful guidance to community mental health center managers making decisions about information system development. First, the study shows managers that no single model exists for developing information systems. The type of computer facility used and the size of the data processing budget vary widely among centers in each stage of development. Centers are using a variety of system development options including the purchase of packaged systems, contract development, in-house development, and participation in state- or county-wide systems. Data processing activities are also staffed and organized differently. The implication is that managers need to assess their center's environment to determine what system development resources are most readily available. The level of funding available for system development and operation is usually the critical determinant of what resource options are feasible for the center.

Second, the profile of computerized applications for centers in each stage shows that information system development generally progresses through incremental steps. The profile of applications at each stage provides an inventory of applications that reflects other centers' highest priorities for computer support. Applications supporting administrative functions and client accountability have been identified as the most useful areas to automate during initial development efforts.

Finally, the trends showing increased formalization of planning and control techniques and increased user involvement seem to be based on practice wisdom accumulated by centers as they gain more experience

in information system development. The study results clearly show that centers which are developing the most comprehensive sets of computerized applications are implementing formal planning and control techniques and user involvement strategies. These include:

- Establishing a steering committee to formulate long term information system direction and to set system development priorities;
- Designating one person to serve as primary advocate of information system development;
- Conducting a formal assessment of users' information needs;
- Establishing formal procedures which allow users to suggest modifications that will make the system more responsive to their needs; and
- Documenting information handling procedures.

Since these centers also report the most favorable staff attitudes toward the usefulness of the information system, their experiences suggest that centers at any stage of development can benefit from these system development strategies.

#### RECOMMENDATIONS FOR FURTHER RESEARCH

Several areas came to light during this study where additional significant research can be accomplished.

This study identified the characteristics of centers in different stages of information system development and showed how these characteristics change as centers develop more comprehensive sets of computer applications. However, the data collected reflect only the

characteristics of community mental health centers at the time of the survey. These data do not document the chronological sequence of how these characteristics have changed over time within individual centers. The collection of chronological data would allow an investigation into the nature of causal relationships which show what must happen to allow a new stage to emerge and what brings a given stage to an end.

As discussed in Chapter I, Introduction, this research has provided a starting point for the development of a normative theory for managing the computer resource. Although it may not be practical to develop a normative stage theory formulation in the near future, it may be practical to establish standards suggesting effective management practices appropriate to centers in each stage of applications development. Further research could fruitfully expand on the findings on this study by examining what management practices related to system development are most effective in the community mental health center environment.

One of the questions included on the preliminary survey addressed the type of system development options which have been used. Further research is needed to assess the impact of the various development options on a center's pattern of information system growth. Of particular interest is whether the transfer of packaged systems into a center allows that center to reach a higher level of information system functioning more quickly than other system development options.

The lack of formal data processing organization revealed by the study also suggests areas for additional research. It would be useful to determine whether the existing organizational structures can effectively

support centers which are ready to move to stage 4. An associated area pertains to the changes that occur in staffing patterns. If decreased federal funding is, in fact, a major reason why centers reduce the number of staff routinely involved in data processing activities, the future impact on information system development and operation needs to be explored. At this time, new staffing grants are not being awarded. If these grants are a primary source of funding for data processing staff, the continued development of community mental health information systems to higher level uses may be seriously affected. If the National Institute of Mental Health does not continue to provide support for system development within centers, the feasibility of having state and county agencies assume this role needs to be investigated.

Each of the above areas provides an opportunity for research into important aspects of information system management and use. Many benefits may be derived from further pursuit of research which contributes to a better understanding of the information system improvement process and about the role of management in guiding its evolution. Ultimately, such endeavors will result in the improved decision making capabilities mental health managers need in carrying out their increasingly complex and diverse responsibilities.

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APPENDIX A

QUESTIONNAIRE USED FOR PRELIMINARY SURVEY

SURVEY OF COMMUNITY MENTAL HEALTH INFORMATION SYSTEMS

1. Name of person most responsible for your center's information system:

Name \_\_\_\_\_ Phone number \_\_\_\_\_  
 Title \_\_\_\_\_

2. In order to identify the size of your center, we need the following:

\_\_\_\_\_ Number of full-time staff (as reported for item 8. on the last  
 NIMH Inventory of Comprehensive Community Mental Health Centers)  
 \$ \_\_\_\_\_ Total annual expenditures (item 11.E. on the NIMH Inventory of  
 Comprehensive Community Mental Health Centers)

3. Is your information system completely manual? ☐ YES ☐ NO  
 If YES, do you have plans to obtain computer support within the next year? ☐ YES ☐ NO

*IF YOU UTILIZE SOME TYPE OF COMPUTER SUPPORT, PLEASE COMPLETE ITEMS 4-9. IF NO, GO TO ITEM 9.*

4. Which of the following best describes the type of computer support for your information system? (Check all that apply)

☐ In-house computer owned by the center  
☐ Computer owned by another organization and accessed through timesharing or batch processing  
☐ Other arrangement (Please specify) \_\_\_\_\_

5. How long has a computer been used? \_\_\_\_\_

6. What is the annual data processing budget? \_\_\_\_\_

7. Do you have timesharing terminals connected by phoneline to a computer?  
☐ YES ☐ NO If YES, how many? \_\_\_\_\_

8. Which of the following options have been used in the development of your center's information system? (Check all that apply)

☐ Purchased a packaged system from another organization  
☐ Participate in a state-wide system  
☐ Developed the system in-house  
☐ Developed the system under contract with an external organization  
☐ Other (Please specify) \_\_\_\_\_

9. Is your center interested in upgrading general staff knowledge about the planning, implementation, and utilization of information systems? ☐ YES ☐ NO

- a. Would your center find it useful to have training materials to use for this purpose? ☐ YES ☐ NO  
 b. Has your center allocated staff release time within the past two years for this purpose? ☐ YES ☐ NO

*When questionnaire is complete, please fold, staple or tape together, and drop in the mail--no postage required. Thank you.*

APPENDIX B

QUESTIONNAIRE USED FOR SECOND SURVEY

SURVEY OF COMMUNITY MENTAL HEALTH  
INFORMATION SYSTEMS (PART II)

1. Person completing this questionnaire:

Name \_\_\_\_\_ Phone number \_\_\_\_\_  
Title \_\_\_\_\_

I. COMPUTER-SUPPORTED APPLICATIONS

2. Indicate the current status of the following application areas (circle one number for each application area):

ADMINISTRATIVE APPLICATIONS

	<u>Computer support operational</u>	<u>Computer support in development</u>	<u>Detailed plans in progress</u>	<u>Long-term planning only</u>	<u>No specific plans for computer support</u>
Patient census and demographic characteristics	1	2	3	4	5
Third-party billing	1	2	3	4	5
Direct patient billing	1	2	3	4	5
Financial/Accounting	1	2	3	4	5
Payroll	1	2	3	4	5
Inventory system for property	1	2	3	4	5
Staff activity data	1	2	3	4	5
Cost outcome data	1	2	3	4	5
Others (Please specify):					
_____	1	2	3	4	5
_____	1	2	3	4	5

CLINICAL APPLICATIONS

Intake data	1	2	3	4	5
Individual treatment plan	1	2	3	4	5
Direct service data	1	2	3	4	5
Diagnostic data	1	2	3	4	5
Indirect service data	1	2	3	4	5
Medication treatment data	1	2	3	4	5
Follow-up data	1	2	3	4	5
Mental status examination	1	2	3	4	5

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	<u>Computer support operational</u>	<u>Computer support in development</u>	<u>Detailed plans in progress</u>	<u>Long-term planning only</u>	<u>No specific plans for computer support</u>
Utilization review	1	2	3	4	5
Special symptom or problem scales	1	2	3	4	5
Goal achievement data	1	2	3	4	5
Clinical progress notes	1	2	3	4	5
Development and social history	1	2	3	4	5
Psychological screening (e.g., MMPI)	1	2	3	4	5
Computerized predictions	1	2	3	4	5
Others (Please specify):					
_____	1	2	3	4	5
_____	1	2	3	4	5

COMMENTS:

II. ORGANIZATION OF INFORMATION SYSTEM ACTIVITIES

3. How are the information system/data processing activities in your Center organized? (Check only one)
- \_\_\_ Separate organizational unit
- \_\_\_ Included in the activities of some other organizational unit (Please specify-- e.g., evaluation, financial/accounting, administrative services, etc.):
- \_\_\_\_\_
- \_\_\_ Joint responsibility between more than one organizational unit (Please specify):
- \_\_\_\_\_
- \_\_\_ Not a distinct organizational activity (data-related activities handled informally by staff)
4. Do you have overall responsibility for your Center's information system?
- \_\_\_ YES      \_\_\_ NO
- If NO, what is the position title(s) of the individual(s) with this responsibility?
- \_\_\_\_\_

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5. Who does the above person(s) report to?

☐ Administrator  
☐ Program manager (Specify program): \_\_\_\_\_  
☐ Business manager  
☐ Other (Please specify): \_\_\_\_\_

6. Indicate the in-house staff routinely involved in information system/data processing activities (include activities such as data collection, data entry, data control, distribution of reports, data analysis, system development and maintenance, etc.; exclude information system users):

<u>Position</u>	<u>Number of staff</u>	<u>Estimated % of time spent on data-related activities</u>
Clerical support staff	_____	_____
Computer programmers/analysts	_____	_____
Keypunchers/data entry staff	_____	_____
Computer operators	_____	_____
MIS specialists	_____	_____
Program evaluators	_____	_____
Administrators	_____	_____
Program managers/supervisors	_____	_____
Clinicians	_____	_____
Researchers	_____	_____
Others (Please specify):	_____	_____
_____	_____	_____
_____	_____	_____

7. Do the positions indicated in question 6 have job descriptions documenting responsibilities specifically related to information system/data processing activities?

☐ ALL    ☐ SOME POSITIONS    ☐ NONE

8. If your Center has in-house computer programmers or analysts, are they assigned to one specific user area (e.g., administrative applications, clinical applications, etc.)?

☐ YES    ☐ NO    ☐ NOT APPLICABLE

9. If your Center has satellite clinics, how are they integrated into the information system?

☐ Not applicable (no satellite clinics)  
☐ Batch processing (data sent to a central facility for processing)  
☐ Terminals connected directly to a computer  
☐ Satellites not involved in information system  
☐ Other (Please specify): \_\_\_\_\_

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## COMMENTS:

III. INFORMATION SYSTEM PLANNING AND CONTROL

10. Does your Center have a specific committee or group which deals with information system issues (e.g., establishes overall direction for system development, establishes information system goals and policies, etc.)?

☐ YES ☐ NO

If YES, who is on the committee? (Indicate position titles of committee members)

_____	_____
_____	_____
_____	_____
_____	_____

- 11.a. When a new system or application is being considered, does your Center document the following?

	<u>Yes, in a formal way</u>	<u>Yes, but not in a well-defined way</u>	<u>Has not been a concern</u>
Capabilities and requirements of proposed system or application	_____	_____	_____
Projected personnel requirements	_____	_____	_____
Computer hardware requirements	_____	_____	_____
System development plan (plan for project organization and review)	_____	_____	_____
Estimated costs of development and operation	_____	_____	_____
Training requirements	_____	_____	_____
Other (Please specify):	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

- b. Who participates in the preparation of the above documentation? (Check all that apply)

☐ Administrator  
☐ MIS committee (or the group responsible for overall direction of the information system)  
☐ Program managers  
☐ MIS specialist  
☐ Clinicians  
☐ Evaluator  
☐ Clerical support staff  
☐ Other (Please specify): \_\_\_\_\_

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12. How are priorities assigned when improvements are to be made in the information system?
- ☐ First come, first served  
☐ Management provides criteria  
☐ MIS committee evaluation  
☐ Other (Please specify): \_\_\_\_\_
13. Are programs/organizational units charged for the computer services they use?
- ☐ YES      ☐ NO
14. Does your Center use any of the following techniques for planning and controlling system development efforts? (Check all that apply)
- ☐ Activity network charts showing the relationships between project activities (e.g., PERT)  
☐ Responsibility charts showing people assigned to specific tasks  
☐ Bar charts showing project milestones or interim target deadlines  
☐ Job definitions related to a specific system development project  
☐ Management by objectives (MBO)  
☐ Other (Please specify): \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_
15. Is your Center's information system formally evaluated to determine how well user needs are being met and whether the system is operating efficiently?
- ☐ YES      ☐ NO      ☐ OCCASIONALLY
16. Does your information system provide security for maintaining confidentiality of client data?
- ☐ YES      ☐ SOME, BUT COULD BE IMPROVED      ☐ NO
17. Are information handling procedures documented (e.g., who prepares data input, error correction procedures, routing and filing procedures, etc.)?
- ☐ MOST      ☐ SOME      ☐ NONE
18. Does your Center's information system have written documentation which includes:
- |   | <u>ALL/MOST</u> | <u>SOME</u> | <u>NONE</u> |
|---|-----------------|-------------|-------------|
| System flowcharts   | _____           | _____       | _____       |
| Data element dictionary   | _____           | _____       | _____       |
| Program descriptions (including program name and number, programming language, inputs, outputs, and flowcharts) | _____           | _____       | _____       |
| Program listings  | _____           | _____       | _____       |
| Record layouts  | _____           | _____       | _____       |
| File characteristics (including number of records, where created, type of file, backup procedure)               | _____           | _____       | _____       |
| Keypunch/data entry instructions  | _____           | _____       | _____       |
| System controls   | _____           | _____       | _____       |
| Samples of source documents and reports   | _____           | _____       | _____       |
| Procedures for requesting modifications   | _____           | _____       | _____       |

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19. Which of the following best describes your Center's data processing budget? (Check only one)
- ☐ No specific data processing budget (e.g., part of a larger budget item or included in the budget of another organization)
  - ☐ General data processing budget (e.g., overall budget specified but no specific breakdowns for data processing personnel, computer costs, system development costs, etc.)
  - ☐ Well-defined data processing budget (e.g., specific breakdowns for data processing personnel, computer costs, system development costs, etc.)
20. Was the most recent system development effort:
- YES NO
- ☐ Installed within the projected budget?  
If NO, what was the % of cost overrun? \_\_\_\_\_
  - ☐ Installed on schedule?  
If NO, what was the % of time overrun? \_\_\_\_\_
21. Which of the following best describes your Center's information system history? (If your Center has had more than one information system, check all that apply)
- ☐ The operation of the system was terminated or lapsed because it failed to meet user needs or because of technical difficulties
  - ☐ The system lasted at least two years with no major additions or modifications
  - ☐ The system lasted at least two years and was upgraded with new applications

COMMENTS:

IV. USER INVOLVEMENT

22. How would you characterize the nature of user involvement throughout the system development process (e.g., planning system capabilities, design of forms, outputs, procedures and uses of data, system modification to improve data utilization)? (Check only one)

- ☐ Hands off
- ☐ Users have final review only
- ☐ Users informed and consulted periodically on decisions being made
- ☐ Users actively and continuously involved throughout system development

23. What is the predominant attitude among the following constituent groups toward the usefulness of computer-supported applications?

	Definitely useful	Somewhat useful	Minimally useful	Creates more problems than worth
Administrator	1	2	3	4
Program managers/supervisors	1	2	3	4
Clinical staff	1	2	3	4
Researchers	1	2	3	4
Evaluators	1	2	3	4
Clerical support staff	1	2	3	4
Other (Please specify):				
_____	1	2	3	4

-7-

24. Are users expressing interest in developing new computer applications?

☐ YES ☐ OCCASIONALLY ☐ NO

25. Is there one person within the Center who served as the primary advocate of information system improvement and guided its development?

☐ YES ☐ NO

If YES, did the same person fill this role for at least two years?

☐ YES ☐ NO

26. When a new computer application is being developed, are the following activities carried out?

	<u>Yes, in a formal way</u>	<u>Yes, but not in a well-defined way</u>	<u>Has not been a concern</u>
Assessment of users' information needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Distribution of newsletters or memoranda to keep users informed as system planning and design progresses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Demonstration project carried out prior to full system implementation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Formal training sessions to familiarize users with new forms/procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Formal training sessions with users on utilization of output	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establishment of procedures to modify new system to be more responsive to user needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. Who has generally benefitted most from computer-supported applications?  
What were the principal benefits derived?

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COMMENTS:

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*Do you wish to receive a copy of the summarized survey results?*

☐ YES ☐ NO

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# APPENDIX C

## FREQUENCY DISTRIBUTIONS OF DEVELOPMENT STATUS OF COMPUTER APPLICATIONS

	<u>Computer Support Operational</u>	<u>Computer Support in Development</u>	<u>Detailed Plans in Progress</u>	<u>Long-term Planning Only</u>	<u>No Specific Plans for Computer Support</u>
<b>Administrative Applications</b>					
Patient census and demographic characteristics	43 (81%)	7 (13%)	2 ( 4%)	0 ( 0%)	1 ( 2%)
Third-party billing	30 (57%)	7 (13%)	3 ( 6%)	8 (15%)	5 ( 9%)
Direct patient billing	30 (57%)	6 (11%)	4 ( 8%)	6 (11%)	6 (11%)
Financial/Accounting	29 (55%)	7 (13%)	2 ( 4%)	10 (19%)	5 ( 9%)
Payroll	35 (66%)	5 ( 9%)	0 ( 0%)	6 (11%)	7 (13%)
Inventory system for property	17 (32%)	1 ( 2%)	4 ( 8%)	4 ( 8%)	26 (49%)
Staff activity data	41 (77%)	4 ( 8%)	3 ( 6%)	3 ( 6%)	2 ( 4%)
Cost outcome data	7 (13%)	7 (13%)	9 (17%)	21 (40%)	9 (17%)
Other	1 ( 2%)	1 ( 2%)	0 ( 0%)	1 ( 2%)	0 ( 0%)
<b>Clinical Applications</b>					
Intake data	29 (55%)	8 (15%)	1 ( 2%)	5 ( 9%)	9 (17%)
Individual treatment plan	4 ( 8%)	2 ( 4%)	3 ( 6%)	11 (21%)	32 (60%)
Direct service data	39 (74%)	4 ( 8%)	2 ( 4%)	2 ( 4%)	6 (11%)
Diagnostic data	26 (49%)	4 ( 8%)	5 ( 9%)	5 ( 9%)	13 (25%)
Indirect service data	32 (60%)	4 ( 8%)	3 ( 6%)	4 ( 8%)	9 (17%)
Medication treatment data	11 (21%)	4 ( 8%)	4 ( 8%)	6 (11%)	28 (53%)
Follow-up data	5 ( 9%)	6 (11%)	3 ( 6%)	10 (19%)	28 (53%)
Mental status examination	4 ( 8%)	2 ( 4%)	1 ( 2%)	10 (19%)	33 (62%)

APPENDIX C (continued)

	<u>Computer Support Operational</u>	<u>Computer Support in Development</u>	<u>Detailed Plans in Progress</u>	<u>Long-term Planning Only</u>	<u>No Specific Plans for Computer Support</u>
Clinical Applications (continued)					
Utilization review	9 (17%)	8 (15%)	6 (11%)	8 (15%)	22 (42%)
Special symptom or problem scales	7 (13%)	5 ( 9%)	4 ( 8%)	13 (25%)	24 (45%)
Goal achievement data	4 ( 8%)	4 ( 8%)	7 (13%)	16 (30%)	22 (42%)
Clinical progress notes	1 ( 2%)	2 ( 4%)	1 ( 2%)	4 ( 8%)	44 (83%)
Development and social history	2 ( 4%)	1 ( 2%)	2 ( 4%)	8 (15%)	40 (75%)
Psychological screening (e.g., MMPI)	5 ( 9%)	1 ( 2%)	3 ( 6%)	5 ( 9%)	39 (74%)
Computerized predictions	1 ( 2%)	1 ( 2%)	2 ( 4%)	10 (19%)	39 (74%)
Other	1 ( 2%)	1 ( 2%)	0 ( 0%)	0 ( 0%)	0 ( 0%)

## APPENDIX D

### GENERAL CHARACTERISTICS OF CENTERS IN EACH STAGE OF APPLICATIONS DEVELOPMENT

Appendix D presents a tabulation and discussion of the general characteristics of centers in each stage. The following discussion is descriptive; no evaluation is made about the statistical significance of the data. Most of these data were collected during the preliminary survey.

#### Type of Computer Facility

<u>Type of Computer Facility</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Own/lease in-house computer	6	23	8	42	4	50
Use computer owned by another organization	20	77	12	63	4	50

These data indicate an increase in the number of in-house computers owned or leased by centers which have developed a more complete set of computer-supported applications. This is to be expected because the feasibility of using the computer for a variety of applications is established and the level of in-house technical expertise increased. The expense of acquiring an in-house computer is therefore more readily justified. Centers may also find they need more control over computer resources in order to develop applications suited

to their particular needs.

Number of Years Computer Used

<u>Number of Years Computer Used</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	No. of Centers	%	No. of Centers	%	No. of Centers	%
1 - 2	10	38	9	47	3	38
3 - 4	6	23	3	16	0	0
5 - 6	3	12	3	16	1	13
7 or more	6	23	3	16	3	38
No response	1	4	1	5	1	13
Mean		4.2		3.6		5.1
Median		3		2.5		5

The mean and median values indicate that centers in stage 3 have been using computers longer than centers in the other two stages. About one-fourth of the stage 1 centers have been using a computer for at least seven years. These centers have evidently had a small set of applications developed for several years with very few new applications being added.

System Development History

<u>System History Category</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
1 - System was terminated	2	8	1	5	0	0
2 - System operational at least 2 years/not upgraded	3	12	4	21	2	25
3 - System operational at least 2 years/was upgraded	16	62	8	42	4	50
4 - System not yet operational for 2 years	3	12	4	21	0	0
5 - Combination of 1 and 2 above	0	0	2	11	0	0
6 - Combination of 1 and 3 above	0	0	0	0	1	13
7 - Combination of 1 and 4 above	1	4	0	0	1	13
No response	1	4	0	0	0	0

In this questionnaire item respondents were asked to describe their center's system development history using the categories listed in the table. This item was included to indicate whether systems are responding to user needs through modifications or additions of new applications. The data show that centers in each stage most frequently reported their information system has been operational at least two years and was upgraded with new applications. A few centers indicated their system had not been operational for two years. An earlier questionnaire item indicated that a larger number of centers reported a computer had been used for two years or less. Since this possibility was not included as a separate option, a number of respondents probably answered using other categories.

System Development Options

<u>System Development Options*</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Purchased packaged system	8	31	4	21	2	25
Participate in statewide system	9	35	6	32	3	38
Developed system in-house	17	65	9	47	4	50
Developed system under contract	8	31	7	37	3	38
Other (i.e., modified packaged system)	1	4	1	5	1	13

\*Multiple responses are possible

The distribution of responses across all system development options is similar for all stages. The most common option used is in-house system development. The responses to this item are somewhat questionable because very few centers indicate they have in-house programmers. It is possible these respondents are referring to participation of in-house staff in establishing desired system capabilities and not to implementation of technical design tasks such as programming.

Data Processing Budget

<u>Annual Data Processing Budget</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
\$1,000 - 10,000	7	27	2	11	1	13
\$11,000 - 20,000	2	8	5	26	2	25
\$21,000 - 40,000	4	15	4	21	2	25
\$41,000 - 100,000	3	12	4	21	2	25
Greater than \$100,000	2	8	2	11	0	0
No response	8	31	2	11	1	13

Responses to this item indicate a wide range of data processing expenditures among centers in each stage with no concentration in any category. Centers in stages 2 and 3 have a higher percentage of data processing budgets exceeding \$20,000 than centers in stage 1. The non-response rate for stage 1 centers was particularly high. Some respondents indicated their data processing budget was included in the budget of another organization; others did not have budget figures available.

Use of Terminals

<u>Computer Terminal Usage</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Computer terminals are not used	19	73	17	89	5	63
Computer terminals are used	7	27	2	11	3	38
Number of terminals:						
1 - 5	6	23	1	5	3	38
6 or more	1	4	1	5	0	0

The relatively small number of centers using terminals indicates that centers are using batch processing instead of interactive processing capability. This is not unexpected because most of the applications being developed involve periodic processing of large numbers of transactions' and are therefore suited to a batch processing environment.

## APPENDIX E

### CHARACTERISTICS OF ENABLING FACTORS FOR CENTERS IN EACH STAGE OF APPLICATIONS DEVELOPMENT

Appendix E presents a tabulation and discussion of data items contained in parts II, III, and IV of the questionnaire contained in Appendix B. The following discussion is descriptive; no evaluation is made about the statistical significance of the data.

#### ORGANIZATION OF DATA PROCESSING ACTIVITIES

##### Location of Data Processing Activities

<u>Location of Data Processing Function</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Separate organizational unit	4	15	5	26	2	25
Included in activities of another organizational unit	15	58	11	58	4	50
Joint responsibility between more than one organizational unit	2	8	1	5	2	25
Not a distinct organizational unit	5	19	2	11	0	0

Fifty percent or more of the centers in each stage include data processing activities as part of the activities of some other organizational unit. One-fourth of the centers in stages 2 and 3 report having separate data processing units. Centers in stage 1 had the

highest incidence of no formally organized data processing activity, while no centers in stage 3 are classified in this category.

Responsibility for Data Processing Activities

<u>Person With Responsibility for Information System</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Administrator	1	4	0	0	1	13
Deputy Administrator	3	12	0	0	1	13
Director of Administrative Services	4	15	6	32	0	0
Program Manager/Clinical Director	2	8	0	0	0	0
Director of Research & Evaluation	4	15	3	16	3	38
Business Manager	1	4	2	11	0	0
Program Evaluator	5	19	2	11	1	13
Director of MIS/D.P. Manager	4	15	6	32	1	13
Other	2	8	0	0	1	13

This question was included to determine the position title of the individual with overall responsibility for the center's information system. Responses were grouped into nine categories as specified in the table. A wide variety of responses were obtained, both for centers within each stage and between stages. Very few centers in any stage assign information system responsibility to the administrator, program managers, or business manager.

Reporting Relationships

<u>Position Title to Whom Person in Charge of Information System Reports</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Administrator	18	69	15	79	5	63
Deputy Administrator	1	4	0	0	0	0
Director of Administrative Services	1	4	2	11	1	13
Program Manager/Clinical Director	2	8	0	0	1	13
Director of Research & Evaluation	0	0	1	5	0	0
Business Manager	1	4	1	5	0	0
Other	3	11	0	0	1	13

The majority of respondents indicate the person in charge of information systems reports directly to the Administrator.

Staffing Patterns

<u>Staff Routinely Involved in Data Processing Activities</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>Median Number of Staff</u>	<u>Median % of Time Spent</u>	<u>Median Number of Staff</u>	<u>Median % of Time Spent</u>	<u>Median Number of Staff</u>	<u>Median % of Time Spent</u>
Clerical support staff	2	20	2	35	1	10
Programmers/analysts	0	0	0	0	0	0
Data entry staff	0	0	1	25	1	30
Computer operators	0	0	0	0	0	0
MIS specialists	0	0	0	0	0	0
Program evaluators	1	5	0	0	1	20
Administrators	0	0	1	1	0	0
Program managers	0	0	0	0	0	0
Clinicians	0	0	0	0	0	0
Researchers	0	0	0	0	0	0

This questionnaire item pertains to the number of staff and percentage of time spent on data-related activities. Respondents were provided a list of job descriptions which might involve activities such as data collection, data entry, data control, distribution of reports, data analysis, and system development and maintenance. The table shows the median values of the responses. These data indicate that community mental health centers have very few in-house staff in positions specifically related to data processing. For example, the majority of centers do not have in-house programmers, computer operators, or MIS specialists. It appears that clerical support staff, keypunchers or data entry staff, and program evaluators are carrying out most of the routine

data processing functions. There are only slight differences in the staffing patterns of centers in different stages.

Assignment of Programmers

<u>Assignment of Programmers</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Programmers assigned to specific user areas	2	8	0	0	0	0
Programmers not assigned to specific user areas	6	23	6	32	3	38
Not applicable (no in-house programmers)	17	65	12	63	5	63
No response	1	4	1	5	0	0

These data show that very few centers with in-house computer programmers assign programming staff to one specific user area (e.g., administrative applications and clinical applications). This finding is to be expected because only a few centers have more than one in-house programmer.

Job Descriptions

<u>Extent to Which Job Descriptions Document Data Processing Responsibilities</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Documented for all positions	10	38	7	37	3	38
Documented for some positions	14	54	11	58	5	63
Documented for no positions	0	0	1	5	0	0
No response	2	8	0	0	0	0

No distinct differences among responses are apparent for this questionnaire item. Fifty percent or more of the centers in each stage reported that some positions have job descriptions documenting data processing responsibilities. At least one-third of the centers reported job descriptions were documented for all positions specifically related to data processing activities.

Integration of Satellite Clinics

<u>How Satellite Clinics Are Integrated Into Information Systems</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Batch processing	22	85	17	89	7	88
Computer terminals	0	0	1	5	1	13
Not involved in information system	1	4	0	0	0	0
Not applicable (no satellite clinics)	2	8	1	5	0	0
No response	1	4	0	0	0	0

Responses indicate more than eighty percent of the centers are integrating data from satellite clinics through batch processing. This is to be expected because very few centers are using terminals.

# PLANNING AND CONTROL TECHNIQUES

## Information System Steering Committee

	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
<u>Use of Information System Steering Committee</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Steering committee is used	11	42	6	32	6	75
Steering committee is not used	15	58	13	68	2	25

This question dealt with the use of a steering committee which establishes information system policy and overall direction of system development. Centers in stage 3 report the most frequent use of such a committee.

Planning Documentation

<u>Type of Planning Documentation</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Capabilities of proposed system						
Documented in a formal way	13	50	8	42	4	50
Documented but not in a well-defined way	10	38	10	53	3	38
Has not been a concern	2	8	0	0	1	13
No response	1	4	1	5	0	0
Projected personnel requirements						
Documented in a formal way	12	46	5	26	4	50
Documented but not in a well-defined way	7	27	9	47	1	13
Has not been a concern	5	19	3	16	2	25
No response	2	8	2	11	1	13
Computer hardware requirements						
Documented in a formal way	12	46	5	26	4	50
Documented but not in a well-defined way	6	23	8	42	1	13
Has not been a concern	6	23	4	21	3	38
No response	2	8	2	11	0	0
System development project plan						
Documented in a formal way	10	38	5	26	5	63
Documented but not in a well-defined way	10	38	9	47	1	13
Has not been a concern	4	15	4	21	2	25
No response	2	8	1	5	0	0
Estimated costs of development and operation						
Documented in a formal way	16	62	7	37	4	50
Documented but not in a well-defined way	5	19	7	37	3	38
Has not been a concern	3	12	4	21	1	13
No response	2	8	1	5	0	0
Training requirements						
Documented in a formal way	9	35	5	26	2	25
Documented but not in a well-defined way	11	42	12	63	3	38
Has not been a concern	4	15	1	5	2	25
No response	2	8	1	5	1	13

These data show the extent of formal documentation prepared when a new system or application is being developed. Six documentation areas are addressed. The distributions reveal no major differences in the extent of formal documentation prepared by centers in each stage.

Assignment of System Improvement Priorities

<u>Criteria for Assigning System Improvement Priorities*</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
First come, first served	5	19	1	5	0	0
Management provides criteria	14	54	8	42	4	50
Information steering committee evaluation	6	23	5	26	4	50
Other (i.e., person with responsibility for system)	2	8	7	37	2	25

\* Multiple responses were received

The most common response to this questionnaire item is that management provides the criteria for system development priorities. Centers in stage 3 indicate the information system steering committee is also frequently used to establish priorities. An earlier questionnaire item showed that these centers had the highest percentage of steering committees. The respondents in stage 1 reported the highest incidence of setting priorities based on the first come, first served criteria.

Charge-out for Computer Services

<u>Charge-out for Computer Services</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Users charged for computer services	5	19	5	26	4	50
Users not charged for computer services	21	81	14	74	4	50

This item was included to determine whether users are charged for the computer services they use or if these costs are absorbed through a central data processing budget. Fifty percent of the centers in stage 3 have a user charge-out system as compared to less than one-fourth of the other centers.

Techniques for Planning and Controlling Development Efforts

<u>Planning and Control Techniques</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Activity network charts (i.e., PERT)	3	12	4	21	0	0
Responsibility charts	5	19	5	26	1	13
Bar chart showing project mile- stone	4	15	1	5	0	0
Job descriptions for system development staff	6	23	3	16	0	0
Management by objectives (MBO)	11	42	7	37	3	38
Other (i.e., verbal agreement on tasks and target dates)	3	12	2	11	0	0

In this questionnaire item, respondents were provided a list of planning and control techniques and asked to check those used to manage system development projects. Management by objectives is the most frequently used technique although responses in this category ranged from twenty-nine to fifty-eight percent. Even though multiple responses were possible, responses totalling only fifty-one percent were reported by the stage 3 centers. This cumulative total is less than one-half that reported by other centers. This finding is surprising because one would expect these centers to have more experience in the use of these techniques.

Evaluation of System Performance

<u>Extent to Which System Per-</u> <u>formance is Formally Evaluated</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Formal evaluation conducted	3	12	7	37	2	25
Formal evaluation occasionally conducted	13	50	5	26	1	13
Formal evaluation not conducted	10	38	7	37	5	63

A wide range of responses was received for this question and no general relationships are apparent. Very little system evaluation is routinely being carried out. Between one-third and two-thirds of the respondents in each stage report no evaluation of system performance.

Provisions for Maintaining Confidentiality of Data

<u>Adequacy of System Security</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
System provides adequate security for confidential data	19	73	14	74	7	88
System security could be improved	6	23	5	26	1	13
System does not provide security for confidential data	1	4	0	0	0	0

The majority of respondents in each stage indicated that adequate security features exist to maintain confidentiality of client data. This issue frequently arises as a major concern among clinicians when automation of client records is being considered. Apparently, however, it is not seen as a problem in operational systems.

Documentation of Information Handling Procedures

<u>Extent to Which Information Handling Procedures Are Documented</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Most procedures	7	27	12	63	7	88
Some procedures	16	62	6	32	1	13
No procedures	2	8	1	5	0	0
No response	1	4	0	0	0	0

This question was included to determine whether procedures for data input, error correction, routing, and filing were documented. The amount of documentation increases dramatically between stages. The majority of centers in stage 1 reported that some data handling procedures were documented, while the majority of centers in stage 2 and 3 indicated most of these procedures were documented.

System and Program Documentation

<u>Type of System Documentation</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
System flowcharts						
All documented	7	27	5	26	5	63
Some documented	12	46	9	47	1	13
None documented	4	15	2	11	2	25
No response	3	12	3	16	0	0
Data element dictionary						
All documented	18	69	9	47	5	63
Some documented	2	8	4	21	1	13
None documented	3	12	3	16	2	25
No response	3	12	3	16	0	0
Program descriptions						
All documented	10	38	9	47	6	75
Some documented	7	27	5	26	1	13
None documented	6	23	1	5	1	13
No response	3	12	4	21	0	0
Program listings						
All documented	16	62	11	58	7	88
Some documented	5	19	2	11	0	0
None documented	2	8	3	16	1	13
No response	3	12	3	16	0	0
Record layouts						
All documented	11	42	9	47	4	50
Some documented	3	12	3	16	2	25
None documented	7	27	4	21	2	25
No response	5	19	3	16	0	0
File characteristics						
All documented	15	58	6	32	4	50
Some documented	3	12	6	32	3	38
None documented	5	19	2	11	1	13
No response	3	12	5	26	0	0
Data entry instructions						
All documented	16	62	9	47	6	75
Some documented	4	15	6	32	0	0
None documented	2	8	1	5	2	25
No response	4	15	3	16	0	0

<u>Type of System Documentation</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
System controls						
All documented	10	38	6	32	4	50
Some documented	8	31	10	53	2	25
None documented	2	8	0	0	1	13
No response	6	23	3	16	1	13
Samples of source documents and reports						
All documented	16	62	8	42	6	75
Some documented	6	23	6	32	0	0
None documented	2	8	2	11	2	25
No response	2	8	3	16	0	0

This questionnaire item contained a list of standard system documentation such as system flowcharts, data element dictionary, system controls, program documentation, and procedures for requesting modifications. Overall, stage 3 centers had the highest percentage of responses indicating that all or most of the specified documentation was available in written form. These responses ranged from fifty to eighty-eight percent of the centers in this stage. Stage 2 centers frequently show the lowest percentage of responses in this category. A few centers in each stage consistently reported that none of this documentation was available. Since programming staff are generally not part of the center's staff, this documentation may be available at others locations.

Data Processing Budget

<u>Description of Data Processing Budget</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
No specific data processing budget	10	38	9	47	2	25
General data processing budget	9	35	6	32	4	50
Well-defined data processing budget	7	27	4	21	1	13
No response	0	0	0	0	1	13

Respondents were asked to describe their center's data processing budget using one of the following classifications:

1. No specific data processing budget (e.g., part of a larger budget item or included in the budget of another organization).
2. General data processing budget (e.g., overall budget specified but no specific breakdowns for data processing personnel, computer costs, system development costs).
3. Well-defined data processing budget (e.g., specific breakdowns for data processing personnel, computer costs, system development costs).

The most common response among centers in stages 1 and 2 was that no specific data processing budget exists. For centers in stage 3, a general data processing budget was the most common response.

Information System Installation

<u>Information System Installation</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Installed within projected budget	15	58	9	47	3	38
Not installed within projected budget	3	12	3	16	1	13
No response	8	31	7	37	4	50
Installed on schedule	8	31	5	26	3	38
Not installed on schedule	10	38	7	37	3	38
No response	8	31	7	37	2	25

These data show that more systems were installed within the projected budget than on schedule. For example, centers in stage 1 reported that fifty-eight per cent of the most recent system development efforts were installed within budget and thirty-one per cent installed on schedule. Approximately one-third of the respondents in each stage did not answer. This questionnaire item also asked the percentage of cost and time overruns, but the majority of centers did not respond.

## USER INVOLVEMENT

Nature of User Involvement

	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
<u>Nature of User Involvement</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Hands off	3	12	2	11	1	13
Users have final review only	2	8	1	5	0	0
Users consulted periodically	13	50	9	47	2	25
Users actively involved	7	27	7	37	4	50
No response	1	4	0	0	1	13

This question pertains to user involvement in planning system capabilities, designing forms, outputs, procedures and uses of data, and suggesting modifications to improve data utilization. The most frequent response by users in stages 1 and 2 was that users are informed and consulted periodically on decisions being made. One-half of the centers in stage 3 indicated that users are actively and continuously involved throughout system development.

Information System Advocate

<u>Use of Information System Advocate</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
One person served as primary advocate of information system improvement	15	58	19	100	7	88
System advocate filled this role for at least two years	11	42	13	68	6	75
One person did not serve as primary advocate of informa- tion system improvement	10	38	0	0	1	13
No response	1	4	0	0	0	0

This questionnaire item was included to determine if one person within the center served as the primary advocate of information system improvement and guided its development. The system advocate role is seen as providing an important liaison between the technical staff and the users so the right people will be involved in making key decisions. More than one-half of the centers in stage 1 indicated that one person filled this type of role. All of the centers in stage 2 and eighty-eight percent of those in stage 3 also indicated the existence of an information system advocate. Stage 3 has the largest percentage of centers reporting the same person filled this role for at least two years.

User Involvement Activities

<u>User Involvement Activities</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Assessment of users' information needs						
Carried out in a formal way	7	27	12	63	6	75
Carried out but not in a well-defined way	16	62	7	37	2	25
Has not been a concern	1	4	0	0	0	0
No response	2	8	0	0	0	0
Distribution of newsletters or memoranda about system development activities						
Carried out in a formal way	3	12	4	21	2	25
Carried out but not in a well-defined way	13	50	6	32	2	25
Has not been a concern	8	31	9	47	3	38
No response	2	8	0	0	1	13
Demonstration project prior to full system implementation						
Carried out in a formal way	8	31	6	32	2	25
Carried out but not in a well-defined way	7	27	3	16	2	25
Has not been a concern	8	31	9	47	3	38
No response	3	12	1	5	1	13
Training sessions or new forms and procedures						
Carried out in a formal way	14	54	13	68	6	75
Carried out but not in a well-defined way	7	27	3	16	1	13
Has not been a concern	2	8	2	11	0	0
No response	3	12	1	5	1	13
Training sessions on utilization of reports						
Carried out in a formal way	8	31	6	32	4	50
Carried out but not in a well-defined way	12	46	10	53	3	38
Has not been a concern	4	15	3	16	0	0
No response	2	8	0	0	1	13

<u>User Involvement Activities</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>	<u>No. of</u> <u>Centers</u>	<u>%</u>
Procedures established to modify system to be more responsive to user needs						
Carried out in a formal way	3	12	6	32	5	63
Carried out but not in a well-defined way	11	42	9	47	1	13
Has not been a concern	9	35	4	21	1	13
No response	3	12	0	0	1	13

Respondents were presented a list of system support activities designed to inform or train users about the system under development. These activities included assessment of users' information needs, distribution of newsletters or memoranda, demonstration projects, training sessions to familiarized users with new forms, procedures, and utilization of output, and establishment of procedures to modify the system to be more responsive to user needs. Responses indicate that training sessions to familiarize users with new forms and procedures is the only activity being carried out in a formal way by a number of centers in every stage. Generally, stage 3 respondents reported the highest percentage of activities being carried out in a formal way, although the range of responses varied from twenty-five to seventy-five percent. Between twenty and fifty percent of the centers indicated that carrying out some of these activities has not been a concern. The use of newsletters, demonstration projects, and procedures for modifying the system were implemented less frequently than other activities.

## INFORMATION SYSTEM IMPACT

Predominant Attitudes

<u>Attitudes Toward Usefulness of Information System</u>	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Administrator						
Definitely useful	12	46	17	89	7	88
Somewhat useful	10	38	1	5	1	13
Minimally useful	2	8	1	5	0	0
Creates more problems than worth	1	4	0	0	0	0
No response	1	4	0	0	0	0
Program managers						
Definitely useful	9	35	4	21	7	88
Somewhat useful	9	35	11	58	0	0
Minimally useful	7	27	2	11	1	13
Creates more problems than worth	0	0	2	11	0	0
No response	1	4	0	0	0	0
Clinical staff						
Definitely useful	1	4	3	16	0	0
Somewhat useful	8	31	5	26	6	75
Minimally useful	11	42	8	42	2	25
Creates more problems than worth	5	19	3	16	0	0
No response	1	4	0	0	0	0
Researchers						
Definitely useful	13	50	12	63	8	100
Somewhat useful	3	12	2	11	0	0
Minimally useful	4	15	2	11	0	0
Creates more problems than worth	1	4	1	5	0	0
No response	5	19	2	11	0	0
Evaluators						
Definitely useful	15	58	14	74	8	100
Somewhat useful	5	19	0	0	0	0
Minimally useful	3	12	3	16	0	0
Creates more problems than worth	0	0	1	5	0	0
No response	3	12	1	5	0	0
Clerical support staff						
Definitely useful	7	27	6	32	3	38
Somewhat useful	7	27	3	16	2	25
Minimally useful	6	23	6	32	2	25
Creates more problems than worth	5	19	3	16	0	0
No response	1	4	1	5	1	13

Respondents were asked to rate the predominant attitude among constituent groups toward the usefulness of computer-supported applications. Evaluators, administrators, and researchers most frequently rated the system as definitely useful. At the other end of the scale, clinical and clerical support staff most often indicated the system creates more problems than it is worth. Stage 3 centers consistently had the most favorable attitudes among most constituent groups.

Interest in Developing New Applications

	<u>Stage 1</u>		<u>Stage 2</u>		<u>Stage 3</u>	
<u>User Interest in Developing New Computer Applications</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>	<u>No. of Centers</u>	<u>%</u>
Users are expressing interest	8	31	12	63	6	75
Users occasionally expressing interest	16	62	7	37	2	25
Users not expressing interest	2	8	0	0	0	0

Stage 3 had the greatest number of centers indicating users are expressing interest in developing new computer-supported applications. Two centers in stage 1 are the only ones reporting no such interest.

Benefits of Computer-Supported Applications

The questionnaire contained an open-ended question asking who has benefitted most from computer-supported applications and what were the principal benefits derived. Administrative and financial staff were cited most often as receiving the most benefit from the system. Very few centers reported that the system provided time savings for clerical staff. Respondents in stage 3 did not report a wider range of benefits than other centers. No other distinctions among stages was evident.