THE ORGANIZATIONAL CONSEQUENCES OF INFORMATION DEPLOYMENT

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

William S. Remington, B.S., M.B.A.
Denton, Texas
December, 1991

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This study investigates the influence that increasing end user autonomy has on organizational data models. The independence offered by microcomputer technology offers users increasing independence in their information-handling activities. As independence increases, uniformity of data models across the organization is theorized to diminish.

The problem motivating this study is the potential for improper allocation of resources that may result from a misinterpretation of organizational data. This study suggests that the expanding use of microcomputers in the business setting will contribute to diversity of data models. This may eventually lead to confusion and even lack of confidence in the information produced.

This project employed in-depth interviews for data gathering using a structured interview guide. Actual data gathering took place in four different firms. A total of 33 subjects were included. Within each subject firm, the person responsible for data modeling in the organization participated in this study. He assisted in the creation of a series of inter-related semantic objects. The remaining

subjects were selected from among the information-using employees of four subject firms. The interview of each subject followed the interview guide. Part of the interview involved the extraction of the subject's version of the data models previously defined by the data modeler. Comparison of the subjects' data model with that of the data modeler gives a relative measure for data model deterioration (Semantic diffusion).

The primary relationship investigated in this study is the relationship between Information Processing Independence and Semantic Diffusion. Semantic diffusion is the degree of agreement or disagreement with the central data model. Content analysis of the subjects' interviews produced a measure for Information Processing Independence.

Data analysis revealed a very strong correlation between Information Processing Independence and Semantic Diffusion. While this study can make no cause-and-effect conclusions, such a correlation is not inconsistent with the expected theoretical relationship.

The emergence of this phenomenon has strong implications for the management of organization-wide information processing. In the future, greater care must be taken to insure that information from various sources contributes to some consistent picture of the overall organization.

ACKNOWLEDGEMENTS

One can never complete such an overwhelming project as a Doctoral dissertation without the support of a great number of people. Many will not be mentioned here, but it does not mean that they are forgotten or unappreciated.

Of course, my most sincere gratitude must be extended to the members of my committee, Dr. Michael Vanecek, Dr. Al Kvanli, and Dr. Doug Johnson. They always found time in their busy schedules to provide just the right touch of guidance. My chairman, Dr. Steve Guynes, was always a steady source of sage advice. Although too numerous to mention, I received a wealth of assistance from my professors and peers at North Texas.

I owe a special debt to the six different firms who allowed me to conduct this work within their organization. All of my subjects were volunteers, and I must thank them as well.

Through all of the struggles, the support of my family was most important. During my entire academic career my parents, Bill and Jean Remington, and my grandparents, Oren and Marion Marbeiter provided their love and encouragement.

I must give particular thanks to my wife, Betty, for her assistance when things went well, and her patience and understanding when they did not.

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CHAPTER 1

INTRODUCTION TO THE STUDY

Purpose

This study investigates the influence that increasing end-user autonomy is having on organizational data models. Microcomputer technology and the independence it affords offer users increasing autonomy in their information-handling activities. As end-user autonomy increases, it is believed that the uniformity of data models across the organization will begin to diminish, as will understanding of information, potentially resulting in information dysfunctions.

Problem

The problem motivating this study is the potential for misallocation of resources that may result from a misinterpretation of organizational data. This study suggests that the expanding use of microcomputers in the business setting will contribute to diversity of data models. This may eventually lead to confusion and even lack of confidence in the information produced. Researchers have followed the development of end-user computing (EUC) for some time. In particular, they have noted a growing concern about the potential consequences of EUC. Dickson and Nechis (1984) conducted a delphi study of MIS management. In this survey,

managers identified the management of EUC as one of the top MIS issues of the 1980's. Later, in a similar survey, Hartog and Herbert (1986) reported that MIS managers were very concerned about EUC management. With specific respect to the concern for data quality, senior executives have reported that one of the highest rated concerns is compatibility of data between mainframe and micro systems (Hackathorn, 1987-88).

Significance of the Research

Data is a critical organizational resource (Burch, 1986; Weldon, 1981). The ability of an organization to understand itself is important to its success. The quality of data definitions and the uniformity of their application are key contributors to the level of that understanding. This research will focus on a potentially dangerous deterioration of organizational data understanding.

The use of computers in the business environment has evolved from isolated and independent computer systems in the early years to the current integrated database approach (Nolan, 1988; Weldon, 1981). As illustrated in Figure 1, below, developmental progress was, to some extent, measured by the ability of organizations to integrate data. At the same time, the inability to integrate data acted as a barrier that inhibited progress into the next era.

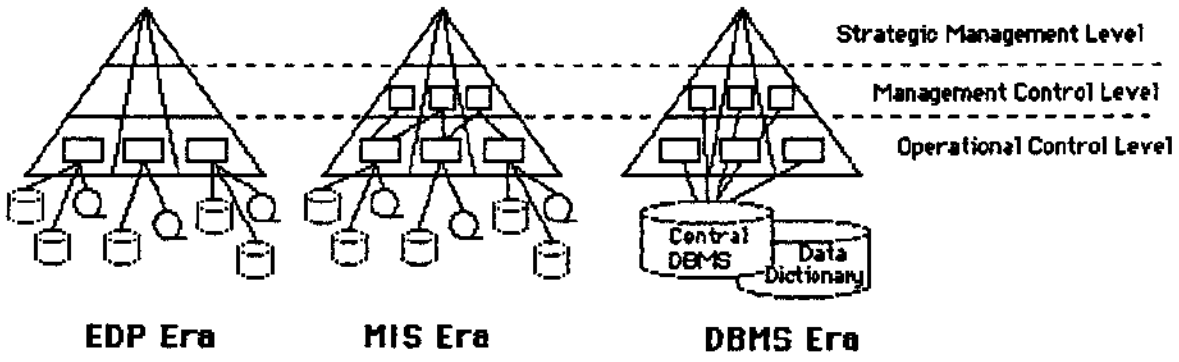

Figure 1. Integration of Data From Era to Era

In a similar fashion, growth in EUC is strongly related to the integration of data. Several researchers have identified strong links between EUC growth and data integration. Davis and Olsen (1985) have pointed out that information systems can be thought of as formal and informal and also as public or private (as illustrated in Figure 2). As this further illustrates, they have asserted that private information systems will increase at the expense of public information systems as a result of EUC. Henderson and Treacy (1986) propose that concern with data within an organization is initially very low, but then it grows dramatically as EUC matures. Huff, Munro, and Martin (1988) have developed what they call a grounded theory of

the stages of growth of EUC with the five stages being defined by the level of data integration.

In the context of the overall portfolio of organizational data, EUC brings with it a potential for long term dis-integration of data. Measurement and evaluation of this phenomenon is a critical missing component of IS theory. This study addresses that missing component.

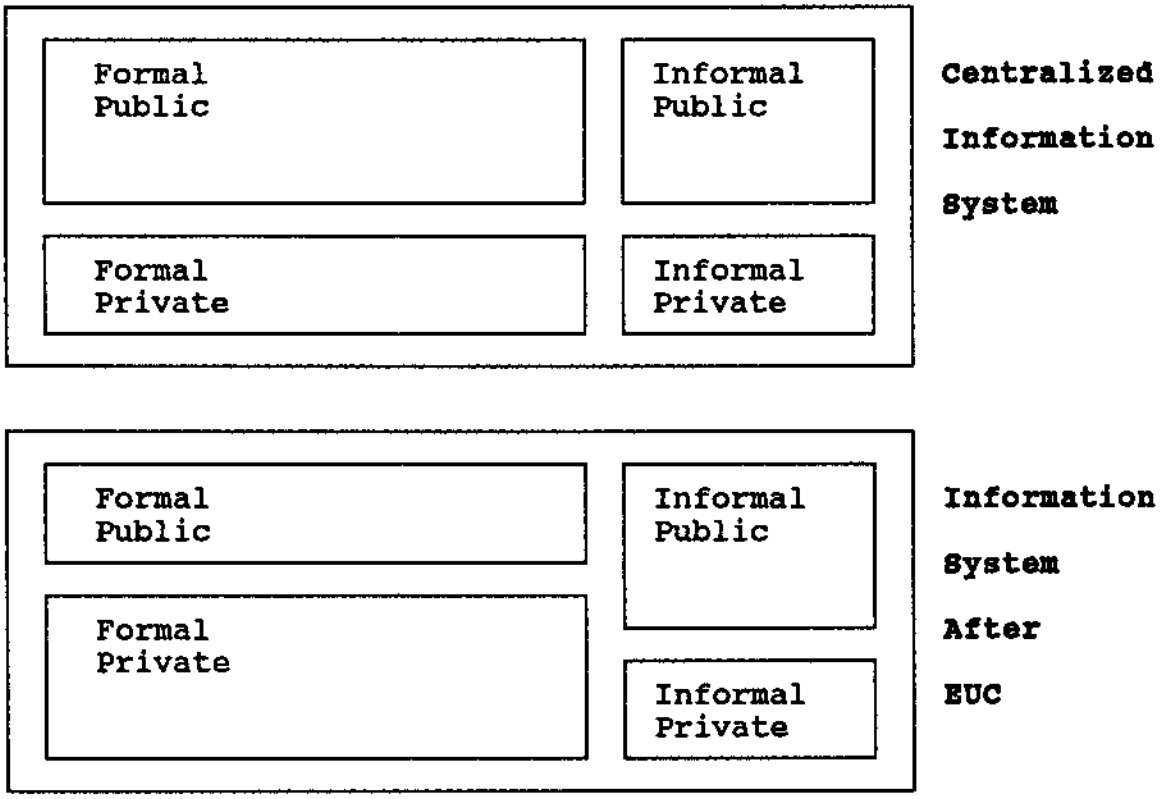

Figure 2. The Influence of EUC on Information System Structure

Adapted from Davis and Olsen, 1985

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CHAPTER 2

PREVIOUS RESEARCH

Analysis of the progress in computerized information processing, as described above, shows that the conceptual approach for data design is a basic determinant of information effectiveness. Indeed, industry-wide progress in information processing is determined, in some measure, by the extent to which data organization has matured. In turn, the specifics of a particular organizations data structures may be influenced by the structure of the organization itself.

Organizational and MIS Structure

Liefer's work (1988) sheds useful light upon the classification of computer-based information systems (CBIS) with respect to organization. Briefly, he shows that they fall within four broad categories; 1) centralized systems, where a mainframe is surrounded by "dumb" terminals, 2) distributed systems, in which semi-autonomous intelligent terminals surround the central facility and depend upon that center for linkage, 3) decentralized systems, where no centralized processor regulates the linkage between systems, and 4) stand-alone systems, which exist primarily in small, fledgling organizations where microcomputers function with full independence. This classification does not, however,

recognize the ever-increasing situation where microcomputers are found in conjunction with systems of the first three types. While the micros are not substantially integrated into these environments, they may act as terminals and/or as independent processing systems.As it happens, organizational centralization and data integration occurred somewhat simultaneously (Olsen and Chervany, 1980).

The prevailing wisdom (Dean, 1968; Ein-Dor and Segev, 1982; Garrity, 1963; Liefer, 1988; and Reichenbach and Tasso, 1968) has been that the structure of the computing activities should mirror the organizational structure. Since there was a movement from free-standing computers to large, centralized facilities (Kaufman, 1978), organizations developed highly consistent, well-integrated data systems.

Later, as they grew larger and more cumbersome, some organizations adopted a decentralized structure. Information Systems reacted by developing Distributed Processing Systems (DPS) which are closely linked processors with well-integrated application and data structures (Appleton, 1978). In this setting, a Data Dictionary System (DDS) becomes a key component (Laning, 1983; and Urhbach, 1984), as does network management (Donavan, 1988; and Lorin et al., 1987). A very different sort of decentralization has been instigated with the advent of microcomputing.

There are many parallels between decentralization through microcomputing and Distributed Processing, the major

difference being the issue of control. A central Information Systems function typically provides the impetus and control for Distributed Processing. However, individuals in the microcomputing environment have much more personal control and are subject to less central control.

Predictions and Prescriptions for the Future

Congruent with decentralization, businesses may choose to alter the structure of their computing organization (Achleitner and Grover, 1988; Donavan, 1988; Lorin, et al., 1987; and Nolan, 1988). Nolan (1988) has suggested that the future involves decentralization of many computing functions. The focus in his prediction that organizations will develop application "portfolios" which will be managed in the functional units. However, he goes on to propose that the centralization of the MIS infrastructure of database management and data communications will continue into the foreseeable future.

Donovan (1988) has followed this lead with a call for the movement of the CIO toward becoming a "network" manager, as a method for managing decentralized computing. His framework (Figure 3, below) describes the decentralization of equipment, software development and decision making. He suggests that this evolution proceeds through several stages bringing about the partially decentralized environments labeled "Big Brother" (A), "Watchdog" (B), and "Helping

Hand" (C). Donovan suggests that all CIO's should aspire to a level of decentralization that he calls "Network Management" (D).

Neither of these two perspectives on the future structure of information systems deployment may actually occur as the future unfolds. Still, there seems to be little doubt that the typical information user of the future will be more active in the development and analysis of the data he processes.

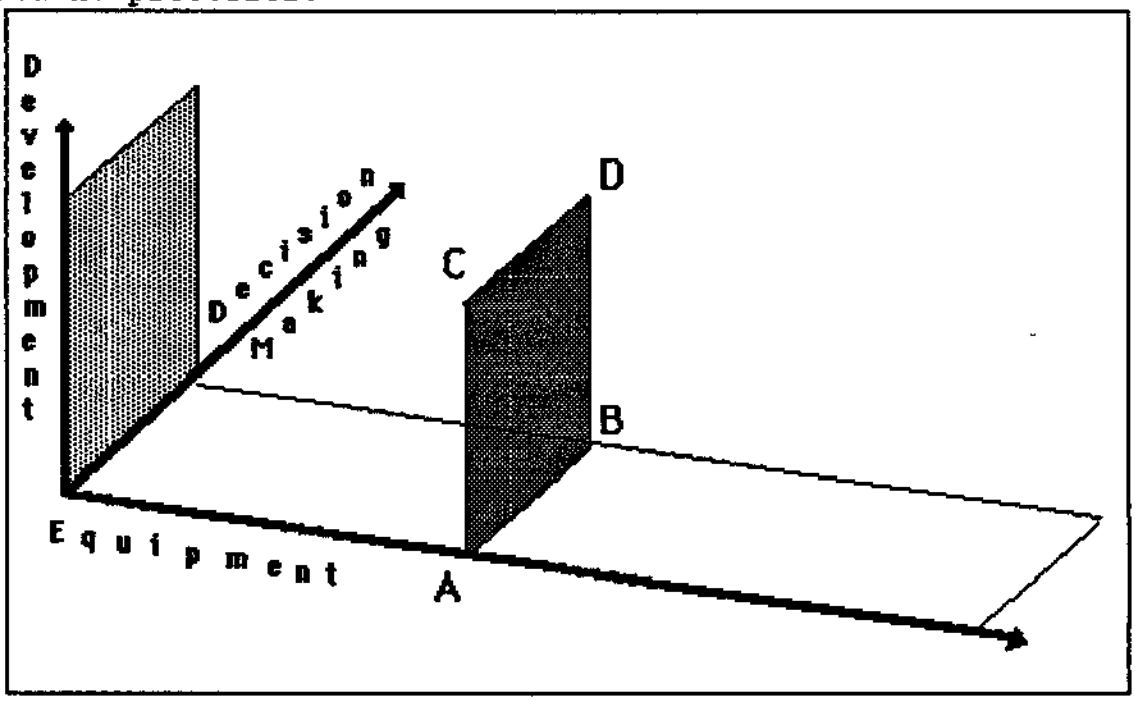

Figure 3. The Four Stages of Decentralized Computing
Adapted from Donovan, 1988

	A. Big Brother	B.Helping Hand	C.Watchdog	D.Network
Equipment	Decentralized	Decent.	Decent.	Decent.
Development	Centralized	Central.	Decent.	Decent.
Decision Making	Centralized	Decent.	Central.	Decent.

End-User Computing

The outstanding computing phenomenon of the present is the penetration of the microcomputer into the business setting. This has resulted in a rapid expansion of end-user computing --that being the combination of roles in which he who uses the output of a system was the one who developed it (Doll and Torkzadeh, 1988)-- the growth of which is projected to encompass as much as 75% of all computing activities by the 1990s (Amoroso, 1988; Benjamin, 1982; Benson, 1983; S. Lee, 1987; Mayo, 1986; Rockart and Flannery, 1983; Sumner, 1985; and Sumner and Klepper, 1987).

Brancheau (1987) studied over 500 professionals in 18 different organizations. This study was conducted to evaluate information technology adoption from the perspective of innovation diffusion theory. He reported that early adopters of spreadsheet technology were younger, higher educated, had more media exposure, had greater media contact, and had greater vendor contact than those who did not adopt the technology, or who adopted it later. Of particular interest, he noted that the information systems group did <u>not</u> play an active role in the adoption process.

Rockart and Flannery (1983) identified a three-generation perspective on the management of end-user computing (Figure 4, below). They likened computing activities to a phenomenon called time-sharing, in which

engineers and scientists utilize computing resources for quantitative problem-solving. End-user computing in a more

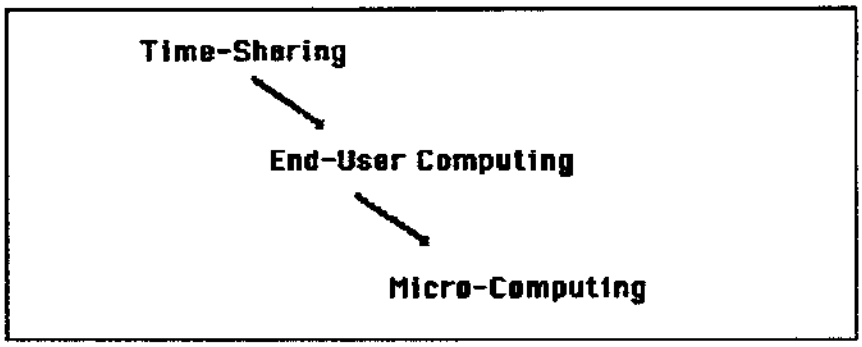

Figure 4. The Evolution of EUC Management Practices. (Adapted from Rockart and Flannery, 1983)

general sense emerged with the availability of fourth-generation languages (4GL). The arrival of the micro-computer signalled a dramatic explosion of end-user computing activities. In their study, which focussed on the pre-micro form of end-user computing, Rockart and Flannery (1983) reported that management practices were often adapted from the time-sharing era. They further projected these practices into the early stages of microcomputing management. In a later study, Gerrity and Rockart (1986) identified three types of management approaches to EUC: 1) monopolist, 2) laissez faire, and 3) the information center.

Many other researchers have addressed short-term issues of data management in the microcomputer setting (Alavi and Weiss, 1985-86; Andersen and Bernard, 1987; Benson, 1983;

Carver, 1988; Cheney et al., 1986; Chu, 1985; Corman, 1988; Dickson and Nechis, 1984; Jancura, 1986; S. Lee, 1987; Mayo, 1986; Mortensen, 1984; Pyburn, 1986-87; Song, 1985; Sumner, 1985; and Sumner and Klepper, 1987). Unfortunately, MIS researchers have lightly examined the long-term implications of this phenomenon, a problem that this study will address.

Data Access and Control under EUC

Some researchers (Anderson and Bernard, 1987; and S. Lee, 1987) have reported that MIS professionals believe central databases to be superior for end users because of ownership conflicts and data structure incompatibility. By contrast, users have expressed ambivalence over this issue. They apparently like the clean data that they can get from the central database, but prefer to have more control over the data that they process (Bensen, 1983). To this end, they are active in the design of their own data models (Hackathorn, 1987-88).

The choice of private versus central databases may depend, in part, on the scope of the application. Researchers have reported that EUC applications range in scope from personal to departmental to corporate-wide involvement (McLean, 1979; Porter and Gogan, 1988; Pyburn, 86-87; Sumner, 1985; Sumner and Klepper, 1987; Rockart and Flannery, 1983; Watson and Carr, 1987). A primary source of the data employed is from "production" systems, some of

which is downloaded from central files, while some is still re-keyed from hard-copy reports (Rockart and Flannery, 1983).

Unfortunately, the errors introduced through re-keying and the differences brought about by independent data model design can be a source of difficulty. Decisions may be made on the basis of data manipulated to the point of inaccuracy (Mortensen, 1984), or managers may come to a meeting with conflicting numbers and information about the same subject (Anderson and Bernard, 1987).

Data Modeling

Data models existed in the solution of business problems long before they were identified in MIS theory, or, for that matter, before business activities were even computerized. These models existed in the minds of the business problem solvers and were employed in their development of solutions. Business computing activities have undoubtedly influenced the nature of those data models.

Specifically, this paper suggests that centralized computing activities have had a unifying influence on those data models. Distribution, decentralization, and, particularly, microcomputing, are hypothesized to have the reverse effect.

Users apparently employ data models without being aware of them. Thus it is very difficult to get them to accurately

express them (Kroenke, 1989). Some research has been done in the area of training novice users to draw data models using various methodologies (Ridjanovic, 1985; Wiederbeck, 1985, and Jarvenpaas and Machesky, 1986). Because of the difficulty in overcoming this barrier, Kroenke (1989) has suggested that user data models be implied from the forms used in the business and the reports produced. Unfortunately that method is unsuitable for this project. Therefore, user data models will be extracted by indirect interviewing techniques.

Summary

Several conclusions can be drawn from the preceding studies. Some researchers, are making predictions about, or suggestions for, certain organizational computing structures. End-user computing seems destined to be a vibrant growing segment of the computing picture. Management of EUC, then, is expected to be a continuing matter of concern as the role of data modeling in computer management emerges.

While the future shape of business organizations and their computing functions may not have been accurately predicted, it is very likely that the microcomputer will play an ever increasing role. Similarly, very little is known about the influence of changing structures or microcomputing activities on data model integrity.

Data, then, becomes an important subject for study, posing such questions as "How are organizations currently managing the conceptual integrity of their data?" and further "How is this to be carried out in a decentralized computing world?"

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CHAPTER 3

THEORETICAL FRAMEWORK

This chapter presents the theoretical background for the project. First, a history of MIS frameworks is used to develop the framework for this paper. Second, each variable in the project is defined in detail.

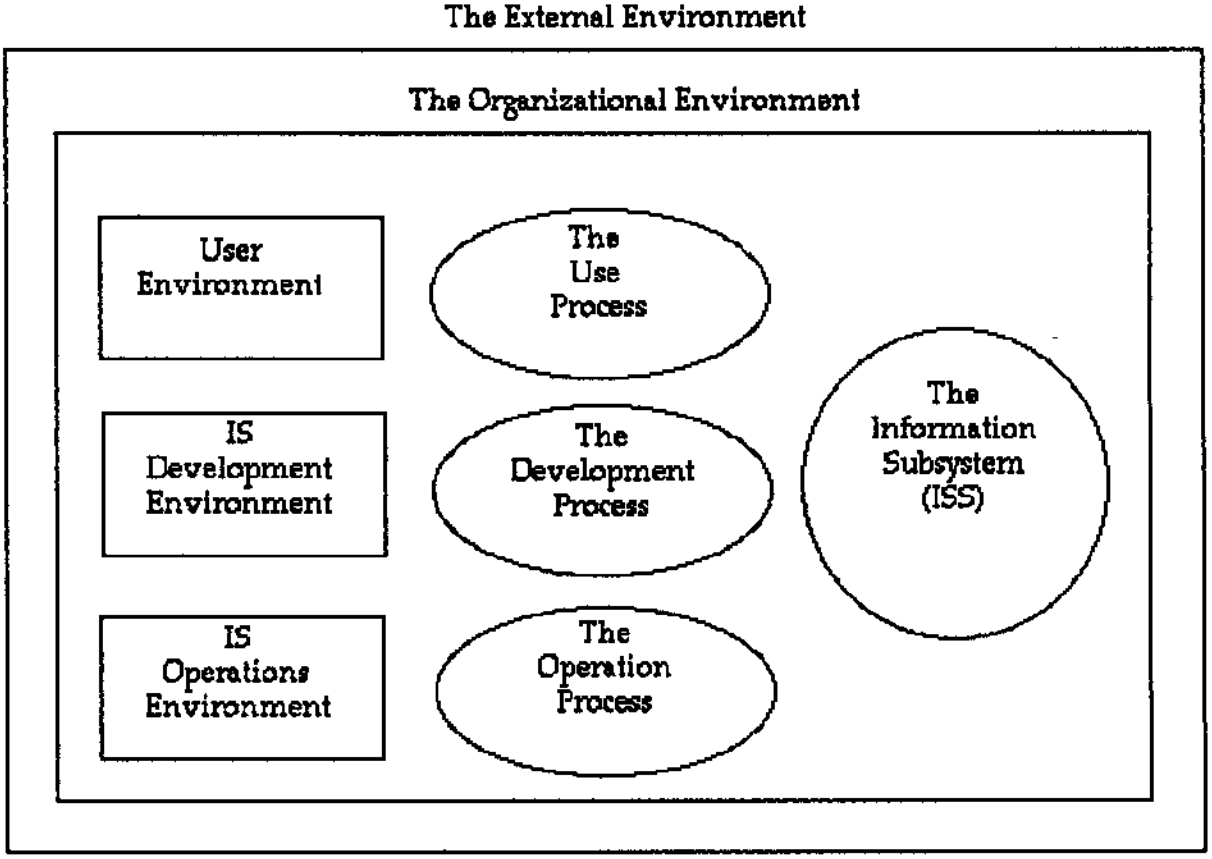

Figure 5. The Ives and Hamilton Comprehensive Framework (1980)

Framework Development

In 1980, Ives and Hamilton (1980) developed a research framework for MIS research (Figure 5, previous page). They specifically intended to develop a framework that was comprehensive in nature by examining a sample of previous research frameworks (Chervany et. al, 1972; Gorry and Scott Morton, 1971; Lucas, 1973; Mason and Mitroff, 1973; and Mock, 1973). Each of these predecessor's efforts had focused-- either explicitly or implicitly-- on a narrow subset of MIS research which Ives and Hamilton sought to overcome. They demonstrated the comprehensive nature of their framework in a number of ways. First, they identified some of the limiting properties of the five predecessors and developed elements in their framework to overcome those limitations. Second, they demonstrated that they had provided coverage for all of the variable classifications in each of the predecessor frameworks. Finally, they utilized their framework to classify 331 doctoral dissertations.

The arrival of the microcomputer and the explosion of end-user computing has shifted some of the areas of research emphasis. With this in mind, Amoroso (1988) developed a research framework specific to end-user computing (Figure 6, below). Amoroso started with the same groups of variables as in the Ives and Hamilton framework, except the Development, Operation, and Use Processes have been collapsed into one variable set because of the nature of EUC. This

framework appears to capture the important variables for EUC research in a comprehensive manner, but some improvement may still be possible.

A research framework can be viewed from two perspectives. First, it can serve to bring order to an existing body of research by identifying studies that deal with similar themes, and instances where the existing research has not addressed a particular topic area. A second role of a research framework is to provide a structure for research to follow by pointing out the overall themes to be addressed by subsequent research efforts. One important aspect of a research theme is to identify relationships among the variables (Kirs et. al., 1989) which neither the Ives and Hamilton framework nor the Amoroso framework address.

This paper offers a theoretical framework for research in end-user computing (Figure 7, below) with four groups of independent variables, found in the Organizational, Developmental, User, and Operational Environments. These variables are suggested to be in a relationship with the dependent variables identified as Primary and Secondary Outcomes. This presentation of the variables may not be as useful for the classification of previous research, since it may suggest that a particular variable is independent when the particular study treated the variable as dependent. On the other hand, this framework is very useful as a guide to

further research since it suggests a wealth of ready-made research hypotheses that have yet to be fully explored.

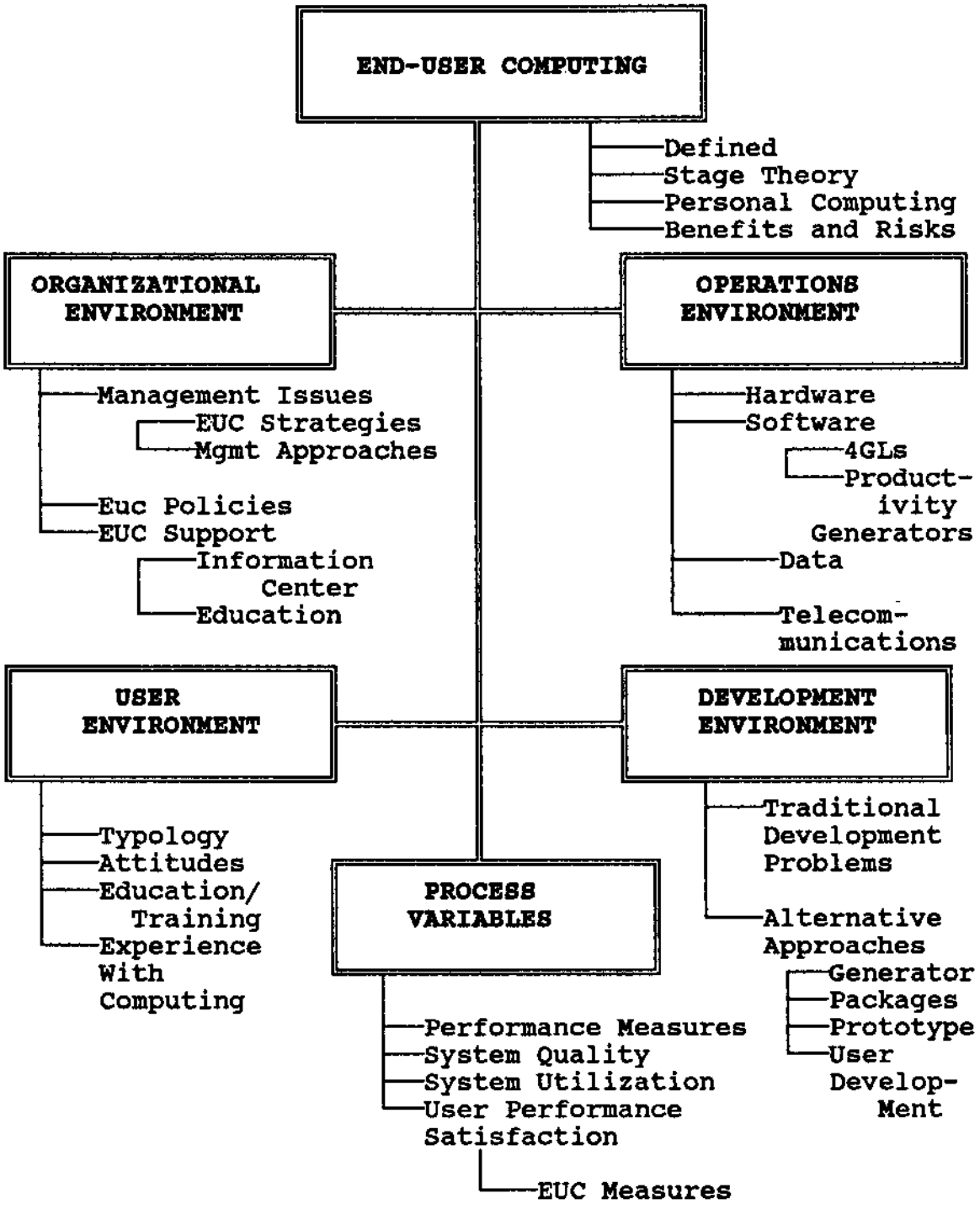

Figure 6. Amoroso Framework for EUC (1988)

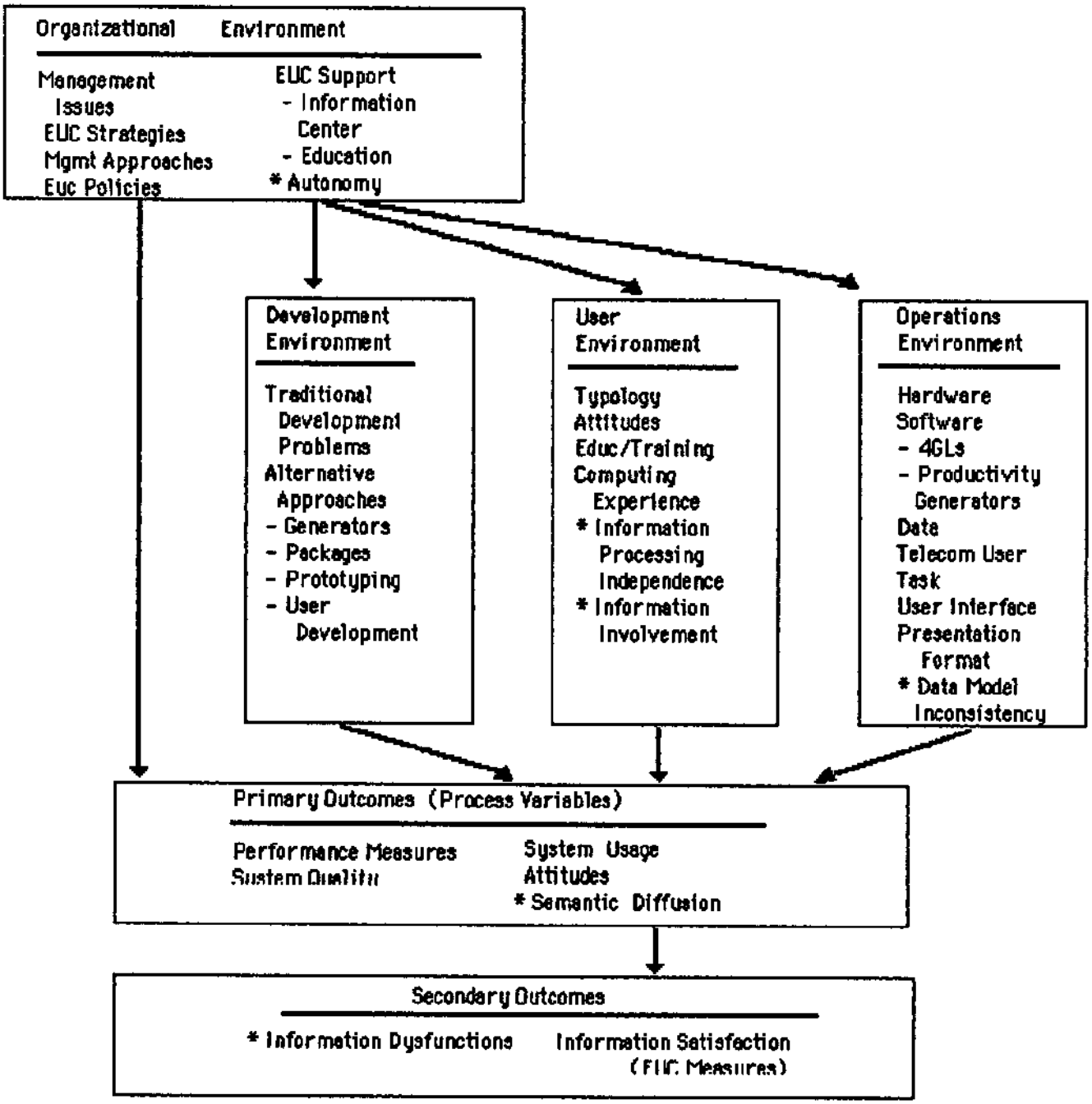

Figure 7. A Theoretical Framework for Research in EUC

The preceding framework (Figure 7) will be the research frame that guides this study. As indicated earlier, it is directly descended from the Ives and Hamilton (1980) frame-

work, which, in turn, got its inspiration from five previous frameworks.

The variables for this study are marked by an asterisk. While many different studies would be developed from this framework, the present study is urgently needed for three reasons. First, it addresses the usefulness of organizational data, which is at the very heart of business information systems. Second, these variables, and their interrelationship, have been lightly treated in the literature. And, finally, the problem suggested here is not only current, but it has the potential for explosive growth in the immediate future.

These variables have been organized into a theoretical relationship suggested by the following model (Figure 8). This model, which only portrays the primary relationships, suggests the Data Model Inconsistency found among organizational information users is a result of Information Processing Independence. This inconsistency of data models can expect to be followed by Semantic Diffusion, a difference in organizational terminology and understanding. Eventually, Organizational Information Dysfunctions can be expected.

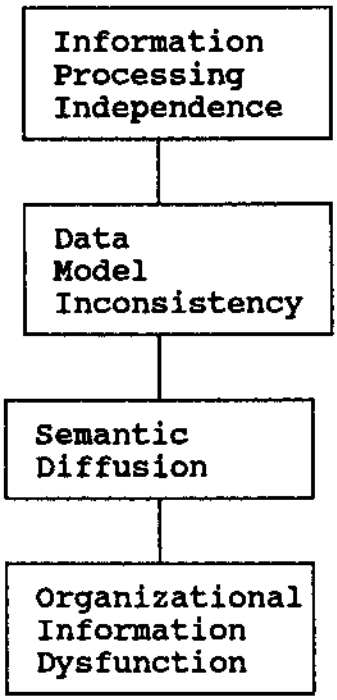

Figure 8. The Relationship between Information Processing Independence and Information Dysfunctions

Variables Defined

In the sections that follow, each of the variables will first be described and the presumed relationships will be discussed, followed by specifically-stated research hypotheses.

Autonomy

Autonomy is a characteristic of a job role somewhat akin to independence. Some researchers have identified multiple facets to the autonomy construct (Breaugh, 1985; and Breaugh and Becker, 1987). In this study, the primary focus is on "scheduling" autonomy and "method" autonomy as

they pertain to the job in general, and, more specifically, as they pertain to a user's computing activities (or Information Processing Independence).

Information Processing Independence

This study defines information processing independence as employee autonomy that is manifested in information processing activities. Indeed, one universally recognized and highly valued property of a microcomputer is independence (Hackathorn, 1987-88; S. Lee, 1987; Pyburn, 1986-87; and Thabit, 1987), consistent with an expectation of microcomputer users becoming more independent in their computing activities (Lorin, et al., 1987). This variable will be a measure of the degree to which a particular subject has been exercising independence in his information processing activities.

Data Model Inconsistency

Data model inconsistency refers to differences between two or more databases in the manner by which data is defined, derived, or interrelated. Corporate databases are evolving toward decentralization because of the impact of microcomputers (S. Lee 1987). Obviously, under this circumstance, microcomputer users will develop their own data models and share them with their colleagues (Hackathorn, 1987-88). Over time, this variety of viewpoints

might stimulate disparity in the understanding between organizational units.

Semantic Diffusion

Semantic diffusion refers to differences in the understanding between two or more individuals within the organization. In this case, the differences are brought about by the differences in the information that the individuals are using as a base reference. Semantic Diffusion naturally occurs as a result of different organizational viewpoints. Whether it becomes harmful is another issue. It may be completely benign if it does not lead to misunderstanding. On the other hand, it may result in confusion, unnecessary disagreement, or other dysfunctional consequences.

Organizational Information Dysfunction

Organizational information dysfunctions are any problems brought about by the structure or management of data within the organization. For example, Anderson and Bernard (1987) have reported that "managers may come to a meeting with conflicting numbers and information about the same subject . . ." because of separately processed data from independent personal databases. Similarly, Mortensen (1984) reports decisions based on data manipulated to the point of inaccuracy. Davis (1985) has warned about the potential for end users to design faulty data models.

To the extent that two reports of the same data are merely different, not inaccurate, one could argue that this represents a healthy difference of opinion brought about by different viewpoints. However, if the reasons for the differences are unknown, or virtually irreconcilable, this could lead to confusion and lack of confidence in either point of view.

Information Involvement

In an organization, some individuals are close enough to a specific data design to understand the subtle differences in a particular data model. In this situation, they do not perceive semantic diffusion as a serious problem, and organizational information dysfunctions are less likely because they understand and can explain or reconcile any information differences. Thus, confusion can be minimized and confidence is not jeopardized.

However, other individuals may find themselves relying on the data models that they did not create. For them, the explanation or reconciliation is not so obvious, and data model inconsistency is a problem as they become possible victims of semantic diffusion. This study will measure the variable Information Involvement to accommodate the different degrees of involvement that may exist between subjects.

The next two variables mitigate the influence of Semantic Diffusion. They are not central to the theme of the study, but must be measured to qualify the potential impact of Semantic Diffusion on Organizational Information Dysfunctions.

Data Item Relevance

As subjects are presented with data items in this study, they will express their impressions of the relevance of each. Some computer based applications are very narrow in scope, being personal or departmental in nature, and do not require universal uniformity in their data models. Uniformity is only important when specific data is the subject of communication or understanding between organizational units. Thus, data models should strive for uniformity within the scope of a particular computer application area.

Scope of EUC Application

Of the many different types of microcomputer applications, only a few involve data design. Of these, some will be sufficiently restricted in their impact to minimize any problems. It is only the few applications remaining that have the scope to be a potential data model problem.

If an application does involve data model design, then one must ask how universal its impact will be (McLean, 1979; Pyburn, 86-87; Rockart and Flannery, 1983; Sumner,

1985: Sumner and Klepper, 1987: Watson and Carr, 1987). Generally speaking, if the scope is personal, then data model uniformity is unnecessary; if it is departmental, then caution is advised; and if the scope is organization-wide, then data model uniformity is quite important.

Relationships between the Variables.

One sees two different forces at work stimulating the outcomes predicted in this model (see Figure 7 and 8 above). First, the general democratization of management style and an emphasis on viewing employees as "knowledge workers" are jointly responsible for the general increase in employee Autonomy (Nolan, 1988) and, to a lesser extent, for the increase in Information Processing Independence. Next, the dramatic increases in end-user computing, particularly microcomputing, are responsible for the increase in Information Processing Independence.

As described in Figure 8 above, four variables capture the essence of the relationships proposed in this study. That is, the increases being experienced in Information Processing Independence will encourage the generation of a variety of data models, which naturally increases the likelihood of Data Model Inconsistency. Data Model Inconsistency can be expected to undermine organizational self-understanding, bringing about Semantic Diffusion. On the other hand, Information Involvement, stimulated by

microcomputing and Information Processing Independence, may reduce Semantic Diffusion. That is, the closer the individual is to the variation in a particular data model (if he is the author, for example), the less impact that difference has on him specifically. The existence of different frameworks of meaning connoted by Semantic Diffusion contributes to the possibility of certain Organizational Information Dysfunctions.

Two other variables are pertinent to the execution of this study. The location of a particular subject in this study within the organization may lessen his requirement to understand a particular data item. For him, Data Item Relevance is low. As a complementary concept, a particular end-user computing application may be isolated to a particular part of the organization. The Scope of the Application defines that area within which data model uniformity is desirable.

Hypotheses

The main theme suggested by this study is that there is a relationship between Information Processing Independence and Semantic Diffusion. Information Processing Independence is thought to be promoted by the use of microcomputers. A surrogate measure will be the subjects statements about their degree of independence as reflected in question V of the interview guide. Semantic Diffusion is an expression of

differences in organizational understanding. The surrogate for this variable is the degree of agreement between subject data models and the central data models as described in questions I and II of the interview guide. The primary hypotheses, then, is the greater the degree of Information Processing Independence, the greater the amount of Semantic Diffusion that will be reported.

Data Model Inconsistency is seen as an intervening variable. It is suggested that Information Processing Independence promotes Data Model Inconsistency, which in turn, leads to Semantic Diffusion. The data gathered will be primarily anecdotal. For data analysis purposes, it will be considered to be a yes/no variable. The hypotheses related to this variable are 1) That there will be more frequent occurrences of Data Model Inconsistency (more yeses) as the amount of Information Processing Independence increases, and 2) That higher degrees of Semantic Diffusion will be associated with a yes answer on Data Model Inconsistency than with a no answer.

Organizational Information Dysfunctions are negative outcomes thought to be associated with Semantic Diffusion. The measurement here is a yes or no answer, followed by a more complete description. It is hypothesized that the higher degrees of Semantic Diffusion, the greater the likelihood of a yes answer.

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CHAPTER 4

METHODOLOGY

This project employed in-depth interviews for data gathering using a structured interview guide. The project proceeded in two distinct phases. In the first phase, which consisted of several steps, the instrument and methods were tested and refined. The second phase employed the instrument in the actual data-gathering process.

Phase One: Instrument Development

Instrument development involved four steps, two pilot studies, and two expert panel appraisals. After each pilot study and expert appraisal, the instrument and methods were revised for the following step.

First Pilot Study.

A major transportation firm agreed to allow the conduct of this study. Three subjects were selected along with the person responsible for central data design. The questionnaire employed, (designated Preliminary Interview Guide in Appendix A), was the same as the questionnaire from the research proposal. The interviews were recorded with an audio recorder. The tapes of the interviews were transcribed.

First Expert Panel.

The results of the first pilot study were examined by a panel of three experts. Appendix E contains the identity and qualifications of the experts. Two of the three experts are employed by the firm which supplied the initial set of subjects. As such, they are qualified to comment on the accuracy of the information gathered. During the review meeting, the experts were first given an explanation of the underlying theory. They then examined the documents from the pilot study. These included the central data model, each subjects' data model, and a transcript of each subject interview session (a sample interview from the first pilot study is found in Appendix E). A set of observations on the subject interviews were read in their entirety during the meeting.

The experts were asked to provide guidance on the capability of the questionnaire to develop values for the desired variables. They were asked to comment on the methods employed and make any suggestions for improvement.

Changes Made.

As a result of the expert review, substantial alterations were made to the interview guide and the methods. Appendix A contains the new instrument used after this point (the Revised Interview Guide). With this instrument, considerable more detail is requested on several

of the questions. In addition, the subject directly enters the information for questions II, III and V. Unlike the original instrument, which only the interviewer could see, the subject reads each question with this instrument. This means that each subject now receives a more uniform set of questions.

Question I received several modifications. In the original form, both objects and relationships were extracted. Experience showed, however, that the subjects could not provide the relationships without being directly led by the interviewer. Any attempt to get relationships was dropped. One of the models was to be used for training and then discarded. This did not prove to be useful and was abandoned. Some of the subjects volunteered classification-type attributes. This became a regular part of the questionnaire.

Question IX is an addition. This question detects individuals within the organization who have adopted methods to accommodate the presence of redundant data sources.

Question IX and X, from the original instrument, were collapsed into one question.

Second Pilot Study.

The administrative personnel of a major university provided the setting for the second pilot study. As in the first pilot study, three subjects were selected along with

the person responsible for central data design. The revised instrument (designated "Revised Interview Guide" in Appendix A) provided the basis for each interview. After transcribing the interviews, responses to certain questions were content encoded. Also, data model similarity was scored by comparing each of subject data models against the central data model.

Second Expert Panel.

The second expert panel included two experts from the University Administration. The third member was an Information Systems expert that had participated in the first expert panel review (Appendix E contains the identity and qualification of these experts). Before meeting with each expert, they were supplied a set of documents to prepare them for their task. These documents include a description of the underlying theory, a copy of the structured interview guide, a description of the intention of each question on the interview guide, and the central data model. Also included, from each subject, are his scored data model, the filled out subject questionnaire, and a typed transcript of his interview (a sample interview and data models are found in Appendix E).

Changes Made.

As a result of this review, three changes were made resulting in the final version of the interview guide

(designated "Final Interview Guide" in Appendix A). First, question I is worded differently to focus the subject's attention on data items. Second, a follow-on question now links question IV to question III.

The third modification is the most substantial. It was clear that the subjects were not responding in a useful manner to question IV. The primary purpose of this question is to measure Information Processing Independence, theoretically brought about by microcomputing (and, in a lesser way, by 4GL's). One expert observed that for a subject to score themselves down on "job autonomy" has negative connotations. It is possible that job autonomy and Information Processing Independence are quite different constructs. Starting the question off on job autonomy may flavor the responses toward supervisory considerations. Therefore, by reversing the order of the questions, the emphasis of the question shifts from job autonomy to Information Processing Independence.

Question IV had another problem. The subjects are, by-and-large, satisfied with their job and "settled into" it. Many see their personal independence as virtually unlimited <u>within certain assumed boundaries</u>. It is the nature of these boundaries that this question should explore. For this reason, the question now asks about limitations to independent action, rather than directly asking about independence. In addition, follow-up questions

now probe the subject's awareness of specific limitations that are inherent in main-frame and microcomputing.

The sequence of questioning seemed a little awkward. To correct this, Question VI and VII were reversed.

Phase Two: Data Collection

Within each subject firm, the person responsible for data modeling in the organization participated in this study. In most organizations, this was a key individual in the data modeling or database administration (DA) function. He assisted in the creation of a set of semantic objects (Kroenke, 1988). It was not necessary for the data modeler to understand semantic objects for this approach to be possible.

Subjects were randomly selected from among the information-using employees of the subject firms. The interview was next, using the interview guide. This process produced the subjects' written and verbal responses to the research questions. Part of the interview involved the extraction of the subject's version of the data models previously defined by the DA. Data from the interviews was then analyzed and encoded for data analysis.

Population/Subjects

The target population for this study is professional knowledge workers in American business. They employ

computer-based organizational information for knowledge work or decision-making.

The parent population from which the subjects were chosen was a convenience sample of four business organizations. Four firms agreed to supply subjects for this study. The first (designated Co C) is a major southwest food processing firm. The second firm (Co W) is a medium-sized public educational institution. The third firm (Co D) is a medium to large hard-goods manufacturer. The fourth firm (Co S) is a major heavy goods manufacturer. Each firm included had a significant history of main-frame computer use and a substantial penetration of microcomputer usage.

Table of Subjects

Co	Number of Subjects	Male	Female	Years of Experience	S.D.
C	9	7	2	9.2	7
D	7	6	1	11.6	7.5
S	8	6	2	3.8	2.0
W	9	6	3	12.2	7.1

Table 1. Subject Demographic Information

The subjects were screened to avoid employees who had a clerical or secretarial role. All members of the IS group were avoided. Subjects selected were limited to knowledge workers in the departments of Marketing, Finance, and Engineering, and the offices of Line Management. This is

consistent with the suggestion that much of the impact of end-user computing is occurring in those portions of the organization that involve professional or knowledge work (Panko, 1984; Panko 1988; and Panko and Sprague, 1982). All subjects had a significant period of experience with their organization.

The selection of subjects was random (as limited by the subject organization) except the DA. The DA was identified through external and internal evaluation as the best available data modeler for the firm.

Measurement

The variables measured in this study are found in the theoretical model (Figure 7). Direct measurement of the variables was not practical. Using the structured interview guide, surrogates of the variables were collected. The surrogates come from the subjects' responses to questions about those variables. A sample of the interview and data model for each company can be found in Appendix D. Each question in the interview guide extracts a measure for a particular variable as shown in the table below. The use of a structured guide ensures that each subject responds to the same set of questions.

Question	Variable
I	Semantic Diffusion
II	Data Item Relevance (for Semantic diffusion)
III	Scope of EUC Application
IV	Information Processing Independence Autonomy
V	Information Involvement
VI	Data Model Inconsistency
VII	Data Integration
VIII	Organizational Information Dysfunction
IX	Data Model Qualification

Table 2. Variables Measured by Each Question

The first two questions extract each subject's version of a series of data models. The data model provided by the DA is then compared to these data models. Differences between the subjects' data models and the DA's data models are a surrogate measure for Semantic Diffusion.

Question III provides supplemental information about the particular micro-based applications of which the subject is aware. The question determines the organizational scope of each application.

Question IV is about independence. It asks about specific ways in which the subject experiences limitations on his information processing independence.

Questions VI through IX elicit anecdotal accounts. These descriptions were analyzed by content coders. They subjectively converted them into a binary value indicating a yes or no answer to the question.

Question X prompted less structured discussion. In actual use, it encouraged the subjects to elaborate on, or correct or improve, some of their previous answers.

Data Collection

Subjects were identified by random selection from among the appropriate subject set as previously described. As many as ten subjects were selected from four different firms. Next followed a 30 to 60 minute tape recorded interview. After the interview, the recording was transcribed using a microcomputer-based word processing system. The interviews were then content coded as described below.

Content Analysis

Content analysis is "any technique for making inferences by objectively and systematically identifying specified characteristics of messages." (Holsti, 1969; and Stone et. al. 1966). This research technique is under used in spite of its great potential (Woodrum, 1984), perhaps because of concern for its supposed limitation to qualitative research. This method is traditionally employed for the analysis of mass communications. The arrival of the computer in the 1960's opened the way to a much broader application (Gerbner, et. al., 1969; Stone, et. al., 1966; Wood, 1980). More recently, content analysis is suggested for a wide variety of research applications (Hicks, et. al., 1985; Krippendorf, 1980; and Norris, 1981).

In this project, content analysis converted the subject's responses to the questions in the interview guide into quantitative expressions. A three-person coding team accomplished these tasks.

One coder was the supervising coder. All of the interaction with the coding team took place through this person. Appendix B contains the instructions that guided the coding process. The team used two dummy interviews for training. The primary researcher trained the supervising coder, who, in turn, trained the other two coders (who did the actual coding). None of the three individuals doing the coding were aware of the underlying premises of the study.

The actual coding took place in two different ways. For questions VI through IX, it was only necessary to read the question and subjectively determine if the subject's general answer was yes or no. Two independent coders did this, with all differences satisfactorily resolved by a third coder.

Information Processing Independence (Question IV) was a much different matter. Statements about this subject were expected in the answers to Question IV but were actually located throughout the interview. Subjects could also make both positive and negative statements.

Coding was a two phase process. In the first phase (called unitizing), the coders merely identified phrases that they felt to be a statement about Information Pro-

cessing Independence. Such statements were marked with a yellow highlighter. Two coders worked independently. The marked documents were compared by a third (supervising) coder who reconciled any differences.

For the second phase, the reconciled documents were returned to the coders who then applied a two part code to each item. They coded each item as being an expression of independence or limitation of independence. Independence statements were scored as a +1, limitations as a -1. They also coded whether the information processing activity was mainframe based or micro-based. These codings were returned to the supervising coder who addressed any differences and corrected any errors. In all, 777 items were coded. Differences in coding were found in 131 items. In 73 cases, the differences were thought to be errors and were corrected. The remaining cases, 58 in all, were considered differences in judgement and were left unchanged. The final measure used was the mean value of the two coding values.

Benefits to the Subject Firms.

In return for their cooperation, the participating firms received a report on the impact of their data modeling effort. The report compared them with the other organizations in the study. Aggregated information compared information the present and expected impact of end-user computing

within the organization. No individual nor any of the cooperating firms was specifically identified.

Limitations and Key Assumptions

The theme of this research may be read to imply that data models, as defined by the central data modeling function, are superior to the implied models that individual subjects might employ. While it may be reasonable to assume that centrally defined data models represent a rational compromise for the overall organization, it is not here intended to suggest that they necessarily represent an objectively determined "best" model.

This research suggests that information processing independence is an increasing phenomenon even though no specific hypotheses of this nature are proposed. Such a proposal is longitudinal in nature, and the measurements were taken at a single point in time. Identifying different subjects that are in different stages of Information Processing Independence partially addresses this deficiency. Still, conclusions about differences in independence do not necessarily extend to the growth of independence for a single subject.

The variables described in this study depict actual conditions that could exist in real business organizations. In an ideal study, the actual variables could be directly measured. Since data are being collected by interview, the

actual variables cannot be measured. Instead, surrogates used are the subjective appraisal of these variables supplied by the individuals being interviewed.

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CHAPTER 5

DATA ANALYSIS

This research involves the measurement of seven different variables for the testing of eight hypotheses. First, each variable is presented along with some descriptive statistics. Next, the results of each hypothesis test is presented. Finally, this chapter contains some overall interpretation.

Variables Measured

Procedures used to develop each measure are described below. The details of the individual data are summarized in Table 3. The tables in Appendix C. contain more complete detail.

Autonomy

The value for Autonomy comes from the last part of question IV. Subjects were asked to give a value from one ten that describes the degree of autonomy in their overall job.

Semantic Diffusion

Semantic diffusion is the degree to which different individuals within the organization understand each other. One source for improving common understanding is the information system employed. For this research, Semantic Dif-

fusion was measured by comparing the personal data models of information users with that of the central data modeler. Question I in the structured interview guide addressed this topic. Each subject, and the central data modeler, supplied a set of data objects. At least four different semantic objects were defined and extracted for each subject. The measure for this variable is the extent to which the subjects' data model agrees with the central model.

In addition to the actual data models, each subject also supplied an expression of data item relevance. Question II asks for the relevance of each data object to the subject's work situation.

Comparing the subject's data model with the central model generates two counts: how many times the subject agrees with the central model, and how many times he disagrees. Multiplying each count by the relevance factor gives a weighted total data model. Dividing the weighted total into the weighted number of differences gives an expression of disagreement with the central model. The expression takes the form of a percentage. This percentage is the measure used for Semantic Diffusion.

Information Processing Independence

Information Processing Independence is the degree of personal freedom, or control, experienced by the subject in his computing tasks. As described earlier, content analysts

screened the entire interview for statements by the subjects on this matter. Both positive and negative statements were included. Also, the analysts distinguished between micro-computer oriented tasks and mainframe oriented tasks. The score for micro oriented independence is the measure employed in the hypothesis testing. Details of the calculations may be found in Appendix C.

Data Model Inconsistency

Subjects were asked to identify instances of Data Model Inconsistency within their organization in Question VII. These would be different data sets which deal with the same subject area but have different perspectives on that same data. Essentially, they were asked to recall instances of redundant data sets. Over half of the subjects were able to recall at least one such instance. In three cases they identified more than one. For analytical purpose, it is considered a binary variable. The only two states used are yes or no.

Organizational Information Dysfunction

Subjects were asked to recall instances of Organizational Information Dysfunction in Question VIII. These would be situations where differences in computer-based data contributed to a problem. In general, subjects were only able to answer yes or no, and then to give examples. Two subjects were able to give more than one

example. Still, for data analysis, all responses were treated as yes or no.

Data Integration

Organizations may correct redundancy by integrating the redundant data sets. This could be an advanced organizational response to difficulties that such situations present. Subjects were asked, in Question VI, if they could recall any such instances of data integration. Again, this variable is only measurable as a yes or no response.

Information Involvement

This research is measuring semantic diffusion in the form of personal data models. Is it possible there are confounding situations? The previous level of organizational information involvement might prejudice the measures. Such a subject might present a data model that already has much in common with the central model. The measurement of prior data design activities in Question V provides a measure of this confounding situation. The responses to this series of questions were used to compute a value for Information Involvement.

Variable	Occurrences noted ..		
	0	1	2
Data Model Inconsistency	12	18	3
Organizational Information Dysfunctions	14	17	2
Data Integration	18	12	3

Table 3a. Dichotomous Variable Measurements

Variable	Range	Mean	St. Dev.
Autonomy	5 to 10	8.2	1.0
Semantic Diffusion	.402 to .957	.613	.106
Information Processing Independence - mf micro combined	-6 to 13 -11.5 to 4 -16 to 11	3.05 -1.73 1.30	4.20 3.53 6
Information Involvement	0 to 100	28	30.8

Table 3b. Continuous Variable Measurements

Inter-rater Reliability

This project uses content coding. As such, it is appropriate to report the degree of inter-rater agreement on the codes applied.

Coding was a two phase process. In the first phase the coders merely identified phrases that they felt to be a statement about Information Processing Independence. The supervising coder reconciled any differences. During this phase, he reported that the coders identified the same phrases 73% of the time.

For the second phase, the reconciled documents were returned to the coders who then applied a two part code to each item. These codings were returned to the supervising coder who addressed any differences and corrected any errors. In all, 777 items were coded. Differences in coding were found in 131 items. In 73 cases, the differences were thought to be errors and were corrected. The remaining cases, 58 in all, were considered differences in judgement and were left unchanged. Since 646 items were coded the same initially, this is an inter-rater reliability of 83.1%. After correction, 92.5% of all codes were the same.

Parallel Measures

One of the variables was measured twice as a reliability check. The two forms of Information processing independence were the variables independently measured. The subjects directly stated their evaluation of this construct on a 1 to 10 scale at the end of Question IV. These responses were not available to the coders. The correlation

between these scores and the content coding was to act as corroboration for the accuracy of the process. This corroboration was only partially successful.

The correlation between main-frame information processing independence and the self-reported value was successful. It yielded an r of .39 and r^2 of .15. This is significant at the .01 level.

Unfortunately, the correlation for micro-based independence was not significant. This is due, in part, to the lack of precision of the verbal measure. Subjects were obviously quite enthusiastic about the independence afforded by microcomputers and were unable to rate this in a discriminating fashion. Over half (18 of 33) reported a score of 10 out of 10 on this scale. With such a restricted range of values, correlation is not likely. It does serve to point out, however, the value of the effort put into the use of content coding for this measure.

Hypothesis Testing

The hypotheses stated below are statistical in nature. The only test is for significant correlations between the variables. This study offers no conclusions concerning cause and effect relationships.

This analysis uses two different methods for determining correlation. The two continuous variables are analyzed using traditional Pearson product-moment

correlation. Since some of the remaining variables are binary, point-biserial correlation must be employed.

Point-Biserial Correlation.

Point-biserial correlation makes it possible to calculate the correlation between a continuous variable and a binary variable (Ferguson and Takane, 1989, and Guilford and Fruchter, 1978). This procedure is actually a refinement of an earlier statistic, biserial r. Biserial r required that the binary variable actually be a continuous phenomenon that had been roughly divided into two groups. The continuous phenomenon must satisfy the requirement of assumed normality. Point biserial correlation came into use for truly binary measures. It does not require either of these assumptions. In time, biserial r has fallen into disuse in favor of point biserial correlation, even in cases where the more rigid assumptions are met (Ferguson and Takane, 1989).

Hypothesis H_1.

Information Processing Independence is positively correlated with Autonomy.

One of the factors that contributes to Information Processing Independence should be the general level of organizational independence. This is coupled with other organizational and personal factors.

Statistical Results:

Constant	8.086633
r	0.131255
r^2	0.017311
t*	0.738969
p > 0.10	
n.s. at $\alpha = 0.05$	

Conclusion: H_1 not supported

The values reported by the subjects for Autonomy did not provide a very wide discrimination. This is somewhat understandable since only four different organizational settings were involved. Much of the difference in reported values are the differences in how each individual perceives the same organizational setting.

Hypothesis H_2.

Data Model Inconsistency is positively correlated with Information Processing Independence.

The responses for Data Model Inconsistency (question VII) were simply discussions. Content analysis converted the discussion into a binary variable (yes or no). The data analysis which follows uses point biserial correlation.

Statistical Results (point-biserial correlation):

	p (no)	q (yes)
Proportion (DMI)	0.333	0.667
n	11	22
Mean (IPI)	0.409	4.364
r_{pbi}	0.443451	
t	2.754694	

$p < 0.005$

significant at $\alpha = 0.05$

Conclusion: H_2 is supported

Subjects reported that they were aware of instances where two different information systems were based on similar but independent (redundant) data sources. This hypothesis suggests that information processing independence contributes to such circumstances. The support demonstrated for this hypothesis is consistent with intuition and prior research.

Hypothesis H_3.

Information Involvement is positively correlated with Information Processing Independence.

Information Involvement may have a confounding influence on Semantic Diffusion. It is the level of previous involvement with the organization's information system. Previous levels of Information Processing Independence could contribute such involvement.

Statistical Results:

r	0.043734
r^2	0.001913
t*	0.243731
p > 0.10	
n.s. at $\alpha = 0.05$	

Conclusion: H_3 is not supported

Information Involvement is undoubtedly related to other factors besides Information Processing Independence. In addition, this study apparently was not sensitive enough to detect such a subtle relationship.

Hypothesis H_{4a}.

Semantic Diffusion is positively correlated with Information Processing Independence.

This is the key hypothesis for this entire study. This hypothesis proposes that Information Processing Independence strongly influences Semantic Diffusion.

Statistical Results:

Constant	0.565321
r	0.617755
r^2	0.381621
t*	4.373904
p < 0.005	
significant at $\alpha = 0.05$	

Conclusion: H_{4a} is supported

Support for this hypothesis is not inconsistent with the theory (Davis, 1984) that Semantic Diffusion is, in part, caused by Information Processing Independence. However, this research is only able to report the strength of the correlation between the two. Thus, cause-and-effect conclusions are not appropriate.

Hypothesis H_{4b}.

Semantic Diffusion is negatively correlated with Information Involvement.

Statistical Results:

r	0.164816
r^2	0.027164
t*	0.93038
$p > 0.10$	
n.s. at $\alpha = 0.05$	

Conclusion: H_{4b} is not supported

Apparently, as noted in Hypothesis H_3, this study is not sensitive enough to detect this relationship, if one exists at all.

Hypothesis H_5.

A "yes" answer for Organizational Information Dysfunctions is correlated with higher scores for Semantic Diffusion.

Semantic Diffusion is proposed to be one of many influences on Organizational Information Dysfunction. The diversity of organizational understanding (SD) can lead to confusion, misunderstanding, or lack of confidence in the infromation produced.

Statistical Results (point-biserial correlation):

	p (no)	q (yes)
Proportion (OID)	0.394	0.606
n	13	20
Mean (SD)	0.627	0.603
r_{pbi}	-0.10925	
t	0.61195	
p > 0.10		
n. s. at $\alpha = 0.05$		

Conclusion: H_2 is not supported

Subjects were reporting anecdotes about problems of which they were aware. It may be that they were aware of problems that were the result of the Semantic Diffusion of others. This relationship might be better studied with the unit of analysis being the organization rather than the individual.

Hypothesis H_6.

High scores for Information Processing Independence are correlated with frequent occurrences of Data Integration.

Statistical Results (point-biserial correlation):

	p (no)	q (yes)
Proportion (DI)	0.454	0.455
n	18	15
Mean (IPI)	1.583	4.800
r_{pbi}	0.381004	
t	2.294396	

$p < 0.025$

significant at $\alpha = 0.05$

Conclusion: H_6 is supported

Information Processing Independence, as demonstrated in Hypothesis H_2 above, is strongly correlated with Data model Inconsistency (redundancy). As a result, many organizations may resolve their inconsistencies by merging the redundant databases. This is considered to be an advanced organizational response to the problems proposed in this study.

Hypothesis H_7.

Semantic Diffusion is positively correlated with Data Model Inconsistency.

Statistical Results (point biserial correllation):

	p (no)	q (yes)
Proportion (DMI)	0.394	0.606
n	13	20
Mean (SD)	.627	.603
r_{pbi}	-0.10925	
t	-0.61195	
n. s. at t = 0.10		

Conclusion: Fail to reject H_6

This hypothesis is the last part of the key relationships model shown in Figure 8. The lack of support shown here is not consistent with the theory proposed. The measure for Organizational Information Dysfunctions is, however, quite inexact. Subjects were responding to general knowledge about such occurrence, without specifically relating the instances to their own situation. This variable might be more profitably pursued at the organizational (rather that individual) unit of analysis. Further, point-biserial correlation is not a highly sensitive test.

Hyp	Variables	p-value	conclusion
H_1	Infor. Proc. Independence Autonomy	p > .10	not supported
H_2	Data Model Inconsistency * Infor. Proc. Independence	p < .005 **	supported
H_3	Information Involvement Infor. Proc. Independence	p > .10	not supported
H_{4a}	Semantic Diffusion Infor. Proc. Independence	p < .005	supported
H_{4b}	Semantic Diffusion Information Involvement	p > .10	not supported
H_5	Semantic Diffusion Org. Infor. Dysfunction *	p > .10 **	not supported
H_6	Infor. Proc. Independence Data Integration *	p < .025 **	supported
H_7	Semantic Diffusion Org. Infor. Dysfunction *	p > .10 **	not supported

* dichotomous variable
** point-biserial correlation

Table 4. Summary of Results ($\alpha = 0.05$)

Interpretation of Results

These hypotheses were developed from a model of expected relationships set out in Chapter 3 (Figure 8). In particular, hypotheses H_2, H_{4a}, H_5, and H_7 represent the primary relationships depicted in this model. Since this

project uses only correlation, cause-and-effect conclusions are not appropriate. Still, the support demonstrated for two of these hypotheses is not inconsistent with the theory presented in this model.

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CHAPTER 6

RESULTS AND CONCLUSIONS

This project finds it's roots in basic theory concerning organizational data. This theory holds that one can expect a relationship between the shape of an information system (public/private, formal/informal) and the influence of end-user computing (Davis, 1985). Specifically, Davis proposes that end-user computing will increase the size of the formal, private information system at the expense of the formal, public information system (as illustrated in Figure 2).

Information systems developers have defined and employed a number of strategies for the distribution of information systems resources (Donavan, 1988; Nolan, 1988, Lorin, et. al., 1987). Such strategies include formal and deliberate plans for the distribution of organizational data.

The explosion of microcomputing in the 1980's brought additional elements of the organization into the picture. All decisions concerning organizational computing, and particularly distribution of organization data, are no longer made exclusively within the central MIS organization. Every microcomputer user makes, to some extent, decisions about computers and computer-based data. Microcomputers

bring a great sense of personal control to the user. He is more-or-less free to determine the data and it's uses with respect to "his computer."

This project has proposed that this situation may have some unintended consequences. Specifically, the independence that the microcomputer affords its' user can lead to the development of data structures that are inconsistent with the centralized data base. Such data structures are only useful if they assist the user in forming an improved perspective for decision making.

Prior to end-user computing, most organizations employed a central facility for the design and development of the data base. Over time, this has had a unifying influence on organizational understanding. Any movement which runs counter to the central data design can reasonably be expected to undermine such unified understanding.

Following this line of thinking, this project identified several variables for investigation. The sense of independence brought on by the microcomputer is called Information Processing Independence. As described in chapter 4, it is measured by content analysis of the interview transcript.

The loss of unified understanding is called Semantic Diffusion. It is measured by comparing each subject's data model with that of the central data designer.

These two key variables are combined with two others (Data Model Inconsistency and Organizational Information Dysfunction) to form the key relationships examined (as illustrated in Figure 8).

The guiding model suggests that Information Processing Independence will bring about an increase in Data Model Inconsistency. That is, with the microcomputer, users will be inclined to make adaptations of centralized data. Such adaptations will more fully reflect their unique view of the organizational data systems.

Data Model Inconsistency is theorized to have an influence on Semantic Diffusion. The ability to create and work with data models that are not consistent with the central model will have an influence on how such individuals view and understand their organization. Their view could be expected to be different from, and, perhaps, even richer than, the view projected by the central model.

These differences in understanding can be expected, in some cases, to lead to Organizational Information Dysfunctions. This can take the form of confusion, misunderstanding, or lack of confidence in the information produced.

These and other related variables were measured using 34 subjects in 4 different organizations as described in Chapter 4. The values obtained were analyzed as described

in Chapter 5. The most pertinent results are summarized in the diagram below.

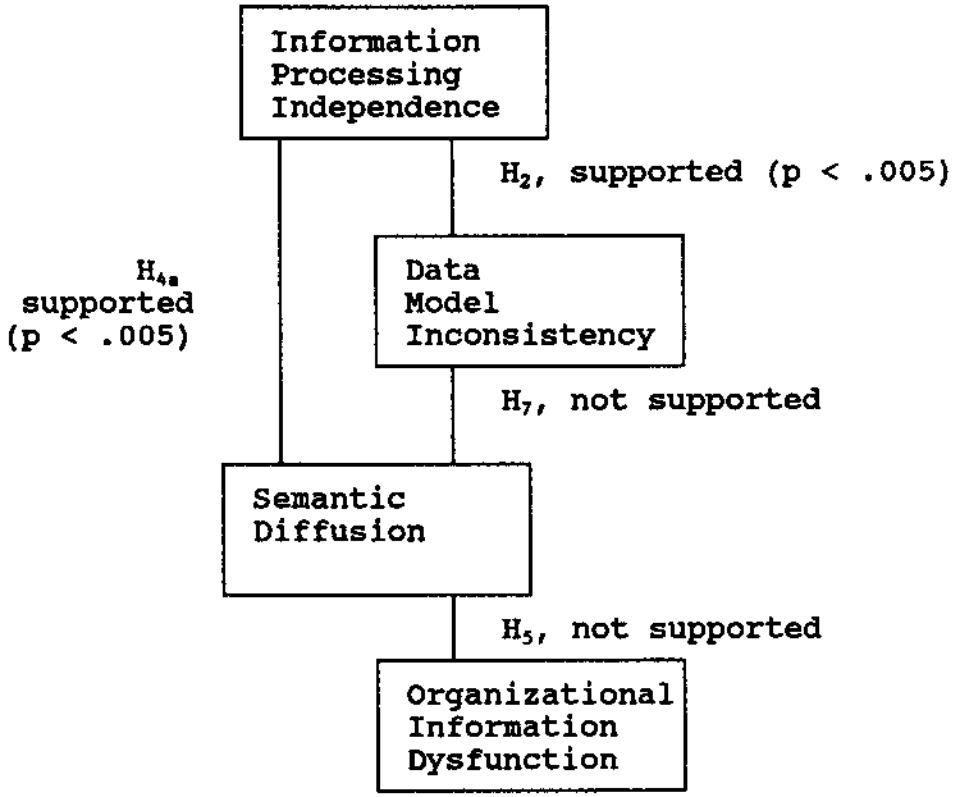

Figure 9. The Relationship between Key Variables

Figure 9 illustrates the primary relationships that are investigated by this project. It is essentially a repeat of Figure 8 with the research results added. The results are mixed.

Hypotheses H_2 and H_{4a} were strongly supported by the correlation analysis. This, in turn, is not inconsistent with the relationships proposed in the model. Hypotheses

H_7 and H_5 were not supported by the data analysis. This casts some doubt on the existence of the last two relationships.

The relationship between Information Processing Independence and Semantic Diffusion was supported. This relationship embodies the most central theme of this entire project. Data Model Inconsistency does not correlate significantly with Semantic Diffusion. This may mean that there are other or different intermediate mechanisms at work. One must note that the nature of the measure for Data Model Inconsistency was binary only which is not particularly robust.

The lack of a significant correlation between Semantic Diffusion and Organizational Information Dysfunction can have a number of interpretations. This measure is also binary and may be similarly flawed. It may be that enough dysfunctions arise from other sources to hide those expected as a result of Semantic Diffusion. It may also be that organizations have already detected and remedied some of the anticipated dysfunctions. Some hint of this is found in the responses to Questions VI and IX. Both of these questions explored the existence of actions that could mitigate the undesirable consequences.

Specific Subject Responses

One subject in this research was very mainframe oriented. This person felt that microcomputers had a role to play in business computing. They were, however, concerned with the wide role that they seem to have attained. The primary disillusionment of this person was the limited ability to share micro-based information. In their view, unsharable information might as well not exist.

This view is somewhat consistent with the primary theme of this project as represented by hypothesis H_{4a}. This person expressed concern about sharing information, while this research looks beyond that notion. Long-term use of private information could lead to a loss of shared organizational understanding (Semantic Diffusion). The support for hypothesis H_{4a} suggests that this may have already begun. The phenomenon may occur more frequently in settings with a high degree of Information Processing Independence.

A number of subjects seemed to feel that it was desirable to have micro-based data brought onto the mainframe computer. These objectives were typically volunteered while responding to Question VI. The general sense expressed by these individuals was that the mainframe environment brought a sense of legitimacy to these applications. They wanted to promote the validity of their private ideas. To this end, they felt it desirable to have

their micro-based systems incorporated into the mainframe database. The support for hypothesis H_6 is consistent with their response. It suggests that this will happen as organizations experience some of the difficulties associated with independent and redundant data sources.

Management Impact

This study addresses the management of a potentially serious problem associated with end-user computing. It explores the management of corporate data under a circumstance of diversity of data model design. If the problem in question is, indeed, a legitimate and serious one, then management solutions become pertinent.

Certainly, users have not ignored the management of end-user computing nor has the research. Rockart and Flannery (1983) traced the management practices back to an origin in time-sharing (Figure 4). One significant approach to this problem will be through long-term organizational education (Garrity and Rockart, 1986; Mayo, 1986; and Pyburn, 1986-87; Rockart and Flannery, 1983).

The solution of microcomputing management problems may require a shift in organizational orientation (Pyburn, 1986-87). Management typically looks to central MIS management for leadership in the computer-based activities of an organization. Now, some are suggesting that the appropriate control for end-user computing must be through

line management (Rockart and Flannery, 1983). Of course, line management is not likely to be aware of the appropriate type of management practices to employ. Ideally, they would look to central MIS for suggestions. This solution may require a good deal of patience. Results will not likely appear until the organization matures in its use of EUC (Alavi, et al., 1987-88; El Sawy, 1985).

The preceding analysis addresses end-user computing problems in the general sense, but what about the specific problem of data model management? Here, the solution may have to come from technological improvements in distributed data dictionaries. Some (Schreiber and Martella, 1979; Urhbach, 1984) have recommended a distributed data dictionary as a solution for an analogous problem with distributed database systems. Perhaps some adaptation of this concept can unite the mainframe and micro world. Corman (1988), for example, has called for interfaces between the data dictionary and micro software.

The current state of micro-level software support for data base (let alone data dictionaries) is quite unsatisfactory. As Eghazy (1984) points out, most micro "DBMS" are just file managers. The industry needs to develop high quality relational databases for micros. Ideally, the more seamless environment is desirable, such as that developed by Oracle. This eases movement back and forth between the micro and the mainframe environments.

Whatever solutions are devised, likely no one answer will fit all cases. New and different situations will call for unique and creative solutions.

For Further Research

This research took place in four different organizational settings. The unit of analysis was the individual subject. Some of the variables investigated might provide further insight if future research used the organization as the unit of analysis. If more members of each organization were involved in the study, the full, organization-wide impacts could be more fully explored.

Such a project might also require further modifications in the instrument. In it's present form, the instrument is an interview guide, requiring direct contact between the researcher and the subject. A completely self-administered design would allow for more subjects in a less restricted geographical setting.

This project only afforded a minimal level of contact with the subjects and their organization. This limited the choice of surrogates and the nature of the data collected. This resulted in certain measures that were binary in nature even though the phenomenon measured could be expected to actually occur with continuous values. Perhaps a future project could develop measures that were truly continuous.

In this regard, it was only possible to elicit the presence or absence of certain occurrences. It was not practical to determine the sequence of events. A longitudinal case study could go to the additional depth to follow such event sequences and, thus, explore the causal relationships.

This project used interviews to extract subject responses about the variables measured. This does not allow manipulation of variables. Because of this, conclusions about cause-and-effect are not possible. A laboratory experiment would be a valuable extension of this work as it would overcome this deficiency.

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APPENDIX A

STRUCTURED INTERVIEW GUIDE

Appendix A. Structured Interview Guide

The instrument used in this project was improved in a two-phase revision process. There were two pilot tests and two expert panel evaluations. After each expert panel evaluation, the instrument was revised. This appendix contains all three versions of the instrument.

The original instrument, unchanged from the defended proposal is identified as the "Preliminary Interview Guide." The instrument as revised after the first expert panel is called the "Revised Interview Guide." The instrument that was finally used in data collection, as revised after the second expert panel evaluation, is called the "Final Interview Guide."

Preliminary Interview Guide

Variable measured is indicated by **boldfaced** notation in braces. {}

I. {**Semantic Diffusion**} Describe the important facts to know about _____ (extracting attributes for an object).

Pause while subject responds. If incomplete response, then prompt with "What about _____ (general area overlooked)?" Items before and after the prompt are noted.

II. {**Semantic Diffusion**} What other things (objects) does _____ (object above) relate to?

What is important to know about _____ (attributes for new object)

Example:

Intv: "Describe the important facts to know about customers."

Respondent: "Name, address, credit status, years of patronage"

Intv: "What about those demographic factors of type of patron?"

Respondent: "Oh, yes. Like income, socio-economic profile, years of education, etc."

Intv: "What are other important things that a customer is related to?"

Respondent: "Their billing record, the store where they shop, the city where they live.

Intv: "Describe the important facts to know about billing records."

III. (**Data Item Relevance**) How relevant are these particular data elements to your position/department? Do you use data on this subject as a part of your job? If so, where is the data obtained? (mainframe or micro)

IV. (**Scope of EUC Application**) Do you have any microcomputer applications that employ this or similar data?

What is the source of your data? What is the scope of the application?

V. (**Autonomy**) Describe the degree of independence which you have in doing your job. (**Information Processing Independence**) How does that relate to your work on the computer?

VI. (**Information Involvement**) How frequently do you get involved in data design? Give an example.

VII. (**Data Model Inconsistency**) Have you personally been involved in a situation in which two different computer applications viewed the same data differently? Please elaborate.

VIII. (**Organizational Information Disfunction**) Have you been involved in an occasion where differences in computer processed data created some kind of a problem? Please describe.

IX. Please describe your impression about the growth of microcomputer-based data, and its' relation to mainframe data.

X. Any other general comments about this subject.

Revised Interview Guide 6/12/90

Ia. Describe the important facts to know about _____.

Ib. What are the different types of _____ .

II. Please describe the frequency with which you or your department deal with each of the sets of data.

		Frequent		Occasional		Seldom
Item 1.	_____	5	4	3	2	1
Item 2.	_____	5	4	3	2	1
Item 3.	_____	5	4	3	2	1
Item 4.	_____	5	4	3	2	1
Item 5.	_____	5	4	3	2	1

III. Do you have any microcomputer applications that employ this or similar data? What is the source of your data? What software do you use? What is the scope of the application?

	Example	Source	Software	Personal	Dept.-wide	Company-wide
1.	_____	_____	_____	P	D	C
2.	_____	_____	_____	P	D	C
3.	_____	_____	_____	P	D	C
4.	_____	_____	_____	P	D	C

IV. Describe the degree of independence that you have in doing your work. How does that relate to your computer work? ... on the mainframe? ... on the micro?

What percent of the time do you use the mainframe? _____%
What percent of the time do you use the micro? _____%

On a scale of 1-10, how much independence do you have in your job? ___
On a scale of 1-10, how much independence do you have in the work you do on the mainframe? _____
On a scale of 1-10, how much independence do you have in the work you do on the microcomputer?____

V. How frequently do you get involved in data design? Give an example.

What % is micro-based? ____%
What % is main-frame based? ____%
Of the mainframe, what % is end-user computing? ____%
Of the mainframe, what % is traditional computing? ___%
Of the traditional computing, what role did you play?
% user? _____%
% designer? ____%
% advisor? ____%
% other? ____% _____ (please describe)

VI. Have you personally been involved in a situation in which two different computer applications viewed the same data differently? Please elaborate.

VII Have you ever seen a situation where an isolated system (such as in VI. above) was merged into the central MIS?

VIII. Have you ever been involved in an occasion where differences in computer processed data caused some kind of a problem? Please describe.

IX. Can you recall any instances where individuals using or reporting about data used descriptive terms to define "which data" they meant?
Example: "These are 11th day student counts."

X. Please describe your impression about the growth of microcomputer-based data, and its' relation to mainframe data. Feel free to add any other comments about this subject in general.

Final Interview Guide 7/24/90

Ia. Describe the important data items to keep about ____.
Ib. What are the different types of _____ .

II. Please describe the frequency with which you or your department deal with each of the sets of data.

		Frequent		Occasional		Seldom
Item 1.	_____	5	4	3	2	1
Item 2.	_____	5	4	3	2	1
Item 3.	_____	5	4	3	2	1
Item 4.	_____	5	4	3	2	1
Item 5.	_____	5	4	3	2	1

III. Do you have any microcomputer applications that employ this or similar data? What is the source of your data? What software do you use? What is the scope of the application?

	Example	Source	Software	Personal	Dept.-wide	Company-wide
1.	_____	_____	_____	P	D	C
2.	_____	_____	_____	P	D	C
3.	_____	_____	_____	P	D	C
4.	_____	_____	_____	P	D	C

How much influence did central MIS have over development of these applications?

IV. What factors do you find that limit you in your computer work?

With regard to the main-frame....
Do you make database updates? _____
Is there a part of the database you may not access?_____

Are you allowed to download data?_____
Are you allowed to upload data? _____
Can you think of any other limitations to mainframe computer activities?

With regard to the microcomputer (PC):
Are you involved in software selection? ____
Are you involved in application design? ____
Do you do any data design? _____
Does central MIS or anyone supervise your computer activities? ____
Can you think of any other limitations to your micro computer activities?

Is there any difference between main-frame and microcomputer limitations?

What percent of the time do you use the mainframe? _____%
What percent of the time do you use the micro? _____%
(percentage of all work including computer work)

On a scale of 1-10, how much personal control do you have in the work you do on the mainframe? _____

On a scale of 1-10, how much personal control do you have in the work you do on the microcomputer?____

How much independence do you have in your job overall?

On a scale of 1-10, how much personal control do you have in your job? ___

V. How frequently do you get involved in data design? Give an example.

What % is micro-based? ____%
What % is main-frame based? ____%
Of the mainframe, was the design end-user computing oriented? ____
Of the mainframe, was it traditional computing? ___
Of the traditional computing, what role did you play?
user? _____
designer? ____
advisor? ____
other? ____ _____ (please describe)

VI Have you ever seen a situation where an isolated system was merged into the central MIS?

VII. Have you personally been involved in a situation in which two different computer applications viewed the same data differently? Please elaborate.

VIII. Have you ever been involved in an occasion where differences in computer processed data caused some kind of a problem? Please describe.

IX. Are you aware of any instance when individuals felt compelled to define the assumptions upon which their data was based? Example: "We have 218 minority employees, and by minority I mean ..."

X. Please describe your impression about the growth of microcomputer-based data, and its' relation to mainframe data. Feel free to add any other comments about this subject in general.

APPENDIX B

CONTENT ANALYSIS

Appendix B. Content Analysis.

A portion of this research involved content analysis of subject interviews. This activity was carried out by a three person coding team. One coder, designated the supervising coder, was trained directly by the principal researcher. He, in turn, trained the other two coders. The material that follows is the written instructions used in the training process.

Content Scoring Procedure
(Training document for coders)

The Independence Construct.

This procedure is being carried out to measure a very specific characteristic that is being stated by the subjects interviewed. That characteristic might be called the amount of information processing independence that the person says that they experience. It might also be described as autonomy, or personal control, or freedom of action in computing activities.

Materials.

The material to be scored is the result of an interview conducted with the particular subject. You will see two kinds of material, 1) a filled out questionnaire that lists all of the topics discussed, and 2) a partial transcript from a taped record of the conversation that occurred.

The interview was structured, in that it generally followed the topical outline indicated by the questionnaire. For various reasons, it is possible, even likely, that the subjects would respond out of the exact order of the questionnaire. For this reason, it is necessary to examine the entire questionnaire for responses, even though Question IV is the main place where responses were expected.

Statements to be identified.

Subjects will make two different kinds of statements that are of interest. Some statements made will express aspects of experienced Independence. Other statements will identify ways in which the subject feels that there are limitations to their independence. Both kinds of statements are important and should be noted.

Independence and limitations on independence will be experienced in two different computer settings, main-frame and microcomputer. It is important to distinguish between the two different types of experiences.

In summary, you will be expected to identify four types of statements in the material: 1) Independence/Mainframe, 2) Limitations on Independence/Mainframe, 3) Independence /Microcomputer, and, 4) Limitations on Independence/ Microcomputer.

Specific Instructions

1. Refer to the questionnaire and the interview together so that you can keep in mind the subject being discussed.

2. In the transcript "I:" means that the interviewer is talking and "S:" means that the subject is talking. Do not score any statements made by the interviewer (unless the subject indicates agreement).

3. The scoring process will take place in two phases. In the first phase, you will identify phrases in the material that appear to relate to the subject of computing independence. At this time, you will NOT attempt to classify the statement. Merely identify it by use of a highlighter.

After you have finished the highlighting, return the forms so that any discrepancies can be resolved. Then the second phase will begin. When the forms are returned, you will be expected to code all highlighted statements.

4. Score question number IV last. Parts of question IV are designed for the subject to write in the answer. There are several lines of such questions. Many times the subjects said nothing important during the time they were filling out this area. If they did say something that the transcribers thought might be important, they typed it in preceded by a letter to correspond to the line on the form that it goes with.

With regard to the main-frame....
(A) Do you make database updates? _____
(B) Is there a part of the database you may not access?_____
(C) Are you allowed to download data?_____
(D) Are you allowed to upload data? _____
(E) Can you think of any other limitations to ...
With regard to the microcomputer (PC):
(F) Are you involved in software selection? ____
(G) Are you involved in application design? ____
(H) Do you do any data design? _____
(I) Does central MIS or anyone supervise your ...
(J) Can you think of any other limitations to your ...

The direct yes-or-no answers to these questions will be scored separately. You should not score any statements that are merely verbalization of their answers to these questions. Any OTHER statements that they make at this time ARE subject to being coded.

5. For every highlighted statement, make a marginal notation about whether this is an expression of independence or limitation and whether this refers to mainframe or micro computing activities.

When the scoring is tallied, every mark of independence will be counted as +1 and every tally of limitation will be counted as -1.

6. At the end of the scoring process, you can make additional, overall, adjustments to the score (from -3 to +3). Such an adjustment might be made because of the fact that the same statement was made several different times (inflating the score and calling for an off-setting negative adjustment) or because of the apparent strength of the statements made (which would call for a positive adjustment). There may be other reasons that you would judge that the score should be adjusted. Indicate the reason for any adjustment made.

Of course, in many cases, it may not be necessary that any adjustment be made.

APPENDIX C

DETAIL OF DATA ANALYSIS

Appendix C. Detail of Data Analysis

Data analysis in this project involved converting the responses of the subjects into numeric values. This was accomplished in several different ways.

This appendix contains the detail quantitative values computed for each subject. Each table has 34 rows, one for each subject in the study. In each table, the subject is identified only by a company code and a subject number.

Table 5. Question I. Data for Semantic Diffusion Calculation

Sub	Co	Data Item # 1				Data Item # 2				Data Item # 3			
		F	CM	Sm	Diff	F	CM	Sm	Diff	F	CM	Sm	Diff
1	C	5	26	8	8	3	22	9	10	5	13	5	8
2	C	5	26	9	13	5	22	6	6	5	13	5	4
4	C	5	26	1	8	2	22	4	2	3	13	2	4
5	C	3	26	10	14	1	22	5	6	1	13	3	11
6	C	5	26	6	10	5	22	2	7	5	13	3	3
7	C	4	26	9	6	3	22	5	7	1	13	2	3
8	C	5	26	10	4	1	22	0	0	3	13	2	5
9	C	5	26	2	27	1	22	4	8	4	13	3	4
10	C	5	26	9	13	5	22	4	7	4	13	3	9
1	D	5	19	2	8	4	12	5	8	4	16	3	9
2	D	4	19	2	3	5	12	2	3	5	16	2	1
3	D	1	19	0	6	5	12	6	7	5	16	4	7
4	D	3	19	0	9	5	12	4	9	5	16	7	6
5	D	5	19	3	15	2	12	4	6	5	16	2	8
6	D	5	19	0	10	5	12	0	12	5	16	1	9
7	D	5	19	5	4	4	12	4	5	5	16	2	7
1	S	5	9	3	3	2	4	1	2	5	10	0	2
2	S	4	9	3	5	1	4	2	0	1	10	0	0
3	S	4	9	5	11	2	4	3	3	4	10	4	4
4	S	5	9	9	8	1	4	2	6	4	10	2	3
5	S	5	9	7	12	3	4	5	4	5	10	4	4
6	S	4	9	9	6	5	4	0	2	3	10	1	4
7	S	4	9	6	5	1	4	3	4	2	10	4	4
8	S	5	9	6	1	3	4	0	6	5	10	4	4
1	W	5	23	6	8	5	23	5	1	3	11	0	3
2	W	2	23	2	8	3	23	0	0	3	11	3	1
3	W	4	23	3	17	1	23	0	9	1	11	0	0
4	W	5	23	4	13	3	23	3	14	3	11	0	7
5	W	5	23	3	11	3	23	8	8	3	11	2	7
6	W	4	23	9	20	2	23	7	3	3	11	4	0
7	W	4	23	6	5	4	23	0	8	3	11	1	3
8	W	4	23	12	6	3	23	5	20	2	11	3	7
9	W	5	23	6	8	4	23	4	4	3	11	2	7

Sub = Subject ID Number
Co = Id of participating organization
F = Frequency of Involvement (Data Item Relevance)
CM = Number of Items in Central Model
Sm = Items for subject that match the Central Model
Diff = Items for subject that do not match central Model

Table 5. (cont.) Data for Semantic Diffusion Calculation

Sub	Data Item # 4				Data Item #5				Weighted Total	% Diff	% Same
	F	CM	Sm	Diff	F	CM	Sm	Diff			
1	3	10	5	6	1	14	7	2	244	0.467	0.533
2	2	10	4	5	1	14	4	3	240	0.467	0.533
4	3	10	4	2	5	14	4	3	128	0.398	0.602
5	1	10	6	11	5	14	7	8	189	0.418	0.582
6	1	10	2	2	1	14	2	3	164	0.360	0.640
7	5	10	2	7	3	14	3	1	158	0.456	0.544
8	2	10	1	2	4	14	3	2	117	0.598	0.402
9	1	10	0	0	5	14	5	3	225	0.227	0.773
10	5	10	2	11	3	14	5	7	314	0.325	0.675
1	2	14	6	7					176	0.307	0.693
2	2	14	2	3					70	0.457	0.543
3	5	14	4	7					181	0.387	0.613
4	5	14	6	5					212	0.401	0.599
5	4	14	5	8					212	0.250	0.750
6	2	14	1	1					164	0.043	0.957
7	3	14	6	1					147	0.469	0.531
1	2	4	1	1					50	0.380	0.620
2	1	4	0	0					34	0.412	0.588
3	1	4	1	0					109	0.394	0.606
4	1	4	0	1					114	0.482	0.518
5	3	4	5	2					183	0.464	0.536
6	1	4	0	1					86	0.453	0.547
7	1	4	1	3					71	0.507	0.493
8	3	4	2	0					99	0.566	0.434
1	5	15	2	6					149	0.436	0.564
2	4	15	5	9					88	0.375	0.625
3	4	15	6	6					137	0.263	0.737
4	5	15	6	6					217	0.272	0.728
5	3	15	3	17					205	0.263	0.737
6	4	15	6	8					204	0.422	0.578
7	5	15	4	9					153	0.307	0.693
8	3	15	2	13					212	0.354	0.646
9	4	15	5	8					181	0.398	0.602
								Mean	158.58	0.387	0.613
								Maximum	314	0.598	0.957
								Minimum	34	0.043	0.402
								Standard Deviation	61.80	0.106	0.106

% Diff = Percent of Subject Data model that lies outside of Weighted Central Model

% Same = Percent of Subject Data model that overlaps on Weighted Central Model

Table 6. Question IV. Coding for Information Processing Independence

coder ->		a		c		Combined		
S	C	Mic	MF	Mic	MF	Mic	MF	Oall
1	C	5	0	4	-2	4.5	-1	7
2	C	-3	-2	-2	-2	-2.5	-2	-9
4	C	6	-6	7	-9	6.5	-7.5	-2
5	C	5	-4	5	-4	5	-4	2
6	C	1	-2	2	-1	1.5	-1.5	0
7	C	5	-2	4	-3	4.5	-2.5	4
8	C	-4	-3	-2	-3	-3	-3	-12
9	C	8	-2	9	-1	8.5	-1.5	14
10	C	1	-2	2	-3	1.5	-2.5	-2
1	D	5	3	5	3	5	3	16
2	D	1	0	1	0	1	0	2
3	D	1	1	2	0	1.5	0.5	4
4	D	-2	-4	-3	-2	-2.5	-3	-11
5	D	10	1	10	1	10	1	22
6	D	13	-2	13	-2	13	-2	22
7	D	3	2	7	2	5	2	14
1	S	6	2	5	3	5.5	2.5	16
2	S	5	-2	4	-1	4.5	-1.5	6
3	S	2	4	2	4	2	4	12
4	S	6	-4	7	-5	6.5	-4.5	4
5	S	3	0	2	1	2.5	0.5	6
6	S	-1	1	0	0	-0.5	0.5	0
7	S	1	-1	2	-2	1.5	-1.5	0
8	S	-1	1	-1	1	-1	1	0
1	W	-5	-10	-7	-10	-6	-10	-32
2	W	1	-8	1	-8	1	-8	-14
3	W	9	-12	9	-11	9	-11.5	-5
4	W	9	2	9	2	9	2	22
5	W	4	3	6	2	5	2.5	15
6	W	1	-2	2	-1	1.5	-1.5	0
7	W	-3	-2	-4	-1	-3.5	-1.5	-10
8	W	-2	-2	2	-2	0	-2	-4
9	W	2	-3	6	-5	4	-4	0
Mean		2.8	-2	3.3	-2	3.05	-1.73	2.6
Maximum		13	4	13	4	13	4	22
Minimum		-5	-12	-7	-11	-6	-11.5	-32
Std. Dv.		4.2	3.5	4.3	3.6	4.20	3.53	12

Mic = Independence in Microcomputing activities
MF = Independence in Mainframe computing activities
Oall = Overall independence

Table 7. Question IV. Additional data

Subj	Comp	% of work on		Personal Control		
		MF	Micro	Mainframe	Micro	Overall
1	C	10	50	6	3	9
2	C	40	40	5	8	8
4	C	1	15	8	3	9
5	C	20	20	2	10	9
6	C	15	15	5	9	9
7	C	5	70	6	10	7
8	C	1	50	1	10	5
9	C	10	40	2	10	8
10	C	10	15	1	8	7
1	D	5	5	8	10	8
2	D	50	10	8	10	9
3	D	5	70	8	10	8
4	D	20	20	5	10	7
5	D	40	5	5	10	8
6	D	5	15	4	10	8
7	D	25	70	5	10	9
1	S	35	35	5	8	8
2	S	5	80	2	9	9
3	S	10	70	6	10	9
4	S	20	40	2	9	8
5	S	90	10	8	5	8
6	S	82	3	10	1	8
7	S	10	50	9	10	9
8	S	10	10	8	9	8
1	W	1	20	7	10	10
2	W	5	70	1	10	8
3	W	20	30	2	4	7
4	W	8	12	7	10	9
5	W	95	5	10	10	9
6	W	0	30	7	9	7
7	W	0	50	1	9	8
8	W	6	20	3	7	7
9	W	15	20	7	10	10
Mean		20.4	32.3	5.3	8.5	8.2
Maximum		95.0	80.0	10.0	10.0	10.0
Minimum		0.0	3.0	1.0	1.0	5.0
Std. Dev.		24.9	23.2	2.8	2.4	1.0

Subj = Subject ID Number
Comp = Id of participating organization
MF = % of job involving mainframe computing
Micro = % of job involving micro computing

Table 8. Responses to Questions V through IX

Sub	Co	Question # V: % Invlve Mic	% Invlve MF	Involvement Role: EUC	TC	User	Des	Adv	O	Coded Responses to Question # ... VI	VII	VIII	IX
1	C	80	20	X	X	X	X			2	1	1	2
2	C	0	0							0	1	1	1
4	C	90	10		X				X	1	1	0	0
5	C	90	10	X	X	X	X	X		0	1	1	0
6	C	0	0							0	0	0	1
7	C	50	50		X	X		X		0	1	0	1
8	C	98	2		X			X		1	0	1	1
9	C	100								1	0	0	1
10	C	95	5	X	X	X	X			2	0	1	1
1	D	60	40		X	X	X			1	0	0	0
2	D	90	10		X	X		X		0	1	1	0
3	D	90	10		X	X	X	X		1	0	1	1
4	D		100		X	X				0	0	0	0
5	D	95	5		X	X				0	1	0	1
6	D	90	10		X	X		X		1	1	1	0
7	D	25	75		X	X	X	X		1	1	1	0
1	S	35	65	X	X	X	X	X		1	1	2	2
2	S	98								0	1	0	0
3	S	60	40	X	X	X	X	X		0	1	1	1
4	S	100								1	2	1	1
5	S									0	0	0	1
6	S	3	100	X	X	X		X	X	1	1	2	1
7	S	20	80	X						0	2	1	1
8	S	50	50	X	X	X	X	X		0	0	0	0
1	W	0	0							0	0	0	0
2	W	98	2		X	X		X		0	1	1	1
3	W	60	40		X	X				1	1	1	0
4	W	75	25		X	X				2	1	1	1
5	W	50	50		X		X	X		0	1	0	1
6	W	90	10		X	X	X	X	X	0	1	1	3
7	W	0	0							0	0	0	1
8	W	0	0							1	2	1	0
9	W	3	3		X	X				0	1	1	1
Mean		57.9	28	Number of					0	18	12	14	13
Max		100	100	Subjects				-->	1	12	18	17	17
Min		0	0	by count					2	3	3	2	2
St.D.		37.7	30.8						3	0	0	0	1

Key to table is on following page

Key to Table 8.

Sub = Subject ID Number
Co = Id of participating organization
Mic = % of involvement with microcomputer design
MF = % of involvement with mainframe design
EUC = involvement role was end-user computing
TC = involvement role was traditional computing
User = involvement role was as a user
Des = involvement role was as a designer
Adv = involvement role was as an advisor
O = involvement role was "other"

APPENDIX D

METHODOLOGY PHASE TWO

EXAMPLE INTERVIEWS AND DATA MODELS

Appendix D. Methodology Phase Two.

This appendix contains a sample of the materials generated during the data gathering phase of the project. In all 34 subjects were interviewed at four different organizations. For each organization one subject is represented here. For each subject, there is the interview transcript, the subject's data model, and the central data model for that organization.

The interviews were transcribed verbatim. No edditting was done to the responses. This is raw uneditted data.

Interview with Subject 6, Company C

Q. II. Data Item Relevance

Q. III. Scope of Application

S: I'm sure it's sitting out there and some know how to access it because I don't deal with it. Well, I'm hooked up to the mainframe.

I: This is not a PC, its a terminal.

S: Well its a combination PC and mainframe.

I: Okay, I'm interested in data that you have on the hard drive on your PC.

S: My hard drive? Like Lotus worksheets? All I have on my hard drive are like Lotus type applications.

I: Exactly, this question is asking about data that is on that hard drive . . . Do you see what I'm saying?

S: Items 1, 2, and 3 yes. I have some products, customers promotions events, I have nothing relative throughout the plant.

I: Do you have lots of those things?

S: Tons of worksheets on sales volumes, by products . . .

I: I get the impression this data is pulled down from the mainframe or entered manually? Is that data downloaded before you put it in your spread sheet or is it...

S: I, ... sometimes I do utilize the download process or capability. Sometimes I have to just key it in off a report.

I: But even when you key it in, you're keying it in off a mainframe report so that is sort of like a keyboard download, if you will. So it all comes from the mainframe. . .

I: How much influence did central . . .

S: My Lotus applications? None

I: You cooked those things up. (S: Right) They didn't, Did central MIS like for instance show you how to get at the data for instance or anything like that?

S: I don't know what you mean by central MIS. All these systems were new at one point in time. When I first started working here, someone did show me how to access the system.

I: And you don't know where that person came from?

S: Sometimes it's been a person in the MIS group. A lot of times its just pulling out a manual and going through the manual. (I: sounds to me like very little) I've learned it through, for instance if I'm going after a system that down in the planning department that MIS has designed for the planning group. I usually contact someone down in the planning department so he can show me how to access his system. So some of this stuff, yeah, I use the MIS group. I'd say its probably 50/50.

I: But they didn't have a lot of influence in what you did? Only in an enabling sort of fashion. (S: Right)

Q. IV. Information Processing Independence

S: I would say my biggest dilemma is the fact that just not having access to a system. The data is out there a lot of times and because I don't work in that specific function I don't have access to the system.

I: You're restricted from accessing or you don't know how?

S: No, I'm restricted from accessing it.

I: So if there data that you think would be useful to you in other areas . . .

S: Right, there's a prime example right now. There's a system called MAP, which is down in the planning department. Market Area of Profitability, and it tracks basically, its a whole P & L system for the company and because I'm dealing with trade activity working in the sales organization and constantly having to track our performance, I need to get a specific contribution information for various line ids promotions and things like that. And I'm not able to go after each of the different components, functional components, that allow me to arrive at your bottom line P& L contribution. So I can get at sales information, typically can get at some of the A& M group, marketing group, sales and marketing information, but it limits me from determining distribution expenses, manufacturing, purchasing, and all the functional types of expenses. So I'm constantly having to call up someone down in planning and say, "Hey, can you do me a favor? Can you go into the system and determine

contribution margin for the various line items? (I: So you have to around the system . . .) Right, they allow me to see a piece of that system and access a piece of the pie where I need to get at the whole thing.
S: C. I have the capability of downloading. (I: Do you do it very frequently) I do. A lot of times the database isn't designed or set up so that you can download from that DB2 that we use. It's on the DB2 database. That doesn't allow you that download capability. But the MIS group is being pretty good about as much as they can setting up systems that give you that DB2 download capability.

I: D. Other than to your own personal files?

S: I uploaded to an MIS system. I was involved last year with a planning system where we were taking the information out of Lotus, uploading it to a TSO file and from the TSO file we were putting it into a mainframe system.

Q. V. Information Involvement

Q. VI. Application Integration

S: No

Q. VII. Data Model Inconsistency

S: No.

Q. VIII. Organizational Information Dysfunction

Q. IX. Data Model Verbalization

S: No, typically the systems that I access there is only one variable out there for sales. I mean gross sales.

I: But if you put together a presentation or a report based on that, don't you have to tell what your source is in order to be clear.

S: No, because typically we've only had one source for sales. Now you have two that being it used to be the HWS system which was historical weekly shipment system. When they went to the hand held system and you had the SDW system, Sales Data Warehouse system, you now had the

capability of accessing sales, true sales dollars. First before it was shipment which . . wasn't true sales dollars so then, yes, you had to clarify that this was sales versus shipments. But typically now we only have one system (I: and everybody knows that) right, and they show sales, actual sales dollars.
I: But if you were to put up a report that showed for the last 10 years it might be very likely be that you would put an asterisk back about 4 years and say now for the last 3 years this is based on this and before that it was based on that, so you get the idea what I'm saying.

S: Right, so the answer would be yes.

I: Well, but not very often. Apparently from your perspective there's one official main figure that you go by and you don't feel compelled to identify it every time you use it.

S: Because we've evolved into that. I mean last year it was a different scenario. Last year the question was always Is this shipment data or is this sales data? Because we were just introduced to the handheld system and you had access to it and you could get the data, whereas this year no one asks you the questions. Like when you show sales figures (I: everyone assumes) sales and not shipment. Last year you had the case where you were constantly trying to clarification of whether was it shipment or was it actual true sales dollars?

Q. X. General Impressions

S: I could never have done my job without a personal computer. Eight years.

I: You remember the time that I'm talking about. (S: Right) About 5 or 6 years.

S: Every since I've been at here I've worked on a computer.

I: But you've seen the micro computers arise.

S: I've seen the advances in technology that we've had with the PCs. Just from my stand point, just how much quicker turn around time is with the PCs and technology as advanced.

It's just been incredible. Systems that we were using in planning three years ago, those applications when you run them on the PCs we have now run twice as quickly as what

they were down in Planning just because of the advances in technology.

I: One of the places, at this company, where the PC has had its most impact is in the analysis and interpretation of data and the presentation of it. (S: Definitely) That you're just able to do a much richer, more meaningful thorough job while you said you couldn't do your job without it. . .
S: We did exactly that. We started off with trying to develop a mainframe system. What we were trying to do was develop a volume planning tool for tree analysts who are responsible for projecting what the sales volume is by brand for specific zones. We initially had everything. We had done a prototype and it was in the Lotus world and it had a lot of clip on features. We hired a consultant, I don't know where he was from, he wasn't from a Lotus corporation, he may have been independent. Hired him to come in and work with us to develop basically a mini mainframe system on our PCs. We just couldn't. . . See you had to have something where you had, What is the capability, that you could quickly turnaround, that you could go in and easily move from screen to screen.

I: And you developed that and then distributed to . . .

S: We worked jointly with the MIS group because initially they wanted a mainframe system because you have much more control if you got it in the mainframe than you have one programming . . spreadsheets. That was a real concern because there was these huge massive spreadsheets that we were having to design because of the level of detail that was needed. And the number of functions that the spreadsheet was performing. So we ended up doing exactly that. We designed the actual application in Lotus and used it. And what we did was design a datafact and extracted the datafact and fed that up to a mainframe system and that mainframe system in turn cranked out additional calculations and sent it to other mainframe systems to ultimately generate profit/loss statements for a particular area for a particular brand.

I: This was used in-house for you to analyze the profitability of . . .

S: Right, we have groups that are responsible for forecasting volume for planning. Basically our volume . . . data . . . expenses . . . unless that's what it was used for

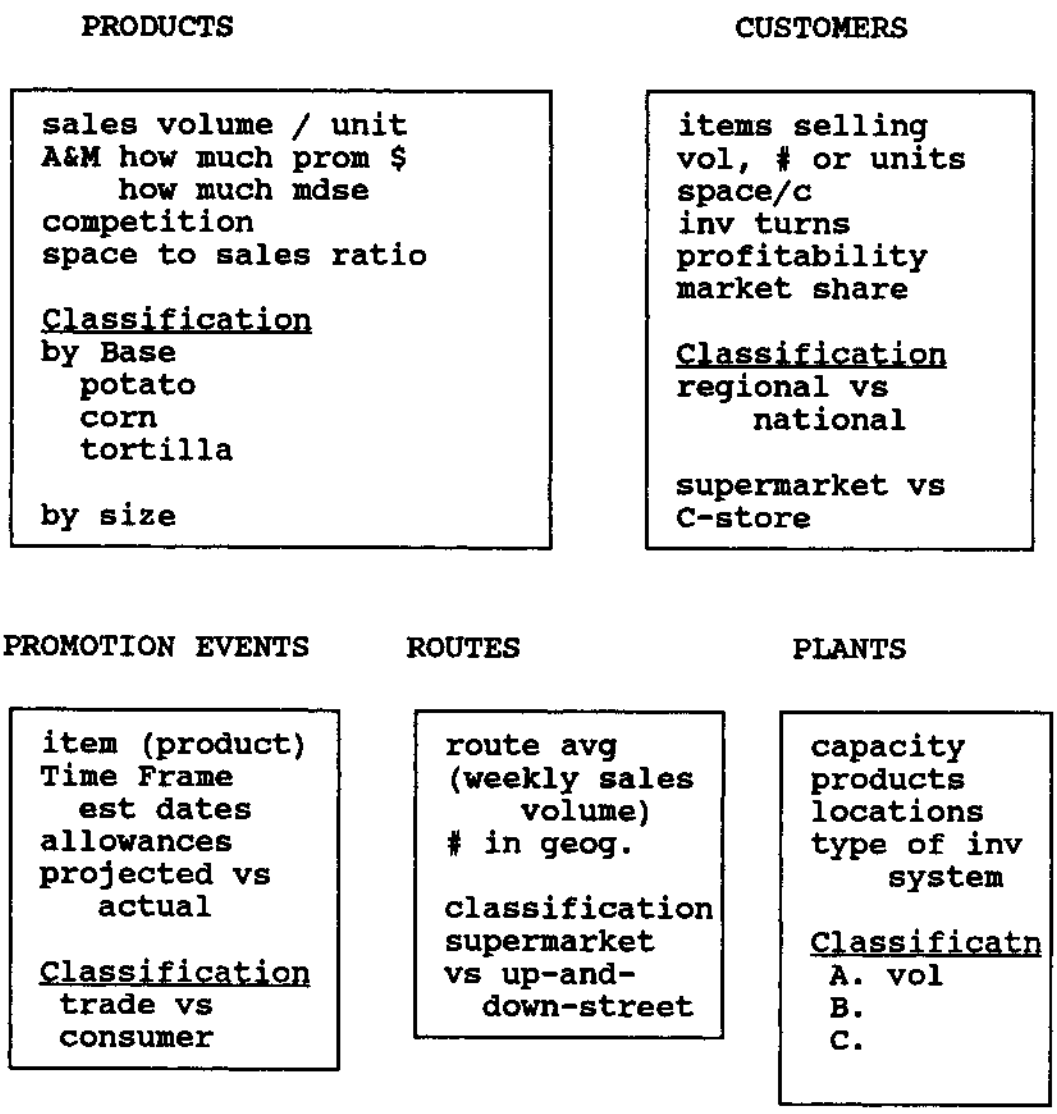
I: But it was easier to set those spreadsheets and do all those calculations on the micro than it was to try to embed those in on the mainframe Cobol programs or something.

S: Exactly, because of the fact you don't get the turnaround. Because of the number of, I guess calculations, the mainframe was having to go through the turnaround time was like ridiculous. It was like 3 or 4 hours.

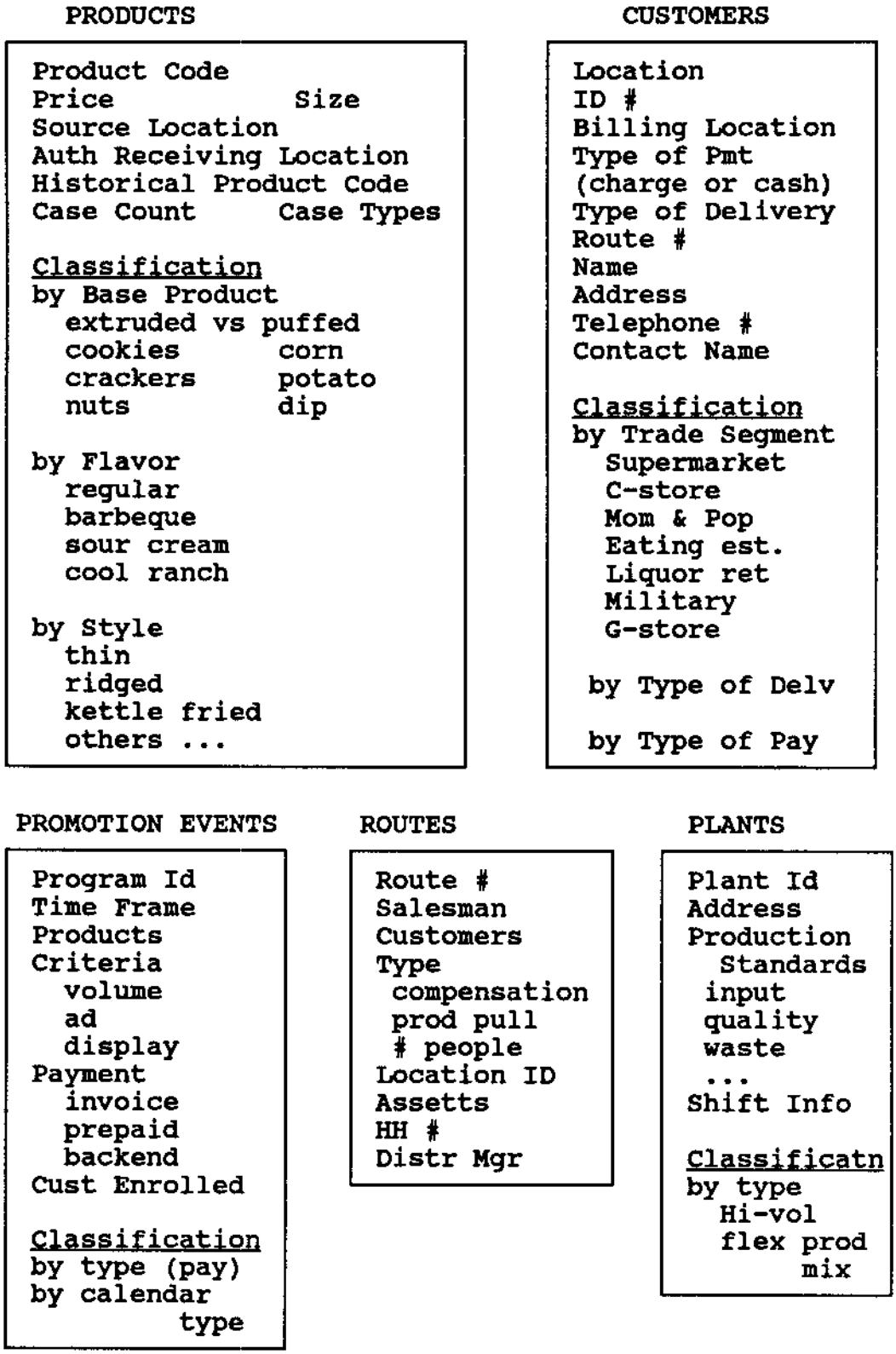
I: Were you trying to do it as a screen interactive type thing where you enter the data . . .

S: That's exactly what they were trying to do. Whereas this PC you hit that enter button and whamo you've got your response back. Whereas with this thing it was, it had to feed over here, it had to go to here from here to here to here and you hit that enter button and you (I: Go to lunch) Right and then come back.

Company C, Subject 6 - Data Model



Company C - Central Data Model



Interview with Subject 6, Company D

Q.II. Data Item Relevance.

I: On the questionnaire, you will notice question 2 there. I have listed these 4 items: raw materials, orders, products, and customers. What I'd like you to do on that part is circle the number there that represents how frequently you deal with each of those subjects. In other words, if you put a 5 that's something you deal with all the time, if you put a 1, you hardly ever deal with that.

S: OK.

Q.III. Scope of application

I: Question 3. Do you have any microcomputer applications that employ data about these 4 subjects? By that I mean it runs on your microcomputer and the data at least in part, or some of the data is on your micro.

S: Yes. (I: ok) Primarily it would be with orders and products.

I: Various and sundry kind of studies or a particular system?

S: I do various studies. For instance, on orders, I track history and I track forecasts and butt it up against production capacity versus planned.

I: That might be just ... on line number 1 give a name to that. It deals with orders and production capacity?

S: We could say finished goods inventory control.

I: Fine. the information comes from...? Do you enter it or...

S: It comes from central mainframe system reports and plant schedules and the forecasting system.

I: As far as your system is concerned, you actually enter that, but some of it comes off of other reports? (s: yes). OK. Some of it you got from other sources so you might say miscellaneous reports. Do you use Lotus to analyze that with?

S: Yes, Lotus.

I: And the scope of that. Is that an application that you use in assisting you in your own decision-making, does it affect a small circle around you ... ?
S: It's something that affects the whole company.

I: It influences in the sense that it affects your decision-making?

S: Well, no, actually the report goes to several different people. On a frequent basis.

I: Any others. That probably captures more than one thing.

S: Yes. I analyze it by the month and also by the week. Sometimes we have to make alterations to our plan, because it doesn't happen the way it is supposed to. Monthly, it is more or less an estimate and used for planning. The weekly is saying, the plan went awry, now what the heck can we do about it. The situation, for instance, if our warehouse fills up too much and nears the critical point, and I'm looking one week or two weeks out and I can see where it could very conceivably go over then I have to either get busy and identify additional warehouse space, or I have to make an emergency curtailment of production, a combination of the both or ... (I: Build stuff that's smaller?) I wish it was that simple. When you decide to build something today, it's twelve weeks before it starts down the line. The scheduling system brings the materials in on a just-in-time basis

Q. IV. Information Processing Independence

S: It very rarely does what I want it to. We have, I think, five programers dedicated to us. One acting as a programmer/supervisor. Generally, we have a weekly meeting to work on the agenda and lay the project out and a few months later, if you didn't get bumped, maybe it is working. So it takes a long time from the time something is identified 'till you get it done. The system is extremely complex and it interacts with lots of other portions of the system. Sometimes when you make a little change here it affects 10 or 12 other things too. (I: I would imagine though by now those people are pretty good at recognizing those interactions?) Yes, generally. Rarely will they slip up. We have a labor analysis that they do for us and we shut down a small assembly plant and they thought they had the formula fixed to take it out but they really didn't so some of the daily average information got skewed for a few days until we got that fixed. They got pretty good at coming back on something like that and fixing it.

A:
S: Yes. People who work mostly indirectly for me make changes. The scheduling system over here I will request certain changes there and sometimes I will request engineering changes. Scheduling system, for instance, we are getting ready to change a product from one plant to another.

E:
S: Yes, I have an 80 column screen and half of my applications are 132 columns. (I: So you can't look at what you're running?) No. I have to go look at somebody else' terminal. (I: You have a 132 character terminal somewhere?) Yes, right across the way in scheduling.

K:
S: The mainframe certainly has more capacity to deal with larger amounts of information. I can encompass all the departments and it has tremendous amounts of information available for you to draw from. It is very slow and tedious to get a report customized or to download a report It seems like it is a big deal to get one. The information is there. It is like a big swimming pool, you can see it but you are not allowed to jump into it. It would be of tremendously greater value if the database were built out there in the mainframe and you had access to facilitate access to the data you are authorized to get to and download it into the format you want to use it in. Then use it on the micro. Now, you don't have to be allowed to upload or whatever. But if that were a big data base on the mainframe you could go in and, for instance, I could do all kinds of analysis if I could grab the right stuff. Get me a list of all the active products or get me a list of all the plants that are currently .. get me a list of all the run rates. Lay it out in order and download it into my Lotus program.

I: Say, you don't want to have to tell someone today what data you might be interested in next month. (S: Right.) You'd like to wait until next month and when the moment presents itself then you say "I need that" and you may have someone out here download it for you and stick it into a spread sheet.

S: Let's say we get three new big accounts on offline products and they want to open up plant 9 again. They are going to come to me and say," How can we do it?" Right there is an opportunity, and I need to grab information, and a lot of it is available on the mainframe. I can't get it. At least not in time to address that particular problem. (I: You would like to have a roughed out plan by day after tomorrow and you can't even get the data by then.) Exactly.

As a matter of fact it will be 2 or 3 months before I get the data. At least sometime, especially if it turns into what they call a project. If they have a program set up it may only take 4 or 5 days before it is downloaded so you can use it. And, they have to pull somebody off and work it. (I: And it is like and emergency situation to get it to you in 2 or 3 days ?) Yes, right.

Q. V. Information Involvement

Q. VI. Application Integration.

S: Yes. The scheduling system was the biggest. It was a stand alone manual system we decided to computerize. (Was it on computer before?) Yes, it was on microcomputer. The purchasing system was on the mainframe. It was stand alone and it has been integrated into the scheduling system. The budget system, our system of budgets and monthly financial statements, etc. were done traditionally on the mainframe and now is a micro-mainframe application. There has been a tremendous amount of growth there.

Q. VII. Data Model Inconsistency.

S: Yes. Where it really was most dramatic was in the purchasing scheduling system. Since those two weren't tied together, the scheduling system might be asking for the stock today and the purchasing system would be asking for the stock 2 weeks later. That caused big time problems.

Q. VIII. Organizational Information Dysfunction.

S: Yes. (The remarks in question 7 give a very apt description of such a problem)

Q. IX. Data Model Verbalization.

S: That happened several times in the past.

I: Do you have any circumstances where that happens now ?

S: Right now? (I: A computer ? doesn't stand by itself, yet, but sorta tells what is behind it.) Not too much. (I: So if you put out a report on the Lotus do you feel compelled to explain the assumptions behind it or are they pretty well known ?) No. There are several different opinions as to how much will sell and the reports I put out are just my

opinion. A lot of them are based on opinion as opposed to fact.

I: Would you expect or see if someone else is producing an opinion, would you like to know what their assumptions are. (S: I would certainly like to see it.) Do you? (S: Not usually.)

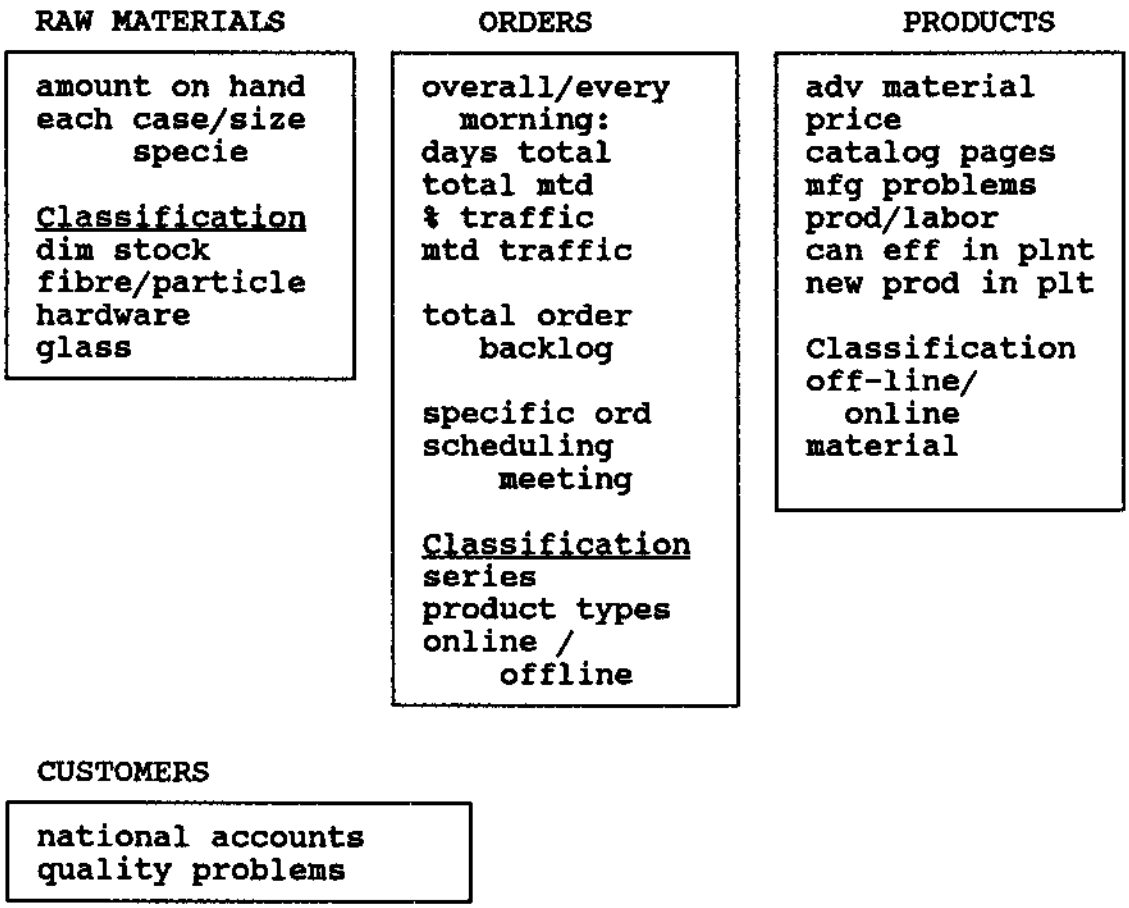
Q. X. General Impressions

S: Well it has had a dramatic impact on the company. In my area specifically, some of the thing I do on the Lotus based applications are the capital expenditure budget. I can keep track of the expenditure budget, items we have budgeted, items we have purchased, payments we have made on a monthly basis. I keep a running total of how much we are authorized and how much we have spent, how much we have paid, how much we have left. It would be an extremely consuming job without the PC.

I: You are able now to do it now by yourself in a circumstance where before you would have had to hire help to do that.

S: I would have had to have somebody just to keep up with that. For the analysis that I do, so many times you have several bits of information standing alone and they don't mean anything. When you can combine them, manipulate them, look at them two or three different ways, it will help you find solutions to a problem. (I: You just probably would not have done the analysis without the microcomputer ?) S; Exactly. Many, many times we would not have begun to do analysis. The labor standards we are doing are incredibly complex. These sheets here are labor standards for case goods. I wouldn't even start to do that job by hand. There would not be enough hours in a day to keep track of all that. That is just the output, and it is a combination of mainframe and microcomputer analysis. (I: Some of that gets downloaded to the micro and you add to it?) You bet. The way it is broken up is that the machine rooms, out here with the big machines, because of the scheduling system, their work is on the mainframe. The cabinet room, the finish room and the packing room are not on the mainframe. Each of those departments are analyzed individually on the microcomputer based on the number of people they have. Then we weld them together on the micro and we have this.

Company D Subject 6 - Data model



Company D - Central Data Model

RAW MATERIALS

vendor
stock code
stand cost
process ->
  route sheets
plant
header code
po
order size
finished size
NPP

Classification
order status
  cutting
  supply
  accumulated

supply or
non-supply

reference

ORDERS

customer
where ship
where sold
transfer
  method
prices

misc notes
credit terms
ship date

Classification
1. curr
2. whs
3. rush

PRODUCTS

plant
price
series
fabric
  how much
designer
% on how to
  charge
commissions
description
base prod #
ref prod #
weight
cube
l/w/h
per box

Classification
A. Base/ref
B. Samples/
   product

CUSTOMERS

address
sold
bill
ship
credit terms
traffic code
employee who handles

sales / qty
when to set up

Classification
large vol vs
small vol

current vs
out-of-date

Interview with Subject 6, Company S

Q.II. Data Item Relevance.

Q.III. Scope of application

S: No. The entire scope of my job is to make sure the rest of the engineering staff has all the information they need. So there is really no need for me to set up my own data base. I consider it my job to make sure I am not the only one who has the information. I try to get it out to all the engineers.

Q. IV. Information Processing Independence

S: I guess in any computer work that I would need to do I would need to justify cost vs. benefit. In order to purchase additional cpu power I would need to justify it. That the benefits derived from that justify the cost. That is really the only restraint. If I can justify it cost wise then I can purchase the cpu and I can get the additional support to help with the installation or what ever else I need.

D. In regards to the IBM main-frame I do not upload because of ignorance of systems not because of any other restrictions. Most of my work is done on VAX.

E. In regard to this part of the question most of my work is done with VAX which is the main system I work with and that is primarily my responsibility so there are no limitations there. If anything I would impose limitations on other people for integrity or security reason or something along those lines.

J. The main limitation would be standardization of implementation. You don't want to make information that is available only to you and usable only by you. Information is only good if it is shared.

I: I know for instance that the organization uses Symphony as a tool. You would have to have some really good reason to go out and buy Quattro. (S: Yes.) That is the spirit of that answer.

S: K. Obviously there is going to be a significant difference between what you are going to do on a main-frame vs. what you are going to do on a microcomputer. On a microcomputer you are going to have complete and absolute control over what information you have and how you are going

to do it. How you are going to analyze that information. On a main- frame you are working in an environment that many other people share therefore if you need to change one thing around or if you need a certain type of access there are a set of procedures or set of rules you must go through to make sure you don't jeopardize the integrity of somebody else's information. (I: The fact that the main-frame is shared imposes a certain amount of restrictions that are not imposed if you are on a micro.) Yes. That is right.

Q. V. Information Involvement

Q. VI. Application Integration.

S: Just about anywhere I have worked in manufacturing as well as I worked with a community college we all had integrated systems. Systems that were independently developed on a micro and at a later point in time reintegrated back in to the IBM main-frame. Or, else, designed from the start to have that hook into the main-frame system.

I: Have you seen that occur here? And, can you give me an example?

S: Sure. The main-frame system has certain financial systems which are used in purchasing all the equipment. It contains some key information about the machinery. The manufacturing systems obviously need to know about the machinery also, so there was the hook put in to transfer the information from the financial, when the systems were still in the design phase, into the manufacturing when the lines were in their implementation phase.

Q. VII. Data Model Inconsistency.

S: Sounds like to me here you are talking about two systems where both of the had information about pieces of machinery? (I: Yes).

S: What came to mind first was SPC because no matter how you look at it SPC information is the thing. You have a part, a part was produced at a specific time and it was produced in sequence and has certain characteristics. That is all there is to it.

I: Then there is another system that does the same thing?

S: There are several systems that do the same thing. Some are PC based and some are the system which I work with.

I: They overlap the same subject items? (S: Yes.)

Q. VIII. Organizational Information Dysfunction.

S: I guess it depends on your classification of problem. I consider it a problem when the information is available to only a small area. When that is information that needs to be shared. So I think any implementation of that type of information on a pc is a problem. This is my personal view. Misuse of computers.

I: What about a situation where it is not in agreement.

S: Oh, yes there are a lot of places where the information is not in agreement. That is between the main-frame and the microcomputers. The systems I work with are more current because the information needs to be correct or else the lines will not be set up. The mini-systems that I work on are based on how the lines are set up. The information on the main-frame are based on how we thought the lines would be set up. That information was not always maintained primarily because that information was not under direct control of the engineers who were designing the line. So there are some discrepancies between what we have on our main-frame system and what was actually installed. It is probably not a serious problem and the main-frame will be brought into line. You know there is the design phase and then the implementation phase. Obviously you don't always implement what was designed. You must then go back after implementation and understanding of future projects, etc. You will always go back to your original design and make sure the documentation accurately reflects implementation.

Q. IX. Data Model Verbalization.

S: Where the model conflicts with reality?

I: Or where the model conflicts with someone else's model.

S: Yes. Anytime you define or model something you have to define what the objects are you are modeling. (I: But, then frequently people start talking about their model or the products of their model without bothering to reiterate what the assumptions are and I am saying that if you have conflicting models then a mature organization will recognize they have more than one way of modeling in our organization so I had better either say which model I am talking about or

I had better say in this context we speak of things this way. Understand what I mean?)

S: Okay. I can give you areas where when I am talking to people I must define the parameters with which I am working. There are several places where I must do that. One of the things we have got is a model of the manufacturing environment that resides on the VAX and it is a computer model of the environment and many times different engineers will need to extract different information from that so obviously they will come over and talk with me to see how to get that information and so at that time I will need to define certain things. What the information is they are looking at so that they can determine what they really need. Now the areas that are in this conflict are things like loadwait time. Someone will want to know if there is a backlog. I a specific part of operation not able to keep up with the operation of the machines. So we can do some analysis and studies on the line and find out if that machine is starved for parts or whether it is chocked with parts and unable to unload. That is a function of the automation that is loading on and loading up to that machine. However when you are looking at that the information we have on the computer is not always obvious. We have 2 pieces of information. The information not only tells you how long did that machine wait but what was the threshold of expected wait time for that machine. Always when a machine says hey I'm ready to be loaded it will take 2 or 3 seconds for a robot to know that machine is ready to be loaded. So even though the wait time on that machine is 30 seconds the actual wait time is only 27 seconds. So there are things like that which always need to be specified when you are going through an analysis on the line. That is one. Do you need me to list off all these.

I: No. I think since you have identified several of these is sufficient for the question.

Q. X. General Impressions

S: I think microcomputers have a place. There is no doubt about it. In a personal situation it is an extremely strong tool and I think it is one humans are going to develop that is in the process of changing how we look at them. However, in an environment where you have information that need to be shared, that is the significant thing, the sharing is the significant thing. At this point in time, with the way the PC networks are, would warrant looking at a main-frame solution or a larger solution that is accessible to a number of people sooner than looking at a micro solution.

I: I have seen a number of cases where people have told me about a system they have developed or a system they were involved in that was based on the microcomputer and they wanted to get the data moved to the main-frame and one (S: The data and the application?) yes, the data primarily and the access to the data, and they felt it would enhance the system to no longer be based on the micro but on the main-frame and that the data seemed like it was more legitimate if it were based on the main-frame. In other words if a system was on the micro and was maintained on the micro it was always a little more suspect that if it were integrated onto the main-frame data base system. Not to him but in terms of him using that data to base decisions on. I guess that when the data moves from a micro to a main-frame it changes ownership. It is no longer his, it belongs to the organization.

S: Correct.

Company S Subject 6 - Data Model

MATERIALS

machine tools
inventory tracking
scrapped
manually (why scr)
SPC post process
gauges
ref when
who supplies
where # need
reorder
how many produced

DESIGN & MANUFACTURING

SPC gauges
statistical proc
control
how long ld wt
unld wt

PART KANBAN

visual
job tracking
no automation
inventory - inlin
(pull system)

SPOT USAGE

COP
cust ord p

Comapany S - Central Data Model

MATERIALS

Where located
(by facility)
contractual
purch
supplier
physical
characteristics
facilities
(info about)
projected usages
actual usages

DESIGN & MANUFACTURING

Product Engineering
built by designer/
engineer
who uses part
dimensions
tied to drawings

PART KANBAN

serial #
standard pack qty
Kanban history
numbers
model code(eos)
paper consumption
reorder
order/consumption/
receipt
(all is EDI)

SPOT USAGE

Kanban
trucking
delivery
location

Interview with Subject 8, Company W

Q.II. Data Item Relevance.

Q.III. Scope of application

I: How much influence did central MIS have over development of these applications?

S: Without their original coding, we couldn't have done the micro.

I: So they helped you by getting the form set up and getting coded (S: Yea, they didn't do it for us, we just tapped in). So they helped with that.

Q. IV. Information Processing Independence

I: The spirit of question 4, what I'm striving for here is I'm trying to find out things that facilitate you doing computer work here on this campus and things that hinder or hamper you. Another way of thinking of it is how much independence, how much freedom of action, you have in doing computer work or I've stated here the other way around. (S: You're in serious trouble now.) What factors you find that limit you in doing computer work? Respond to it verbally. Tell me these are the things that make it easy to do computer work, and these are the things I find frustrating or hold me back or what ever.

S: In general, one is, for the better or the worst, the computer center director is responding to his duties not for the division had, but for the MIS had as a typical data processing director. In trying to control the flow of data, control the access to machines in the department, and the types of machines and therefore, the types of software that will run, and that decision is essentially made at his desk. He sends it to administration, but he is essentially the source of that, for better or worse. In other words, this is a IBM blue campus and unfortunately, because of the state bid list, mostly Zenith, which is not particularly a good clone for IBM (they're better, much better), but because of the list we are locked in it. We have two restrictions: one, the state bid list, which makes you select a clone that we have a lot of maintenance problems with; and two, we are IBM bound and is great difficulty to bring someone like Macintosh on, but no way we can do that. (I: I'm aware of that, I had a Macintosh and was sitting right up there in the heart of the enemy camp.) There are certain things that

you can do with them easier, quicker, better than you can do with IBM.

I: Reflect on what you're saying, if you think prior to microcomputerization there was essentially a MIS strangle-hold on every organization that existed in the country.

S: And they've moved away from that. They are more of service of a decentralized system only responsible in those areas you require passwords and need-to-know kind of things that control that and the maintenance of that, and in some cases, helping with the LAN arrangements or the networking, whatever, and not to put a strangle-hold on the kinds of uses in data that is collected. That is a management decision at what ever level you're at, and the data processing people are starting to move the management decision making by the very fact that you can't access what you want to use. So you are distorting, by doing that, the management decision making process and functions by access to equipment and access to software. (I: And access to data, and the way the data is structured.) By running tons and tons of green sheets, when you don't always need tons and tons of green sheets. You may need only a couple of pieces off that and manipulate it in greatly different purposes at a lot less expense, then generating tons and tons of green sheets. But there's only one way of doing anything, it's the mass way.

I: Is there a difference between the limitations on the main- frame and microcomputer?

S: Yea, I guess the main difference is, right now, there are three things: one, there is tremendous centralized control of what software and what utilization runs on mainframe. So we can only access certain little pieces in corners of existing programs on mainframe. (I: Or try to get those pieces changed and that's a long process.) Two, with the up-grading of the MIS system as it is suppose to be, they want to control even the microcomputer system by networking everything to the mainframe, and not allowing individualized software at the local controlling the software by running it on the mainframe and then everyone accessing it through the system. (I: So you're saying the software would reside on the system, you'd load that software onto the network rather than having it reside on your disk.) A kind of unique need that I want, for example: the student affairs director, if he wants a piece of software on there that manages theatrical performances and box office tickets, and if they haven't got it on there he is just out of luck.

I: Or conversely, if he wants to get it he has to convince them to put it on there. (S: Yes, I disagree with that) He has the money in his budget and convince his boss to spend the money (S: that should be a management decision)

Q. V. Information Involvement

Q. VI. Application Integration.

S: Yes, individual department budgeting. (S: Was done on the micro, now being done on the mainframe?) It is, but will be taken away. The software is not mine, in cause of another chair. A technology instructor designed the system for technology, I can't remember the software used, but it was a budget system. And that was greatly discouraged. It will be done away with the new MIS system.

I: One of the things that some people told me and one thing that surprises me is the budget system, but part of the problem is central budget system is always some scrolled time frame out of date, and in terms of you running your department you have to know, you can't know what the system is telling you three weeks into this month you had at the end of last month. That is of little value to you.

S: Yes, and when you're farther than that behind, but the new system is suppose to make immediate transactions, deduct from your budget line item, and post to the requisition at the time the requisition is issued. You should be able to see it on the screen. (I: Can you make the entries yourself?) Theoretically.

I: O.K. Which means you should be able to enter the requisition yourself at the time it is approved by whatever signatures there are and see an immediate impact.

S: And almost like electronic mail, when the person sees it on their screen, acts on it, then it would change on your screen by electronic mail so it might not be instantaneous but it would be as the approval process.

Q. VII. Data Model Inconsistency.

S: Probably the greatest example of that is in student data. The computer system could only do certain functions, the limitations of the software, the limitations of the machines would not allow them to track certain data information. So there was a contraband system developed by the counseling and admissions people in order to operate their database. They had to. And it is still running because it is not, in

the MIS development the first priority by majority vote was finance and the second was student data. So they will be the second wave after this is insinuated so they're looking at waiting five years.

Q. VIII. Organizational Information Dysfunction.

I: I can see counseling sitting over there and coming up with the number of students that have applied and the system thinks how many students have applied, they are not the same.

S: They have a hard time figuring out how many students we really have. Coming up with an accurate number.

Q. IX. Data Model Verbalization.

I: I can see the folks in counseling saying well we saw 5,680 students and that's how many we think are here, and the system says no, no you got 4,980. So the counseling folks well I know they have different numbers than we do so we better say, "as per the counseling database or on the bases of students who filled out an application form and were accepted and paid their fees or whatever the assumptions need to be. What I'm looking for are situations where people are sufficiently aware of the different partitionings that they're volunteering. They're saying well we generated 4,619 FTE this last year and by FTE I mean students that ... Do you see people doing that?

S: Probably the best personal example of that is the business office could not separate B and I from continuing education because they both dealt with non-credit training events. So everything that came in, in terms of billings and checks, was dumped into one budget category, continuing education, one public service pot. But the division grew so drastically that we couldn't use their system. It was too cumbersome for us and was meaningless in term of trying to track client billings and whether or not they paid. We created our own invoice and billing system numerical codes and everything, tracked every bill that was sent, every check that returned, and now the business office checks our records to find out how much money we have brought in.

I: That's another parallel system of course because you thought you had to do that to track... because what you are saying is that as far as their system is concerned they had a fund out here that is continuing education and they were also getting money from what use to be continuing ed down

there for folks taking aerobic dance and things like that, and they didn't have a way to distinguish them.

S: And our budget now is $800,000. We were wagging a dog real bad. So the only way they could actually find out how much money are we generating was to track our system and they still don't have a system so they come to our office get our records to find out how much money we actually brought in. (I: And then break out their whole revenue use that as a partitioning device to partition the entire number which they have a bunch of...) They use that number then they subtract that from the total they have and they know where continuing education is at.

I: Actually you answered a previous question, but that is exactly what I'm getting at is situations where inadequacies in the mainframe system generated something, but you had budget money and revenues and invoices and so did the mainframe but it wasn't adequate.

Q. X. General Impressions

I: Finally what I'm getting at here, one thing that I'm seeking out is the growth of microcomputerization in organizations and information using organizations, and there weren't any microcomputers on this campus 7 or 8 years ago. None in administration or, well the P.C. came onto the market in 1981 so we are talking about 9 years ago they were nowhere. And it took a couple of years before they had any kind of penetration. So in a short period of time a lot of things have happened. Two things we have got them physically shattered around the campus and probably a lot of the right places. We are probably not using the technology to the potential that it presently has, and yet there has been a tremendous impact. And what about what the technology is going to be 5 years from now. What we have out there now is pretty incredible and it probably just scratches the surface of the kind of capability that you are going to have right out there in a very short period of time. What do you see going to happen to this institution. I know the MIS project influences that a lot, but in relation to the role of microcomputers.

S: There is a bitter sweet to having the micros hooked to the new MIS mainframe system. The sweet part is that more people will have increased access to them and therefore, even if there is a great deal of commonality to the software at least there will be a lot of utilization, so a lot of functions will go up in terms of number of people on line, number of people using them in daily work, number of people

moving things off of paper and onto the machines, and so forth.

I: Don't you think that equates to an enhanced understanding of ourself? That is, this institution will understand itself in a richer sort of way and probably therefore make more informed decisions because of the fact that the division chair can understand his situation a lot better based on the ways perceived in the information system?

S: Yeah, you are better in control of your knowledge base so that your decisions are based more on knowledge than opinion. The bitter part of it is that the fear there is going to be too much standardization if you don't have the uniqueness which is actually the flower of the microcomputer explosion is that you have a lot of diversity and what ever the mind can conceive you can come up with. You don't want the limitations of a common system in all cases (I: In fact, the gist of my dissertation really is that centralized computing had an influence on all kinds of information using organizations and it had an unifying influence. Some good and some bad, but the unifying influence was that the fact that certain code numbers and certain ways of classifying things were developed by a central group, and that group that the influence it had the way reports and people talked about things in terms of code numbers and classifications all across the campus, so that it helped this institution to understand itself in a uniform way. And I think that is good.)

I: Microcomputerization runs against that train to some extent in that it opens up lots more ways of thinking about yourself (options, flexibility). Well that probably is richer, but the old MIS part of that was blinders. It was nice to have the communication and understand ourself well, but we only understood ourself in a limited way and maybe what we are going to be able to with the micros is see other and better different things. Maybe a lot of stop and smell the roses strange things, but there's more out there then can be conceived by a small group of people in a central facility.

S: If you're doing research on the mainframe that's one thing, but when you are following a patterned software system that is totally another. The data that you get to make your decisions on with a mainframe system that is very standardized, in a lot of cases unless your management staff is not influenced to much by the data processing function itself you tend to look at rear-view mirror data instead of projections and creativity which a microcomputer can do for you, but the disadvantage with microcomputer stuff is you

may not have as large a database for your statistical projections.

I: What you need the rear-view mirror you need to be guided from where you have been, you need that (S: You can't look at the rear-view mirror and try to drive. There's two sides to that and so view the difference. If it has to be two sides to the house and to try to completely control that creativity is a big mistake. A lot of campus want to do that because of security reasons. You can't have too many on the systems.

Company W Subject 8 - Data Model

STUDENTS

male/female
yrs prev coll
present job
major
degree plan
award/ schol

Classification
age groupings
race
ft/pt
day/eve
employed:
ft/pt

COURSES

sequence
fall/spr
day eve we sum
core/elective
tfr/ non-tfr
last revision date
text ch date
program
fresh/soph ...

Classification
hum/bus/math/sci
cr/ non-cr
tfr/ non-tfr
level:
lower upper grad

MAJORS

students
course seq
enroll trends
grad rates
master/post mast
credentials of
faculty teaching

Classification
disc/ sub disc
tfr/non-tfr

INSTRUCTOR

tenure track
yrs exp
this inst
all coll
acad prep
degrees in major
PhD Mast
work exp
comm assign
service
research
mentor status
dpt head
div head

Classification
doct/master
pt / ft / lect
faculty rank

Company W Central Data Model

STUDENTS

ss #
address
phone #
race
sex
employer
gpa
major
educational
goals
counselor
admission st
admission dt
first/last
term attend
transcript

Classification
new/cont/ret
full/part time
day/eve

COURSES

department
course #
section #
beg/end dates
class meets:
time of day
days
instructor
room and bldg
spec fee
discount
unique # (hist)
division/sch/dept
students enr
seats

Classification
day/eve
cred- non-cr
by div/dept

MAJORS

title
code (CIP)
enrolled
enrollment cap
prereq for maj
special fee

Classification
Cert/AA/AAS
Vocatioal/
Occupational

INSTRUCTOR

SS#
name
address
start date
tenure track
div/dept
contract amount
9/10/12 mo
basis

Classification
full/part time
div/dept

APPENDIX E

METHODOLOGY PHASE ONE

PILOT STUDIES AND EXPERT PANEL

Appendix E. Pilot Studies and Expert Panel

This appendix contains a sample of the materials generated during the instrument development phase of the methodology. There were two pilot studies, followed by two expert panel evaluations.

The first item in this appendix shows the identity and qualifications of the expert panel members. Next is a sample interview from the first pilot study, followed by an interview and data models from the second pilot study.

The interviews were transcribed verbatim from the tape recording of the interviews. This is raw, uneditted data.

Expert Panel Makeup

Expert Panel # 1

Jerry Bell Director of Operation Systems
Primary responsibility for corporate communication Systems, both telephone and radio
For a long time, Company liaison with computing services
26 years with company
21 years in present job
Bachelor of Business Admin, Texas Tech

Carl Castrianni Manager of Database Administration
Takes logical design and processing requirements to develop database design.
B.S. Applied Math, University of Missouri at Rolla
8 years experience with company
4-5 years in present position

Dave Cogswell Director of Technical Services (Systems Programming)
11 years experience in systems analysis and systems programming
B of Computer Science, Kansas State

Expert Panel # 2

Carl Castrianni Manager of Database Administration
Takes logical design and processing requirements to develop database design.
B.S. Applied Math, University of Missouri at Rolla
8 years experience with company
4-5 years in present position

Coy Hoggard, BA, CDP Manager of Systems Development
B.A. Hardin-Simmons
30 years industry experience
25 years with present organization

Joneel Harris, Registrar
M. S. Educational Psychology, University of North Texas
14 years with University
9 years as Registrar

5/17/90

Interview with Subject 3, Company A

Q. III. Data Item Relevance.

I: The first thing I want to ask you, we talked about five or six or seven different things and I want to get a sense of how relevant these things are to you and to your job and to your department and how many of those things are not quite so relevant. Why don't you list these in the order of ... which ones do you care about and work with the most and then come down to the ones you don't work with so much? So, What do you work with the most ... of the things we've talked about?

S: We talked about the customer master and that's where we're living in which is, you might say, the shipper/consignee on the freight bill. It's maintained by the sales department but we're looking at that for pricing.

I: So, of all the things we've talked about here, the customer data is probably the most important to you?

S: Yes that's one of the most important. Next would be the City. The origin/destination of the city which is on the freight bill.

I: That's part of the freight bill it's not a set of data (but it really is). Now we did talk about...

S: We maintain all the routing

I: I've got something called city routing... Is that a separate file?

S: It is a separate file in which we take the cities...

I: So those three are all fairly important to you.

S: That's right.

I: After those three,and something that we didn't talk about as a separate set of data but (what about) the rating data is obviously of great interest to you?

S: yes

I: What about the terminals?

S: The terminal is basically where we keep the routing, which is the city routing. We have to know the codes so we

can say, for instance, Moffat Oklahoma, How do you route that? Where does it go to? What station do we send that to?

I: That's based on the City file, Right?

S: Right, that's the city file.

I: So, in terms of specific terminals, the city tells you what terminal, but you don't care that much about terminals? And manifest, you don't think about those at all?

S: No, that's really outside ...

I: Somebody else worries about those?

S: Right. Like I say, we maintain... we know the terminal is there and we keep up with that information but where we use it is like talking between two carriers for interlining. And we keep the other carriers information as to the types of splits, which gets into the rating part of it.

Q. IV. Scope of EUC Application

I: Now, we've talked about this data here. Do you have any applications in and around your area that you are aware of that run, strictly on the PC, where you keep data on the PC, or you are gathering data on the PC or anything like that, that is at all similar to any of this data?

S: Well, the rating part of it we do... we have the floppies for rating under our system.

I: Is that the rates you send out to customers?

S: The actual rates we send out to customers, You can rate off these.

I: What about the actual tariff construction?

S: All tariff construction is kept on the mainframe.

I: You actually print out and publish the tariffs off the mainframe then?

S: Well, ok. Tariff publication is done on PCs from what pricing (does). They send messages to our publication section and they publish it over there. And that's done on the PC. It may be up on the mainframe one day. They would work it from the PC but maybe keep it on the mainframe for,

you know, bigger capacity. Everybody would be able to access it.

I: And that's kind of slightly out of your department, right?

S: Right. That's a completely different department.

I: OK. We've talked about two sets of data. We talked about the tariff construction data and we talked about the rates for the customers. First of all, the pricing data. Where do they get that? Do they make that up? Do they get it back off of the mainframe? Where does that data come from?

S: The pricing data is what is agreed to between the pricing .. the person ins the field, the salesman, and the customer. They get together and whatever price they come up with is forwarded to ...

I: I'm thinking about tariff publication data. Where does it come from?

S: Pricing department.

I: And they make it up.

S: Right.

I: They make it up and enter it directly there? So it's not in any other computerized form before they put it in there?

S: They produce it out to a form then send it to publications or to us and we put it in the computer.

I: And the scope of that application, In other words, the things that they do with that on the PC, ... How wide an interest does that have within the company? Is that just something that they care about, or is it something that is company-wide?

S: The actual tariffs, everybody would be interested. The actual publications, the customer's got something in a publication, he would be interested in. I'm interested in it. The assessments (?) are interested in it.

I: So it has company-wide application, then?

S: Right.

I: Now let's go to the second set of data. That's the data where you put floppies out to the customers. First of all, where does that data come from?

S: Well, that would be the data that was actually published. And what that is just a system set up for ease of him rating his freight bills. So instead of manually rating freight bills, we programmed on PC, for him, an automated way for him to rate his freight bills ...

I: You have a PC program that you let him use. And you send the rates out there to him. Where do those rates come from? Mechanically, where do they come from? Do you download them off of the mainframe? Do they come, like from the data that pricing builds? Do you use that data to build them?

S: You can have both. Let me put it this way. The customer himself sometimes sets up pricing or sets rates in the same format we have and they can send in where we can upload. And we do the same thing where we make the rates and it can go back the other way. We can upload from PC or download to PC.

I: And, certainly, I would think that the scope of that application would be reasonably broad. In other words. it's not just something you do within you department?

S: No, that's several departments. I'm the one interested in all that because I maintain all the rates. I have to make sure they have the right dates, and the right information out there. Basically, when I see it's published, I will say "Do I, or do I not want those rates?", on the big mainframe. Just because rates are published, out there doesn't mean I put them on the mainframe. Because it would be so big ... Who's got the most freight moving?

Q. V. Autonomy.

I: I would like to know the degree of independence that you have in doing your job. In other words, how much freedom you have to schedule what things you are going to take on, and what things you're going to put aside. You know, scheduling your time, and that sort of thing. How much freedom do you have in your job?

S: That's totally left up to me. Most of that is based on my decision as what needs to be done first. I'm going to take the list of priorities of what has to be done.

I: The work tends to schedule your job rather than your supervisor?

S: Right.

I: To the extent that you do work on the computer, how does that relate to you computer work? How much freedom do in what you do there?

S: Now you might say that I'm only limited to what is already programmed. And I do have the capability of asking for new programs. I, myself, do put projects on the agenda.

I: So, when we're talking about this, we're actually talking about your interaction with the mainframe computer?

I: And so, since you can't change the program, you have to operate within those constraints? But, other than that, since the programs are somewhat flexible, you have a lot of latitude within that?

S: Right.

I: Do you do any work on the microcomputer?

S: I do have my own personal computer where we keep certain information out there more related just to our department it's not hooked to the mainframe.

I: And, to the extent that you work on that, you have an even wider range of freedom, I would suspect?

S: Right. Anything that I can program myself to put on there ...

Q. VI. Information Involvement.

I: How frequently do you get involved in data design? And, by that I mean, deciding what data should be recorded, what form it should be in, how long the fields might be, how to encode the data, different codes mean different things? How often do you get involved in that?

S: I would say very active because all the stuff that we keep makes a big effect on everything. Right now, as the freight bill is restructured, I had the input of tariff lengths, rate line lengths, because if it is too small, they can't carry the freight. I had great input into that.

I: So you had a lot of input in the way the mainframe programs were designed? What about when you do something on your micro? What kind of restrictions do you have there?

S: None. Same thing, if it's not big enough then I make the change there.

I: Because that's something you can change, you have more freedom?

S: I have more freedom there. On the mainframe it's more like you have to schedule and ...

Q. VII. Data Model Inconsistency

I: Have you personally been involved in where there were two different computerized applications, perhaps two different departments, or just two different people that were keeping data, either on the mainframe or on the micro, and the data dealt with the same subject, but dealt with it in some way differently?

S: Yes, It wouldn't be totally related to mainframe and PC, I've also had it on the mainframe. Two types of the same information have been kept in two different formats.

I: OK. and what was that data about?

S: That is city-type information and the routing. You might say, the old-type version of being able to print information, and the newer type where we can read it right on the freight bill at the time of instant...
and

I: That's a good example. Can you think of any other examples?

S: Other examples would be carrying two sets of carrier information. Revenue accounting people they are connected with, and then I've got my own set right now,1 of what we're seeing on freight bills.

I: Where do you keep it?

S: Both things are on the mainframe, but they are two separate programs. It's like, I need this information, they need a different type of information. And the two programs

were not really hooked together. We're in the process now of linking the two.

Q. VIII. Organizational Information Dysfunction.

I: Have you ever experienced a situation where, in either of those cases we talked about, either the cities or with the carriers, where the fact that the data was somewhat different, different formats or structure or something like that, caused some kind of problem?

S: Yes, especially in the routing of the cities. It was almost like two different departments. And what happens if one department is not closely hooked to the other one, or feeding the correct information quick enough, you can get out of synch and misroute freight. That's a problem that we have had. Not that it would be anything big or major, but ... one may say (route) direct, and the other may say connecting line.

I: Let's suppose you had a situation where some analysis was being done and some decisions were going to be made. Have you ever seen a circumstance where conflicting information kind of muddied the waters about some kind of decision-making?

S: Yeah, that could very well happen.

I: You can't think of a specific instance?

S: I can't think of a particular city, but I know we have had them. One person was looking at the list and it said one thing, when he looked on the computer it had something else. ... That is fixing to be together in about three weeks.

Q. IX (and X.) General impressions.

I: What I am studying in this research .... (description or research hypothesis). ... Do you think that there is going to be more and more data stored on microcomputer?

S: I'll say most of ours, we have microcomputers in several departments, most of it is hooked to the mainframe. Most of the data, right now, that is kept on microcomputers, if it's something that's not on the mainframe, it's more pertinent to that department only, and nobody else would be that interested in it or knowing what that information is,

because as soon as something like that happens --like say, the two city deals, (of course, they were both on the mainframe), one of which was, you might say 'active', the other one was a batch program you couldn't get to on the screen -- when something like that happens, you're going to merge the two, and put it out on the mainframe. (Gives example)

I: My impression is, if you were to take a look at data that existed on a microcomputer, an awful lot of it was downloaded.

S: Right.

I: So, it's going to be more consistent with the mainframe because it existed on the mainframe?

S: You might say, the microcomputer is being used more for, say, study. In other words, here's all our stuff on the big mainframe. I need to know something, a particular thing, say "How much freight is going to Fort Smith?" I can go out to the mainframe, gather that information, put it back in my PC, and do a study and get to things like loads and do "If, then" situations. That's where the PC's are being used.

I: So, since that's kind of a snapshot piece of data, nobody would be surprised if couldn't tie the numbers out to the mainframe?

Interview with Subject 2, Company B

Q. II. Data Item Relevance.

I: Now, for the next question, you'll notice that in the little boxes I've written down these sets of stuff. I want you to indicate by marking on the form by circling the correct number how frequently you work with each of those things. You'll notice that 5 is the most frequent and 1 is the least frequent.

Q. III. Micro Application/Scope of EUC Application

I: Now, we've talked about a certain body of data. Actually five different sets of data. do you have, or are aware of in your general vicinity any microcomputer applications that employ this data or anything similar? That is applications that are actually on a PC somewhere?

S: Well, within the registrar's office, you have access to SIMS.

I: That's on the mainframe. I'm talking about if anybody has a PC that has any data like that on it.

S: No.

I: You don't think that there's anything that has students or ...

S: I'm not aware of anything.

I: There happens to be a system that one of your colleagues keeps that you were not aware of.

S: No. And she works right next to me.

I: That's ok. She portrayed that as being a very personal system. A second piece of work like that is not really on microcomputers, but I think it qualifies and that is ... an awful lot of the colleges have degree plan systems that are independent of the mainframe.

S: And I should know that because they send me copies.

I: And you know they are computer printouts.

S: But, when you stop and think about it now, I was thinking student, all students at North Texas. Now I have a program that we use to process certifications.

I: Oh. well. See that's it there.

S: And it has data about a subset of the students.

I: I think we ought to include that. Describe it as best you can there in example number one. Is this some software that was provided to you?

S: It was developed in Florida. And we were one of the test sites.

I: And I assume that on that you record data about every student of that type that goes through.

S: Well, we just do the enrollment certifications that we transmit electronically to the regional offices.

I: The data that's in there, where does it come from? That source column means ...

S: Well, it comes from SIMS and students. The student furnishes it and we verify it.

I: The software that you're using is some government-supplied software?

S: Yes.

I: Just put that.

I: And now, for that particular application, I've got three possible choices of the scope, that is how broadly it impacts. One would be, I just use this for my job and it doesn't really affect anyone else, Another way would be it affects lots of different people in my department but it doesn't really get out of the department, or you could say, No, it goes all over the university.

S: Well it only affect those in this area, yet what we do with this impact the student himself.

I: Those reports are not routinely seen in other places on campus?

S: On campus, no.

Q. IV. Autonomy. Information Processing Independence

I: Ok. Why don't you read question number four there.

I: Let's just sort of verbally discuss it. What degree of independence do you have in doing your work?

S: I have a lot of independence in doing my work.

I: And how does that relate to what you do on the computer?

S: Well. We have access to the mainframe to update. I do very little update ... Well I do to, I take that back. In my position I have these responsibilities and I know that they are there and I do them. And, of course, if I don't do them, you have students at the door.

I: What if the program on the mainframe doesn't quite suit your needs? Can you get it changed?

S: Sure.

I: And you do that sometimes?

S: Yes, In fact we have just modified one of the screens.

I: And what about on the microcomputer?

S: I've updated several manuals, created one.

I: And your own initiative, your own latitude to do that?

S: Well, that's in my job description.

I: Now, the next question there. What percentage of the time do you use the mainframe? What percentage of the time do you use the micro?

S: I would say that it would have to be pretty well divided, 50-50.

S: But, of course, all of these are subject to review. (referring to quantitative expression of independence.

Q. V. Information Involvement.

I: Most people say about question number 5, "Oh I don't do that at all." And it may be that you don't but let me describe what it might be.

S: If you want to modify a screen?

I: No, if you want to decide what, Yeah, exactly! If you want to modify a screen, If you want to say, Oh we should be

keeping this piece of information, or, there's not enough room in this line for the address, or we need to have another line of address, that kind of thing. Can you give me any kind of idea of how frequently you get involved in that sort of thing?

S: Oh, It just so happens that our boss asked us to give her a screen, the 'perfect screen' that we could use to process transcripts on. Three of us had input and (another person) worked it up and it looks real good.

I: And they have set it up for you?

S: Well, it's in the process.

I: What portion of this data design is micro-based and what portion is main-frame-based? There is a little box for you to fill in. Try to think if you can relate to anything like that on the micro. I guess, were you involved when the system came in here from Florida?

S: Yes.

I: And you were involved in feedback to them saying, "Well, this doesn't work very well, or this works well' ?

S: That's right.

I: So you did ... But that's been some time ago?

S: Yes, it's been two years.

I: Just try to put some kind of flavor of how much of the time you do any micro-based data design and how much time you do any main-frame-based. That's what this little slot right here is for.

I: If you did main-frame work, did you do anything (end-user-computing is a poor term here) do you use some kind of query package that allows you to explore around the data that's in the mainframe? We call these fourth-generation languages.

S: NO.

I: Then what you do is what I call traditional computing. Now, of the traditional computing, what role did you play? Were you a user, were you the designer, were you an advisor, etc?

S: I think designer and advisor, because ... The percentage is just really minute though as far as total.

I: Yes, a minor part of you job responsibilities. I understand that.

Q. VI. Data Model Inconsistency

I: Have you been personally involved in situation where there were two different computer applications that involved some of the same data and yet they viewed that data differently?

S: I am going to ask you to repeat that.

I: You've got two systems, both of them have data about students, but one has one kind of data and one has another. They think of students in different ways.

S: Sure.

I: That's what your PC system is.

S: Well, that, and we can view admissions records, we can view bursars records, but their interest in the student is not the same as ours.

I: And, the reason your system exists on the micro, is, in part, because the mainframe just doesn't do that?

S: Well, no, we're working on a program right now to where we can download from the mainframe. I will no longer have to do the data entry.

I: So you won't have to read SIMS reports and do that, you're going to link them together.

S: Right.

I: Good, 'cause look at question number seven there. So that's what';s going to happen.

Q. VII. Merged Applications

see q VI.

Q. VIII. Organizational Information Dysfunction.

I: Have you been involved in a situation where there were differences between two different computer processed sets of data, and it created a problem? You've got a student set up

on your little system here, but the main system doesn't realize he's a student, or thinks he's a different category than you do.

S: A lot of times the information that the student gives and what he has given the registrar does not match. That's usually with degree program, or his major, or his address. They will update with me because that affects their money and they just fail to do that with the registrar.

I: That would be on a specific instance. Now do you ever have a situation where for instance, the mainframe tells you that you've got 218 students receiving and your system says 312.

S: No.

Q. IX. Data Model Qualification.

I: Now the last thing, if you'd just read question number 9 there.

I: What is says is can you recall instances where individuals using or reporting about data used a descriptive term to define what kind of data they meant? I give an example there that ought to be very relevant.

S: Well, final class rolls is really what comes to mind. And of course, you know that is after the twelfth class day.

S: I have seen it in state reporting. It's how that student was classified.

S: I count all of my students, where if they withdraw, I no longer count them.

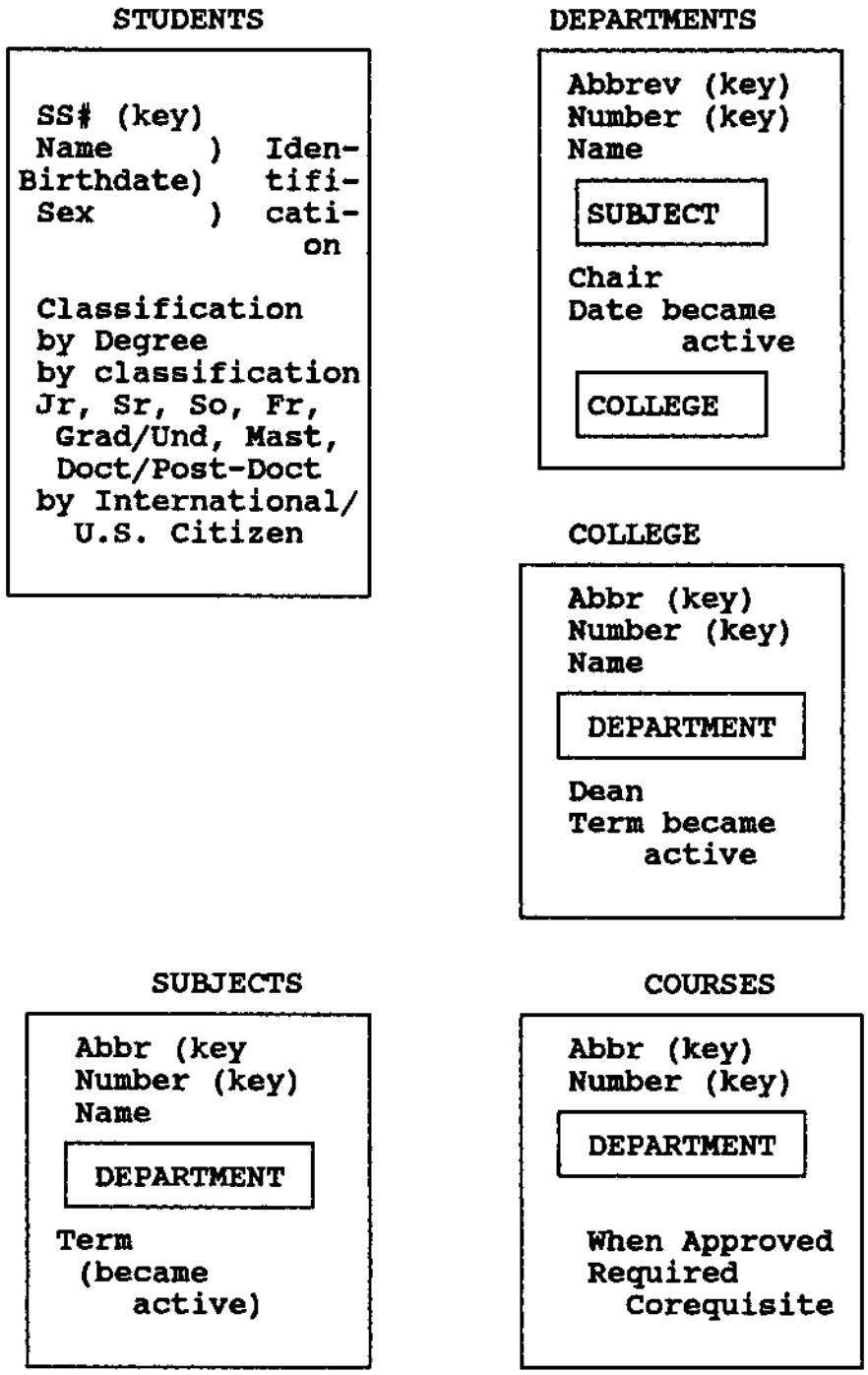
I: And the university is twelfth day.

S: Once that count has been made, then that is the count.

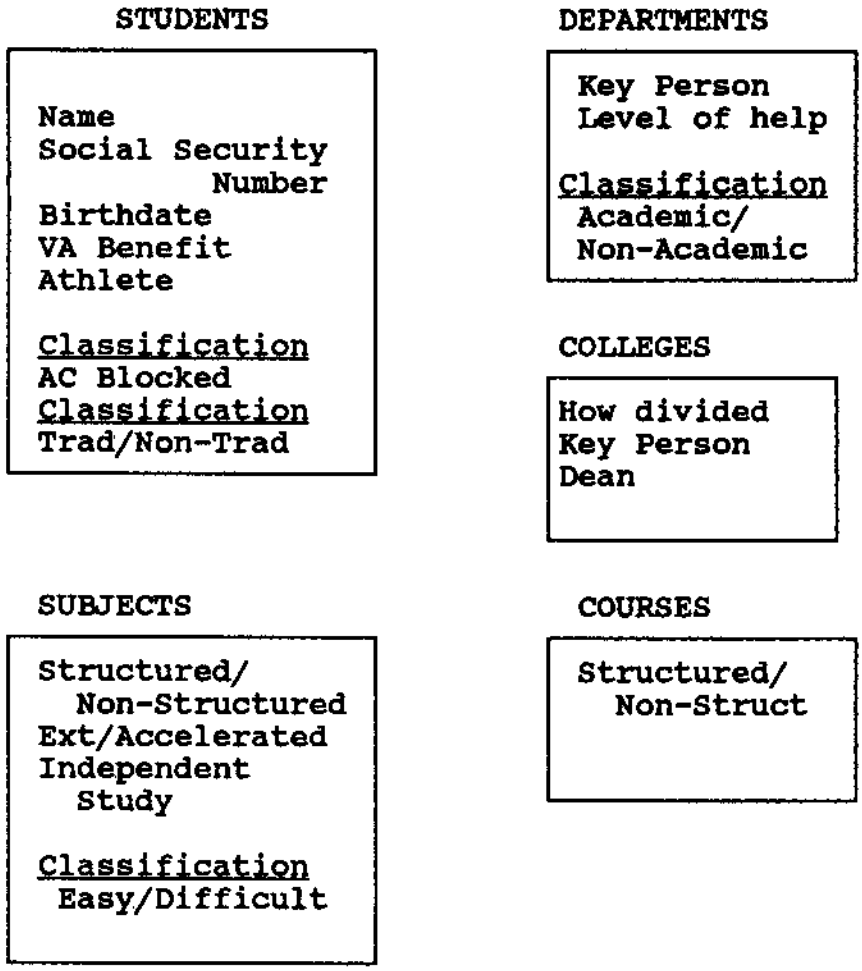
Q. X General impressions.

S: Well, of course, I feel like this is the only way to go. Everything else is outmoded, outdated. There is just no comparison. I feel like when people become more comfortable, say the younger generation, comes up they are so much more at home with it. I use it. I wouldn't take for what I have, but I am not into programming. To go in and create something, no I haven't done that.

Company B - Central Data Model



Company B Subject 2 data model



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