LOGISTICS END-USERS EXPERIENCES AND SATISFACTION WITH INFORMATION SYSTEMS DEVELOPMENT UTILIZING AN INTEGRATED-COMPUTER AIDED SOFTWARE ENGINEERING TOOL

A Dissertation

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Doctor of Philosophy

Degree

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To the Graduate Council:

I am submitting herewith a dissertation written by Kevin Eugene Fitzgerald entitled "Logistics End-Users Experiences and Satisfaction with Information Systems Development Utilizing an Integrated-Computer Aided Software Engineering Tool." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy , with a major in Business Administration.

Dr. Frank W. Davis, Jr., Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor
Dean of the Graduate School

DEDICATION

This dissertation is dedicated with love to my wife, Elayne. Without her this dissertation and Ph. D. would not have been possible, nor would they have been worthwhile without her to share the pleasure of the experience.

She and I have come a long way and gone a long way together. From her old Buick, a U-Haul-It, Gainesville and the early years at the University of Florida -- to around the world!

It seems like yesterday, not the twenty-seven fantastic years, since we began our adventure through life together.

THE ADVENTURE CONTINUES!

ACKNOWLEDGMENTS

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This section would not be complete without thanking my parents, my mother, may God rest her soul, for teaching all three of us children compassion, and my father for teaching us responsibility.

ABSTRACT

Since the mid-1980's information and its management have become recognized as having intrinsic value to the competitive advantage of the organization. However, the traditional information systems development methods used by organizations have been found wanting as they do not fully engage the end-user of the information system in the development process, which results in information systems that do not satisfy the end-users information requirements.

The advent of Integrated-Computer Aided Software Engineering (I-CASE) tools has been touted as a means to more fully engage the end-user in the information systems development process, which should result in an information system that more fully responds to the end-users needs and requirements. However, to date there has been no research from the end-users perspective to determine if indeed I-CASE tools more fully involve the end-user in the information systems development process and does this involvement result in information systems more responsive to the end-users needs and requirements.

This exploratory research consisted of in-depth interviews conducted at four field sites with end-user and information systems personnel to determine if an I-CASE tool does increase end-user involvement in the information systems development process. In addition to the in-depth interviews the subjects were administered an adjusted Doll and

Torkazadeh End-User Computer Satisfaction Instrument to aid in determining the degree to which this involvement result in an information system more fully responsive to the end-users needs and requirements.

For the four sites included in this research the end-users did participate more fully in the information systems development process and the resulting information systems more fully meet their needs and requirements enabling them to more effectively complete the duties and responsibilities associated with their positions.

TABLE OF CONTENTS

APPENDICES

CHAPTER 1

INTRODUCTION

BACKGROUND

Since the introduction of the first widely available commercial computers in the early 1950's, they have become ubiquitous in the industrialized world. Computers now range from personal computers for use in the home for entertainment, education and record keeping; to computers on the shop floor for managing and keeping track of production; to the mainframe computers that continue to be the major sources of management information for most firms. However, even with their wide applicability and use, there are continued cries from business users that their needs for information are not being met; costs are too high; it takes too long to obtain results, and there are continued gaps between promised benefits and the bottom line.[1]

This seeming anomaly with the ubiquitousness of computers and the cries of business managers that their information requirements are not being met can be attributed to a number of factors, among which are:

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[1] Keen, Peter G. W., Shaping the Future: Business Design through Information Technology(Boston: Harvard Business School Press, 1991) 10.

(1) Most business information systems are mainframe based and evolved from the transaction based financial accounting systems that were the first computerized applications for most business firms.

(2) Software development has not kept pace with the rapid developments in hardware capabilities, with their increased processing speeds and storage capacities, which are available at decreased costs. Utilizing 4.5 million instructions per second as a constant a 1988 MIT study concluded the costs were/would be in 1980, 1990 and 2000: $4.5 million dollars, $100,000 and $10,000 respectively and would cost the equivalent of 210, 2 and .125 people at a specific skill level.[2] Table 1 provides further evidence of the cost decreases, if one considers the distance/time/cost relationships of transmitting one page of text from New York to Chicago, approximately 850 miles.

Table 1: Distance/time/cost relationship of transmitting one page of text from New York to Chicago.

	Pre-Railroad 1840's	Railroad 1850's	Telegraph 1850's	Data Comm. 1988
Time (hours)	252	48	.083	.0019
Speed (mi/hr)	3.37	17.7	10,240	447,000
Cost ($)*	0.25	0.03	7.50	0.31
Mi/Hr/$*	13.5	590	1,370	1,440,000

*In actual $, adjusted for inflation the comparisons would be more dramatic.

Source: Yates, Joanne and Robert I. Benjamin in Scott Morton, Michael S., ed. The Corporation of the 1990's: Information Technology and Organizational Transformation (New York: Oxford University Press, 1991) 72.

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[2] Scott Morton, Michael S., ed., The Corporation of the 1990's: Information Technology and Organizational Transformation (New York: Oxford University Press, 1991) 9.

> For most firms, 70 - 80%[3] of Information Systems (IS) departmental staff budgets in time and costs are devoted to the maintenance of existing "geriatric" systems or "maintenance monsters." As a result, little time is available for the development of new systems or the enhancement/revision of existing systems to make them more responsive to user requirements.

These concerns were echoed at a July, 1993, international workshop on Computer Aided Software Engineering (CASE) tools:

> The demand for software to manage information in business, to drive computer-controlled products and manufacturing processes, and to enable advanced scientific exploration is growing faster then our ability to produce it. Simultaneously, there is a growing realization of the vital nature of software in virtually all industry segments. "Mission-critical," a term once reserved for software controlling key military systems, is now applied to strategic applications for business and commercial applications in potentially life-threatening areas such as nuclear reactors and air traffic control systems. Software is not only a larger and more important component of our products and services, it is now a key factor in global competition, and is rapidly becoming a dominant, if largely unnoticed, fact of our daily lives.[4]

However, these concerns are not a recent phenomenon, and were noted in the landmark January, 1977, issue of IEEE Transactions on Software Engineering which is generally considered[5] to signal the advent of the development of computer aided tools for

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[3] Douglas, David P., "Improving Application Development Productivity," I/S ANALYZER March, 1990: 3. (Reporting on 1989 Andersen Consulting study).

[4] Lee, Hing-Yan, Thomas F. Reid & Stan Jarzabek, eds., Proceeding of the Sixth International Workshop on Computer-Aided Software Engineering: CASE '93 (Los Alamitos, CA: IEEE Computer Society Press, 1993) x.

[5] Chikofsky, Elliot J., "Software Technology People Can Really Use," IEEE Software March, 1988: 8.

systems development. In his guest editorial, Ross notes the following on the special issue:

> It addresses the most special of all issues in our field -- how can man master his use of computers rather than being mastered by them?
>
> Our efforts have for too long been misplaced toward the system end of the scale. The real solution lies toward the human end of the scale, where the real needs must be recognized and channeled into the strengthened machinery for system building.
>
> It is encouraging, rather than amazing, that these several efforts, taking place independently in place and time, show such significant commonality. Their terms differ slightly, and the emphasis are different, of course, but all agree on (among other things) the importance of strict separation between requirements, specification, design, and implementation, and the need for completeness, consistency, and human visibility at every stage.[6]

In their article, in the same issue, describing "PSL/PSA: A Computer-Aided Technique for Structured Documentation and Analysis of Information Processing Systems" (Problem Statement Language/Problem Statement Analyzer) Teichroew and Hershey note, "The systems are not ready when promised, do not perform the function the users expected, and cost more than budgeted."[7] There were three fundamental premises underlying the development of PSL/PSA:

> ...The first is that more effort and attention should be devoted to the front end of the process where a proposed system is being described from the user's point of view. The second premise is that the computer should be used in the development process since systems development involves large amounts of information processing. The third premise is that a computer-aided approach to systems development must start with documentation.[8]

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[6] Ross, D. T., "Guest Editorial--Reflections on Requirements," IEEE Transactions on Software Engineering January, 1977: 2-5.

[7] Teichroew, Daniel and Ernest A Hershey, III, "PSL/PSA: A Computer-Aided Technique for Structured Documentation and Analysis of Information Processing Systems," IEEE Transactions on Software Engineering January, 1977: 41.

[8] ibid. 41.

PSL/PSA was first described in 1971[9] when it was initially being developed. In the article, many of the benefits that would accrue from the use of CASE tools, which would become available fifteen years later, were first described:

> Once it is decided to base the system building process on the use of the computer, there are other potential benefits than just the reduction in elapsed time. It should be possible to accommodate changes in requirements more easily both during the design process and during systems operation. The computer can also be used as the basis for coordinating the activities of many analysts and to relieve them of many tedious and laborious clerical tasks which they must do manually.[10]

As with every article describing a new systems development technique, procedure or methodology, then as well as now, a description of the problems associated with systems development is presented, and as previously noted, the problems haven't changed much over time.

The criticality of this issue, in addition to the preceding concerns, is evidenced by the fact that for the first time in the history of the world, nearly one half of the economic product for the major industrialized countries is in information-related activities. Information is now considered a resource in its own right, rather than something that was an integral part of other resources.[11]

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[9] Teichroew, Daniel and Hasan Sayani, "Automation of Systems Building," Datamation August 15, 1971: 25-30.

[10] ibid. 27.

[11] Mason, Richard O., "A Historical Overview," in The Information Systems Research Challenge: Proceedings McFarlan, F. Warren, ed., (Boston: Harvard Business School Press, 1984) 262, 276.

As a result of the above factors and the increased "comfort level" as users became more familiar and comfortable with IS through their exposure to it on the job and in the home, there has been a proliferation in demand for responsive systems in the work environment. This demand for user friendly systems in the work environment may be partially fueled by the experiences of users with personal computers in the home environment, and the relatively easy to use personal financial packages that are available to the computer novice at a cost of less than fifty dollars.

Using these inexpensive personal financial packages the user can prepare home budgets and have them automatically updated as checks are entered in the bank account portion of the package and then prepare a myriad of reports quickly and easily; with the information being "sliced , diced, and presented" in a format and time period that the user desires. The manager then questions why the same user friendly reporting and information are not readily available in his/her business environment.

In reply to these concerns, IS professionals responded on two tracks: (1) one being the development of structured techniques for systems development; and (2) the development of higher level computer languages. It was realized that the problems were not with the hardware where costs continued to decrease, but in the software that responded to users needs. As was pointed out at a 1984 colloquium at the Manchester Business School, "The short history of computing shows that technological development

does not lead inevitably to successful information systems in organizations and society."[12]

STRUCTURED TECHNIQUES

The first of the structured techniques, structured programming was initially used in the early 1970's and attempted to increase the efficiency in programming through the use of three control techniques and procedures that reduced the complexity of the code used in the program. The control techniques: sequence, selection and repetition[13] reduce the complexity of program instruction by ensuring that the program code does not "jump" around to other parts of the program but follows a logical flow. Also, blocks of code are reused throughout the program, where appropriate, in order to further reduce the time spent in coding.

Structured programming was followed by structured design in the mid 1970's. Structured programming tried to put efficiency at the back end of the systems development life cycle, whereas structured design fell into the middle of the development process. The basic premise behind structured design was that programs should be designed from the top down in a somewhat modular fashion adding greater levels of detail throughout the process.

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[12] Fitzgerald, G., et al, "Information Systems Research Methodology: An Introduction to the Debate," in IFIP WG 8.2 Colloquium (1984: Manchester Business School) Research Methods in Information Systems Mumford, Enid ed., (Amsterdam: Elsevier Science Publishers B. V., 1984) 6.

[13] Laudon, Kenneth C. and Jane Price Laudon, Management Information Systems: A Contemporary Perspective 2nd ed. (New York: Macmillan, 1991) 492.

While both of these structured techniques did add some benefits, they did not attack the fundamental problems that were becoming apparent to IS professionals, i.e., that most of the problems encountered in the final systems were due to problems at the front end of the process. In a 1982 study[14] of software error types, it was determined that maintenance due to coding errors represented 7% of total errors; design errors 27%; and incomplete requirements specifications 56%. However, the effort required to correct for these errors was heavily weighted towards the incomplete requirements specifications, since they required 82% of the total correction effort versus 18% for the coding and design errors combined.

Additionally, in a 1981 article on the early diagnosis of MIS implementation failure, Ginzberg noted:

> Further analysis of the cases where users and designers disagreed about what took place indicated that, for the most part, these disagreements related to issues which should have been resolved at the definition stage. Thus, the data, if interpreted as outlined above, suggest that the basic disagreements which led to user dissatisfaction could have been identified early in the projects' lives. That is, they suggest that users and designers failed to reach agreement on key issues prior to or during the Information Analysis/Business System Design phase, and that these issues remained unresolved throughout the project.[15]

While IS professionals were probably not specifically aware that 82% of their systems correction efforts were required to correct the 56% of the errors generated at the

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[14] Finkelstein, Clive, An Introduction to Information Engineering: From Strategic Planning to Information Systems (Sydney: Addison-Wesley Publishing Company, 1990) 5. (Reporting on T. DeMarco studies)

[15] Ginzberg, Michael J., "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions," Management Science April, 1981: 462.

front end of the systems development life cycle or the perceptions of the front-end problems noted in the Ginzberg article, they realized that the systems development problems they encountered were due to problems at the front end of the process. Consequently, structured analysis was developed in the late 1970's and it represented an attempt to achieve more user involvement in the design process through the use of logical graphical models in increasing levels of detail that would be easier for the users to understand than the traditional narrative text of the systems design process.

EVOLUTION OF PROGRAMMING LANGUAGES

While structured techniques were being developed, software was evolving from the first generation of software, the machine languages of the first computers (1940's). In the first generation of software each command was written as a series of 0's and 1's, a highly specialized and very laborious task. The second generation of software (early 1950's), used assembler language, which consisted of one word statements used in the program that a compiler translated into the 0's and 1's of the machine language.

These were followed by the third generation (mid-1950's to 1970's), higher level languages such as FORTRAN and COBOL, in which statements at this level generated multiple statements at the machine language level. This is analogous to someone making the statement "clear the table" (third generation language) that would be translated into a number of individual components (machine language), clear the leftovers from the table

and store to avoid spoilage, remove the dirty utensils and plates, remove the table linens, etc.

These languages were followed by the fourth generation (1980's), very high level languages, that allow non-information systems professionals to develop or use their own applications. The most common manifestations of the fourth generation language software are the spreadsheet, graphic, database and word processing programs that run on personal computers.

It is interesting to note that a 1992 book[16] on CASE indicated that eighty-five percent of all IS organizations still utilize third generation languages for the majority of their systems development work. It is unlikely that the percentage has changed significantly since completion of the study.

INTEGRATED- COMPUTER AIDED SOFTWARE ENGINEERING TOOLS

Structured techniques developed for the various stages of the development life cycle were being used in concert by the late 1970's. The use of the structured techniques along with the emergence of the higher level languages in the 1970's and 1980's, led to the emergence of numerous CASE tools in the mid-1980's as a means of responding to users' demands for responsive and timely information systems. CASE tools mechanized

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[16] Dixon, Robert L., Winning with CASE: Managing Modern Software Development (New York: McGraw-Hill, 1992) 49.

the processes of the structured techniques and used the higher level languages to simplify the coding process.

As a result of the development of the CASE tools, systems developers were faced with the automation of their duties as they had been automating users tasks for years. The early CASE tools were either front end, dealing with the initial systems design and specifications, or back end, dealing with coding and testing.

By the late 1980's, I-CASE or integrated CASE tools began to appear which integrated the entire systems development process. The implications of the traditional waterfall system of life cycle development versus the use of I-CASE tools are significant. Under traditional development methods the majority of the time and effort are focused at the end of the development process, during the coding and testing stages. Users were involved only during the preliminary analysis stages. The specifications were set "in stone" during these very early stages of the entire development life cycle, a period that could easily take eighteen to twenty-four months. This frequently resulted in systems that were no longer applicable to the existing business environment and; as previously pointed out, often resulted in poorly designed systems for their intended use. A Jones study[17] reported that the average MIS development project was one year late and one hundred percent over budget.

In contrast, the basic premise of systems development utilizing CASE tools and procedures is that the substantial majority of development time and effort are in the front

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[17] Yourdon, Edward, Decline and Fall of the American Programmer (Englewood Cliffs, NJ: Yourdon Press, 1992.) 24.

end of the process during the analysis and design stages. An additional premise is that users are heavily involved throughout the entire process, which is an iterative process during the entire development cycle. Consequently, the systems specifications can be modified to reflect changing business conditions or insights gained by the users as they go through the process. As a result of the automation gained through the use of CASE tools and the more accurate and reliable front end specifications, systems developed utilizing these procedures are expected to have a much shorter development cycle than the traditional development methods.

The components of I-CASE tools are designed to mechanize the systems development process, taking the implementation group in a sequential process through the use of the planning, analysis and design tools through the generation tools of code, databases and documentation. While the process is sequential, it is flexible enough to allow numerous iterations in order to continually update the systems for changes in the environment in which the system will be implemented as well as insights gained by the development group as it moves through the process.

The numerous iterations throughout the development process led some groups to realize that the new tools would also lead to significant savings in the systems maintenance area, which is the black hole of all IS department budgets. Balzer, in a 1985 invited paper on his fifteen year experiences with automatic programming noted the following:

> We also realized that the revisions made to the specifications during this validation cycle are just like those that arise during maintenance. This realization suggested a radical change in how maintenance is accomplished: modify the specification and reimplement.

> This change in the software life cycle resolves the fundamental flaw in the current software life cycle. By performing maintenance directly on the specification, where information is localized and loosely coupled, the task is greatly simplified because the optimization process, which spreads information and builds up (largely implicit) interconnections between the parts, has not yet occurred. In the current life cycle, we attempt to maintain the optimized source code, with predictable consequences.
>
> At the specification level, such maintenance is almost always simple (if not trivial), usually explainable in a few sentences.[18]

While the promise of I-CASE tools is significant, implementation and use has been more problematic. Kemerer[19] reports on a number of studies demonstrating that after implementation, usage of the tools falls off dramatically. The three studies reported, generally show that less than twenty-five percent of the tools potential is being utilized by less than twenty-five percent of the potential users.

These findings are attributed to the failure of the adopting organizations to consider the learning[20] and Murphy's (Figure 1) curve effects in the adoption of a new technology. Both of these curves demonstrate the initial adoption of a new technology generally results in higher costs and increased time requirements than retaining existing methods and procedures.

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[18] Balzer, Robert, "A 15 Year Perspective on Automatic Programming," IEEE Transactions on Software Engineering November, 1985: 1260-1261.

[19] Kemerer, Chris F., "How the Learning Curve Affects CASE Tool Adoption," IEEE Software May, 1992: 23.

[20] ibid. 24.

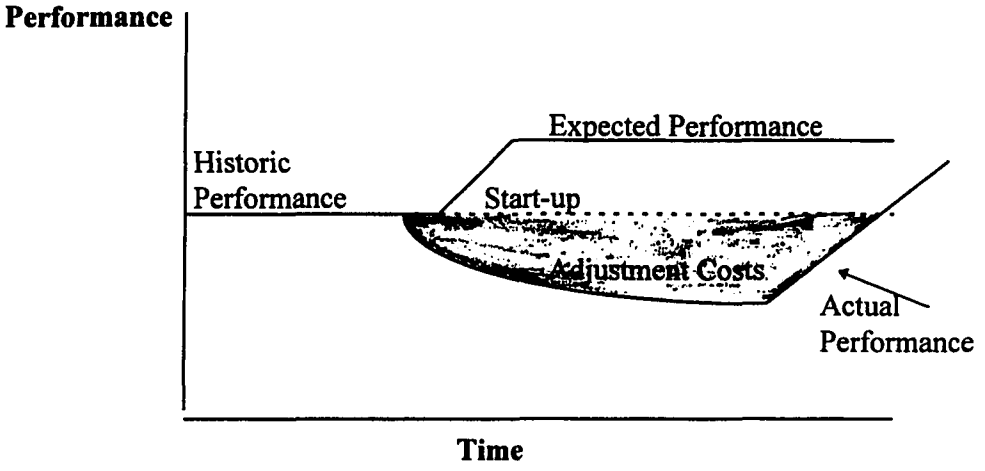

Figure 1: Murphy's Curve

Source: Chew, W. Bruce, Dorothy Leonard-Barton & Roger E. Bohn. "Beating Murphy's Law." Sloan Management Review Spring, 1991: 7.

As a result of the significant pressures on IS departments to respond to users requests, and the failure to consider the impacts of the learning and Murphy's curve effects when I-CASE tools are proposed as a solution to the organizations systems problems, the initial poor results of increased time and costs are attributed to the tools. Consequently, as reported by Kemerer, the tools are abandoned or virtually abandoned. In order for the tools to operate effectively in an organizational setting, IS management

will have to provide a realistic assessment of the potential of the tools as well as the implementation problems when proposing their adoption to senior management.

TAXONOMY OF END-USERS

With the myriad of problems faced by IS departments and the urgency to develop timely and effective systems, end-users saw a way around the problems of the IS department through the development of their own systems. As a result, research into end-users and their satisfaction with the systems they developed by themselves or in connection with the IS department began to expand rapidly in the mid-1970's. However, as Rockart and Flannery noted in 1983:

> Despite all this activity, "end-user computing" is still poorly understood. There has been a mass of exhortative literature and occasional single case-based discussion of end-user computing. But there has been a paucity of conscientious research into who the users are, what they are doing, what their needs are, and most significantly how to manage these new phenomenon.[21]

Rockart and Flannery, in 1983, building on the work of the Codasyl end-user facilities committee, Martin, and McLean, developed a taxonomy with six distinct classes of end-users[22] that became the most widely used taxonomy in subsequent end-user research, or formed the basis for taxonomy's developed by other researchers.

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[21] Rockart, John F. and Lauren S. Flannery, "The Management of End-user Computing," Communications of the ACM October, 1983: 776.

[22] ibid. 777-778.

The classes are:

(1) Nonprogramming End-Users -- These end-users do no programming nor do they use report generators. Their only access to information is through a menu driven environment or a strict set of procedures.

(2) Command Level Users -- These end-users perform simple inquires with or without simple calculations. They are interested in having only enough knowledge concerning the systems to be able to accomplish their individual responsibilities.

(3) End-User Programmers -- These end-users develop their own applications using both procedural and command languages. These applications may or may not be utilized by others.

(4) Functional Support Personnel -- These are sophisticated end-users located within a functional area who devote a great deal of their time and effort to developing programs for their own use and assisting others within the functional area in the development of programs. Although a significant amount of their time is devoted to the programming activity, they do not consider themselves as programmers but as integral parts of the functional area.

(5) End-User Computing Support Personnel -- These individuals are typically located in a centralized "Information Center" operated by the IS department and specialize in providing support to end-users throughout the organization.

(6) DP Programmers -- These individuals are located in the IS department and are similar to the traditional COBOL programmers except they program in end-user languages. Organizations established these groups to enable end-user departments to purchase services in-house, rather than hiring outside programmer/consultants. They were also established to allow the IS department to build a base of expertise in end-user languages within the organization.

For those researchers that attempted to utilize a taxonomy in their end-user research, the Rockart/Flannery taxonomy was the most widely utilized. In 1989,

Cotterman and Kumar[23] developed the "User Cube" as they felt the taxonomies in use were inadequate as the taxonomies did not consider all of the dimensions of end-user computing and the associated risks. The dimensions were operations, development and control. The explanation of the "User Cube" describes how the other taxonomies fit into the cube and how the cube allows the researcher to focus on the risks and dimensions associated with the particular class of end-user under study. The classifications of the user cube are:

User -- Consumer
User -- Operator
User -- Developer
User -- Controller
or any combination thereof

The dimensions of the user-cube are defined as follows[24] :

Operation -- the initiation and termination of system operation, monitoring, or operation of hardware and software, and the execution of manual tasks necessary for the operation of the Computer Based Information System (CBIS).

Development -- the performance of any or all tasks of the system development process, whether traditional systems development life cycle or prototyping. It consists of the specification of system requirements, systems design, programming, and/or system implementation and conversion.

Control -- the decision making authority to acquire, deploy, and use the resources needed to develop and operate the computer based information system.

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[23] Cotterman, William W. and Kuldeep Kumar, "User Cube: A Taxonomy of End-users," Communications of the ACM November, 1989: 1313-1320.

[24] ibid. 1315.

As will be noted in the Literature Review (Chapter 2) and Methodology (Chapter 3) of this dissertation, there continues to be a lack of the use of a taxonomy in the classification of end-users in the substantial majority of the research being conducted on end-user computing. However, for purposes of this research, utilization of a taxonomy is appropriate and desirable in order to place this research in the ongoing stream of end-user research. As this researcher believes the user cube is a more complete taxonomy and is appropriate for this research its taxonomy will be utilized. The end-users involved in this research will be in the "user-operator/developer/controller" and "user-operator/developer" classifications. Or more specifically, those individuals within the organization who interact with the firm's computerized information system on a daily basis in the accomplishment of their responsibilities, and operate at the tactical level within the firm with authority over the dimensions of operations and development, with or without control responsibilities, as defined above. These groups will be included in the research, as the aim of the research is concerned with the process of systems development using CASE/I-CASE tools as well as the results of utilizing the tools.

RELEVANCE OF THE RESEARCH TO LOGISTICS

In 1984 the Council of Logistics Management adopted the following definition of logistics:

> ...the process of planning, implementing, and controlling the efficient, cost effective flow and storage of raw materials, in-process inventory, finished

> goods *and related information* from point of origin to point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal and external movements.[25] (emphasis added)

The inclusion of information as a component of the definition was one of the major additions from previous definitions of logistics by the Council. However, even with the inclusion of information as a component of the definition, it continued to retain a strong emphasis on the physical movement, etc., of a tangible product. This emphasis on tangible products as the main purview of logistics was dramatically revised in 1991 with the publication of Logistics in Service Industries[26] by the Council of Logistics Management. With this book the Council moved the logistics perspective beyond the handling and movement of physical goods to the coordination and delivery of services.

This broader concept of logistics is probably more commonly understood than the narrower concept involved with physical goods. Indeed, as Davis and Manrodt point out:

> Ironically, people instinctually understand the term logistics when used in the expanded context. For example, if someone indicated that they were responsible for the logistics of a presidential candidate's visit to the town on Saturday no one would expect the person to be operating trucks, trains and forklifts. Rather they would understand the need to coordinate and oversee hotel arrangements, travel arrangements, invitation lists, seating arrangements, security, publicity, meals, photo opportunities, and any other unforeseen need. Likewise, if someone were asked to handle the logistics of a conference they would equate the term with being responsible for all arrangements. The narrower definition of logistics is only applied to business.[27]

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[25] Council of Logistics Management, Leading Edge Logistics Competitive Positioning for the 1990's (Oak Brook, IL, 1989) 10.

[26] Council of Logistics Management, Logistics in Service Industries (Oak Brook, IL, 1991).

As a result of these trends, logistics is being viewed as a "boundary spanning" and coordinating activity involved with both tangible products and the coordination of intangible services. Additionally, information has become increasingly critical in the accomplishment of the logisticians responsibilities. This criticality of information is evidenced in the grocery industry with the development of Efficient Consumer Response, an information intensive plan to take time and product out of the supply chain in order to reduce costs and thereby increase profitability.

> The ultimate goal of ECR is a responsive, consumer-driven system in which distributors and suppliers work together as business allies to maximize consumer satisfaction and minimize cost. *Accurate information* and high-quality products flow *through a paperless system* between manufacturing line and check-out counter with minimum degradation or interruption both within and between trading partners.[28] (emphasis added)

As with the definition of logistics, information and the paperless system through which the information will flow are critical components of the traditional grocery stores effort to combat the increased competition from wholesale clubs and mass-merchants. These new entrants to the grocery field "cherry pick" the high volume food items from a manufacturers product mix in order to increase inventory turns and thereby reduce costs and prices.

While not specifically addressing ECR, Keen in his 1991 book noted the: "almost certain business realities of the 1990's:

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[27] Davis, Frank W. and Karl Manrodt, Principles of Customer Responsive Management (Boston: Blackwell, 1995) 28.

[28] Food Marketing Institute, Efficient Consumer Response: Enhancing Consumer Value in the Grocery Industry (1993) 1.

(1) Between 25 and 80 percent of companies' cash flow is processed on line.

(2) Electronic data interchange is the norm in operations.

(3) Point-of-sale and electronic payments are an element in every electronic transaction processing system.

(4) Image technology is an operational necessity.

(5) Companies are directly linked to major suppliers and customers in electronic partnerships.

(6) Reorganization is frequent, not exceptional.

(7) Work is increasingly location-independent."[29]

As a result of this movement to an expanded interpretation of the field of logistics and recent discussions in academic literature and the general business press concerning the need for firms to concentrate on their "core competencies," plus the emergence of the consideration of time as sources of competitive advantage in today's market environment, some firms have begun to contract out services that were formerly performed in-house, such as data processing and logistics and transportation services, among others.

In order for logistics and transportation service providers to respond in an effective and timely manner to their customers, they will have to develop integrated packages of services of which major components will be information, and systems that respond to individual customer requirements. As a result of the rapid pace of change in today's business environment, this will not permit the use of traditional systems

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[29] Keen, Peter G. W., Shaping the Future: Business Design through Information Technology (Boston: Harvard Business School Press, 1991) 2.

development methods. Instead, logistics and transportation services providers will have to respond with customer service teams that are able to develop and deliver information, and systems that respond to customer requirements in an timely and effective manner. This applies to new customers as well as existing customers that have changing requirements as a result of changes in their market place.

Consequently, logistics and transportation service providers will have to become involved in the use of I-CASE tools, as they are currently the only tools on the market that will allow rapid systems change to meet customers requirements. Hence, the applicability of this research to logistics and transportation services providers.

STATEMENT OF THE PROBLEM

I-CASE tools are a relatively new entrant into the market place to overcome the problems associated with the current "software crisis." The majority of the focus of the I-CASE tool manufacturers has been to get the tools into organizations through IS departments. As a result of I-CASE tool newness and the still evolving state of significant user involvement in systems design, the literature on I-CASE tools mainly deals with the perceptions and organizational problems of implementation and productivity, etc., from an IS department perspective. The IS perspective is also operating in the field, as evidenced by the fact that a division of a major defense contractor with a commitment to I-CASE tools has sent approximately one hundred of

their employees through I-CASE training and of this number, less than five percent have been end-users.

However, as I-CASE tools become more user friendly, the impetus for their dissemination by manufacturers will more than likely shift to end-users. This is evidenced by the fact that it has been estimated that by the year 2000 the duties of IS professionals will be concerned with the maintenance of the corporate information infrastructure.[30] This emerging trend was pointed out in 1985 by Porter and Millar in their article on the competitive advantage to be gained from information. They noted,

> ...Rather than control information technology, however, an IS manager should coordinate the architecture and standards of the many applications throughout the organization, as well as providing assistance and coaching in systems development.[31]

In addition to the advantages to be gained from information, the economics of centralized IS departments have changed. Previously, with the high costs of hardware and the lack of available software packages, internal development by a centralized IS department was an economic necessity. However, as Dearden pointed out in 1987, "...the factors that made in-house capability an economic necessity have now been overcome. Less expensive hardware has tremendously reduced the economic disadvantages of software packages. The increased availability and lower costs of software have presented businesses with a realistic alternative to internal development."[32]

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[30] Harmon, Paul and Curtis Hall, Intelligent Software Systems Development: An IS Manager's Guide (New York: John Wiley & Sons, Inc., 1993) 25.

[31] Porter, Michael, E. and Victor E. Millar, "How Information Gives You Competitive Advantage," Harvard Business Review July-August, 1985: 159.

The economics were further noted by Zuboff in her 1988 book:

> ...During the past thirty years, the price per second of instruction had decreased dramatically: a computation that now costs one dollar would have cost about $30,000 in 1950. (Salvendy) Porter and Millar calculate that the cost of computer power relative to the cost of manual information processing is at least eight thousand times less than the cost thirty years ago. Between 1958 and 1980, the amount of time needed for one electronic operation fell by a factor of 80 million. They also cite Department of Defense studies that show that the error rate in recording data through bar coding is one in 3 million compared to one error in three hundred manual data entries. During the past fifteen years the memory capacity of an integrated circuit has increased by a factor of one thousand, as has its reliability. As another writer remarked, "If the automotive industry had paralleled the advances that the computer industry has experienced in the last 25 years, a Rolls Royce would cost 50 cents and would deliver 15 million miles to the gallon."(Kiesler)[33]

In addition to the above factors, there has been a significant amount of research on traditional systems development methodologies, the results of the substantial majority of this research, points out that the problems associated with the traditional method results from lack of user involvement in the process. There is also substantial research to indicate that with increased user involvement in the systems development process more effective and timely systems are developed.

This trend was noted in 1983 before the acronym CASE was widely known; indeed, before the development of many of the CASE tools on the market today. Rockart and Flannery noted:

> Today, interest in end-user computing (EUC) is booming. While most information systems departments are still heavily involved in processing

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[32] Dearden, John, "The Withering Away of the IS Organization," Sloan Management Review Summer, 1987: 88.

[33] Zuboff, Shoshana, In the Age of the Smart Machine: The Future of Work and Power (New York: Basic Books, Inc., 1988) 415-416.

> paperwork, there are a host of signs which suggest that this traditional focus will soon become a junior partner to user-developed and operated computing. End-user oriented languages are increasingly plentiful and better than ever. Improved man-machine interfaces are being developed: users are becoming more aggressive and more knowledgeable.[34]
>
> A "third" or shared environment is now necessary to effectively manage the growing number of departmental and multidepartmental end-user systems.
> ... this environment demands that I/S perform its "housekeeping" functions,
> such as data management, privacy, security, maintaining up time, and so forth, while the users take responsibility for developing and operating their programs.[35]

A basic premise behind the use of I-CASE tools is that, by their very nature, they require increased levels of user involvement to be effective. Indeed, virtually every article that mentions I-CASE tools specifically states or implies that I-CASE tools increase user involvement in the systems development process. However, to date, there have been not studies to verify this contention.

There have been a few studies verifying user satisfaction with systems developed utilizing I-CASE tools, however, the reasons for this satisfaction were not enumerated. The satisfaction could be due to the fact the users were so used to traditional systems development methods, that a system that was delivered in a relatively rapid manner caused the satisfaction.

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[34] Rockart, John R. and Lauren S. Flannery, "The Management of End-user Computing," Communications of the ACM October, 1983: 776.

[35] ibid. 783.

Consequently, the purpose of this research will be to determine the degree of user involvement in systems developed through the use of I-CASE tools as compared to the degree of user involvement with traditional systems development methods, and the level of satisfaction with the resulting systems. The information from the end-users perspective will be compared to IS personnel's, perception of the end-users experiences and satisfaction with the systems developed with the I-CASE tool.

The method used for the acquisition of information in this study will be the research interview which is discussed in Chapter 3 "Methodology" of this dissertation.

The premise of this research will be that I-CASE tools result in increased levels of user involvement in the systems design process, and consequently results in more user satisfaction with the resulting system.

Specifically, the following problems will be examined:

1. Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?

2. If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

CONTRIBUTIONS OF THE RESEARCH

The basic objective of CASE/I-CASE tools is to provide the end-user with systems that are responsive to their needs and requirements in a timely and effective manner. However, to date there has been no research to determine if this objective is being achieved. This research will provide an indication if CASE/I-CASE tools are achieving their objective.

As this dissertation is an exploratory investigation utilizing in-depth field interviews, another primary contribution will be the elucidation of possible causes for the end-users satisfaction or lack thereof with systems developed utilizing CASE/I-CASE tools as compared to systems developed with traditional methods.

The information on causation should provide practitioners with potential areas to attack if the tools are not living up to expectations. It should provide other researchers with a specific base on CASE/I-CASE end-user satisfaction, upon which to build future research.

LIMITATIONS OF THE RESEARCH

As this research is exploratory in nature, CASE/I-CASE tool users were secured from a number of sources. Consequently, the results may not be generalizable. However, the lack of generality is a condition endemic to exploratory research.

It is necessary to use perceptual measures in assessing the end-users satisfaction with systems developed with the CASE/I-CASE tools, rather than an objective measure. While the survey instrument utilized for this research has its basis in instruments utilized and tested for general end-user research, it has not been clearly demonstrated that they have considered all possible variables to end-user satisfaction. Consequently, this research will suffer from the same limitation.

CHAPTER 2

LITERATURE REVIEW

CASE tools are a recent entrant to the field of IS, with their first mention in the late 1970's at software engineering conferences. In 1979, at an international software engineering conference held in Munich, Amey[1] described the CASE system being developed at The John Hopkins Applied Physics Laboratory. The term came to the attention of the general business community in a 1986 Wall Street Journal article that contained the following comment: "In a sure sign that an industry is being born, the business recently has acquired and acronym: computer-aided software engineering or CASE."[2]

This literature review indicated that a multitude of articles and books have been written concerning CASE/I-CASE tools, however, only a very small portion of these books and articles reported on research related to CASE/I-CASE.

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[1] Amey, William Scott, "The Computer Aided Software Engineering (CASE) System," Proceedings of the Fourth International Conference on Software Engineering (New York: The Institute of Electrical and Electronics Engineers, Inc., 1979) 111-115.

[2] Wessel, David, "Software Writing is Becoming Automated," The Wall Street Journal 24 Sept. 1986: 6.

The evolution of this field and lack of research in it are evidenced by the growth in the number of CASE/I-CASE articles in the ABI-Inform database, a comprehensive business database that contains, among other things, information on most of the widely disseminated journals and periodicals dealing with systems development and IS[3]. The database contains information on three of the highest quality IS journals in terms of published research and readership, Communications of the ACM, MIS Quarterly, and Management Science.[4] [5] The ABI-Inform database contains academic and general purpose business journals and periodicals, it therefore, represents the emergence of a subject to the area of general knowledge, as opposed to specialized journals and conference proceedings. The growth of CASE/I-CASE is demonstrated by the number of references to them in the database. Table 2 summarizes the growth in the number of articles.

To the 1990's, the substantial majority of the articles were explanatory as to the nature of CASE, firms that were utilizing it and the great promise it held to take care of the systems developments backlog in most organizations. In the 1990's, the articles began to describe the problems involved with CASE implementation, and how it had not lived up to its expectations. Virtually all of the CASE research described in the ABI database was performed by the practitioner oriented IS publications and consisted of

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[3] MacDonald, Laurie E. and Wallace A. Wood, "Do MIS Research Journals Address Practitioners' MIS Issues?" Interface Summer, 1993: 3.

[4] ibid. 3.

[5] Walstrom, Kent A., Bill C. Hardgrave and Rick I. Wilson, "Forums for Management Information Systems Scholars," Communications of the ACM March, 1995: 93-107.

Table 2: Number of CASE/I-CASE Articles in the ABI-Inform Database 1971 -- 1994

Year(s)	Number of Articles	Cumulative Num. Articles	Number Research Art.	Cum. Num. Research Art.
1971 - 1980	0	0	0	0
1981 - 1986	10	10	0	0
1987	49	59	0	0
1988	107	166	2	2
1989	149	315	4	6
1990	192	507	5	11
1991	182	689	5	16
1992	233	922	7	23
1993	173	1095	7	30
1994	72	1167	2	32

surveys concerning the penetration of CASE in the market place, satisfaction with the tool in general, and with the specific vendors tool being utilized by the firm.

This literature review will be concerned with the academic research that has been done on CASE and I-CASE tools. However, prior to the review of the CASE literature, it would be useful to briefly review the development of the research in the IS field in general and end-user satisfaction research specifically, both of which are the direct antecedents of the research being conducted in this dissertation. In order to put the evolution/development of research in these three relatively new fields in perspective, the literature for all three will be reviewed in chronological sequence.

As the sections on IS and end-user research are reviewed, the reader will note that an important component relating to individuals and groups is missing from most organizations concerns for its people versus its machines. This was dramatically pointed out by Keen in 1991:

> Business needs to learn to treat people like machines. It accords the machinery of IT -- the hardware, software, and other components -- care, long-term planning, and commitment. Every large company that invests heavily in IT spends substantial sums of money maintaining its IT equipment and has a hardware plan that typically assesses technology changes and vendor offerings three to five years hence. Much rarer is the firm that acknowledges the importance of education, which is the equivalent of maintenance for people, and has a formal organizational plan that looks ahead in detail at job, career, and skill changes and needs. This situation is surprising in light of the fact that (1) the human element is the critical facilitator or bottleneck to effective use of IT, especially as the technology becomes more cost-effective and easier to install, and (2) IT can quickly and almost completely erode the value of their experience, create demands for totally unfamiliar skills, and stop careers dead.[6]

Researches in the various areas of IS investigation are attempting to provide possible solutions to some of the problems raised by Keen and others. However, as will be noted in the review of the IS and end-users sections that follow, both of these areas are still in the evolutionary/developmental stages. The literature contains much discussion/analysis of where the fields are, where they should be going, and the methodologies that are appropriate for their study.

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[6] Keen, Peter G. W., Shaping the Future: Business Design through Information Technology (Boston: Harvard Business School Press, 1991) 117.

IS RESEARCH -- GENERAL

In one of the early reviews of information needs and uses, Paisley[7] in 1968, points out that in order to perform research in this area it will be necessary for information scientists and behavioral scientists to collaborate and educate each other, a process he indicates began in the mid-1960's. The thrust of the study was a review of the 1967 literature in information gathering/dissemination techniques and channels within and between various groups.

While the thrust was not specifically computer information systems, they were included, and the conclusions of the need for collaboration between information scientists and behavioral scientist are also cogent in the IS area. This is due in large part to the propensity of the information scientists of that time to utilize "hard information" generated from the computers and the behavioral scientists to use "soft information" from observation.

In a 1972 study that was to serve as the basis for much of the research on various aspects of IS satisfaction, Wanos and Lawler[8] analyze nine different operational definitions of job satisfaction developed by other researchers. Their analysis and comparison of the research on the nine operational definitions resulted in the following conclusions; (1) there was (is ?) a serious lack of good theory on the very meaning of job

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[7] Paisley, William J., "Information Needs and Uses," in Cuadre, Carlos A., ed., Annual Review of Information Science and Technology (Chicago: Encyclopedia Britannica, Inc., 1968) 1-30.

[8] Wanous, John P. and Edward E. Lawler III, "Measurement and Meaning of Job Satisfaction," Journal of Applied Psychology 56 . 2 (1972): 95-105.

satisfaction; (2) depending on the meaning of satisfaction measured, e.g., fulfillment vs. equity vs. desires, there are varying degrees of divergence in the correlation between the facets of job satisfaction and overall satisfaction. The divergence is more pronounced in the models, based on the meaning of satisfaction measured, as opposed to the form of the model in that the facets could be either multiplicative or additive; (3) selection of the measure of satisfaction will have significant influence on the results. In comparisons of the nine measures, the level of correlation among different variables ran from significant to zero correlation; and (4) there was no one best way to measure satisfaction, the "best" measure would depend on the variables to be studied.

Another study that was to have significant influence on research in the IS area came from management sciences. In their 1975 study on influencing change in organizations, Zand and Sorensen[9] surveyed one hundred and fifty-four management scientists with a sixty-four question survey instrument (Appendix F) on successful/unsuccessful projects the management scientists had been involved with.

During the course of their research they noted the following developments in management science, that to a large extent are analogous to the developments in the IS research field. In the 1950's management scientists assumed that to complete successful projects it was only necessary for them to accurately define the problem, design an optimal solution, and it would be accepted by management. However, the management

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[9] Zand, Dale E. and Richard E. Sorensen, "Theory of Change and the Effective Use of Management Science," Administrative Science Quarterly December, 1975: 532-545.

scientists discovered that their elegant solutions were not necessarily embraced with enthusiasm by management.

Consequently, during the 1960's and early 1970's two tracts developed in management science to explore the phenomenon. The primary tract was a personality centered theory of change in which it was hypothesized that due to the different cognitive styles of managers and management scientists, communications were obstructed. Managers through their training and experience were pragmatic, concrete and not conceptualizers. Conversely, management scientists as a result of their training and experience were analytic, abstract conceptualizers. Therefore, communications were hindered and the mutual understanding for change was not present.

The primacy of this tract is evidenced by the editorial policy of Interfaces (1974) a joint publication of the Institute of Management Sciences and the Operations Research Society of America which invited: "...articles dealing with difficulties in...implementation... [and] problem solving stemming from the *personality differences* between managers and management scientists/operations researchers."[10] (emphasis added)

The other tract was a multifactor behavioral tract with factors such as management support, technical capability, adequacy of resources, etc. Neither of these tracts was found to be satisfactory by itself and in the mid-1970's management scientists

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[10] ibid. 533.

began to coalesce around and expansion of Lewin's theory of change, which is a three phase process:

> (1) unfreezing--behavior that increases the receptivity of the client system to a possible change in the distribution and balance of social forces;
>
> (2) moving--altering the magnitude, direction, or number of driving and resisting forces, consequently shifting the equilibrium to a new level; and
>
> (3) refreezing--reinforcing the new distribution of forces, thereby maintaining and stabilizing the new social equilibrium.
>
> Lewin also suggested that although common sense might lean toward increasing driving forces to induce change, in many instances this might arouse an equal and opposite increase in resisting forces, the net effect being no change and greater tension than before.[11]

Some of the conclusions reached as a result of this research are remarkably similar and analogous to conclusions found throughout IS research: (1) management is unable to clearly define its problem, the importance of the problem, the scope of the problem or the need for change; (2) unless the management scientist devotes adequate effort to the early stages of the project (unfreezing), later efforts may be futile; and (3) typically there will be decreases in performance during the early stages of the implementation process.

In another early analysis of system development problems, Boland[12] in 1979, discussed the need for a theory of systems design that would change systems designers existing perceptions and attitudes. According to Bolands research, systems designers felt

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[11] ibid. 534.

[12] Boland, Richard J. Jr., "Control, Causality and Information System Requirements," Accounting, Organizations and Society 4 . 4 (1979): 259-272.

managers; (1) were not active problem finders and did not create movements to action but were passive; and (2) did not know the information they needed, and what they wanted was not necessarily what they needed.

Boland concluded that in addition to the model based approach to systems building, with its flowcharts and structured interviews, the systems designer must be more cognizant of the human interactions involved during the systems design process, and the decision maker/systems interactions that will take place after implementation. Additionally, the process had to be interactive for as Boland quotes Weick on the feeling of many users, "How can I know what I mean until I see what I say?"[13]

Zmud[14], in 1979, reported on his analysis of over one hundred empirical investigations on the manner in which individual differences impact MIS success. The general conclusions based on the synthesis of the research were that individual differences do impact MIS success and much remains unknown about the specific relationships involved and the relative importance of the individual differences within specific contexts.

Within different categories of the empirical studies the synthesis revealed some specific conclusions related to the individual areas: (1) decision makers information requirements are related to their individual "world view"; (2) decision makers do not understand their own information requirements; (3) inclusion of irrelevant information in

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[13] ibid. 262.

[14] Zmud, Robert W., "Individual Differences and MIS Success: A Review of the Empirical Literature," Management Science October, 1979: 966-979.

reports tends to degrade performance; (4) MIS satisfaction is positively related to the degree information needs are *perceived* to be met; (5) user involvement in the early stages of systems development is positively associated with user satisfaction; (6) attitudes are associated with MIS usage; and (7) involvement is associated with MIS satisfaction.

Recognizing the need for a framework for research in MIS, Ives et al[15] in 1980, reported on their framework which was based on their analysis of the existing frameworks, all of which they felt took too limited a view of the MIS field. The model was validated by mapping three hundred and thirty-one MIS doctoral dissertations on to the framework.

The Ives et al model, while seemingly inclusive has not received significant support as a model for research in MIS.

Their model (Figure 2) places the system being developed in the environments that might affect the system, additionally it places the system within the process or interactions of the environments that may affect development. Depending on the specific system being developed the environments and interactions could vary marginally or materially from one system development project to another.

Also in 1980, Keen[16] discussed the problems with MIS research and what was required to bring some coherence to research in the field. He contended that MIS research

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[15] Ives, Blake, Scott Hamilton and Gordon B. Davis, "A Framework for Research in Computer-Based Management Information Systems," Management Science September, 1980: 910-934.

[16] Keen, Peter G. W., "MIS Research: Reference Disciplines and a Cumulative Tradition," 9-18 in McLean, Ephraim R., ed., Proceedings of the First International Conference on Information Systems (Conference on Information Systems, December, 1980)

was a theme rather than a substantive field, and that it was necessary to: (1) clarify the reference discipline(s); (2) define dependent variables; and (3) build a cumulative tradition. Keen provides an extensive discussion of the existing problems in the field, the outlets for research in the field and a call to arms to move from a theme to a field.

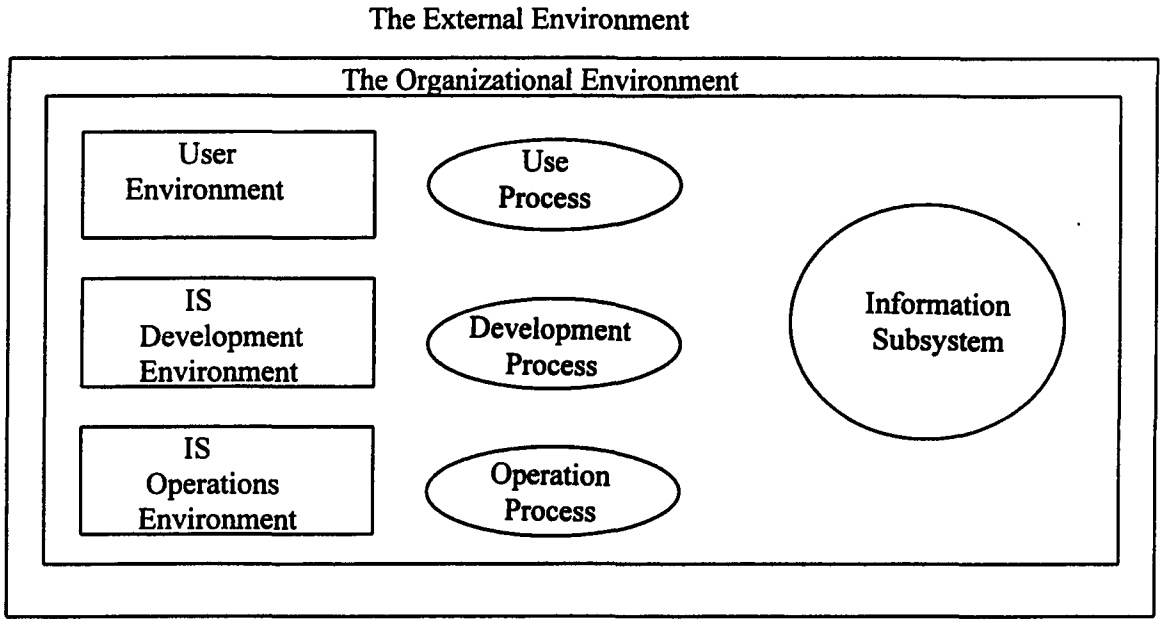

Figure 2. Model for Information Systems Research
Ives, Hamilton and Davis

Source: Ives, Blake, Scott Hamilton and Gordon B. Davis. "A Framework for Research in Computer-Based Management Information Systems" Management Science September, 1980, 917.

In a review of the research strategies used in the MIS field, Hamilton and Ives[17] reported on five hundred and thirty-two studies from fifteen journals for the period 1970-1979. Their survey indicated that seventy percent of the studies utilized non-empirical methods, for those that utilized empirical research methods, case studies predominated. Using citation frequency as an indication of article usefulness/significance, they found the research that utilized empirical methods was cited more frequently, a result that would be expected.

Organizational studies had and continue to have a strong influence on MIS research. Therefore, a survey by Podsakoff and Dalton[18] on the research methods of choice in the 1985 volumes of six of the primary organizational sciences journals is of relevance to this research. They found that survey and laboratory research predominated at forty and thirty percent respectively. As with other authors who performed surveys of research in their fields, they also found the rigor of much of the research somewhat wanting. Particularly, in the completeness of the reporting on all aspects of the research from the reasons and methodology adopted to a reporting of the analysis techniques and results.

They conclude with a review of some of the possible reasons for the state of affairs in organizational sciences research and issued a call to arms to bring more rigor and alternative research methods to the field.

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[17] Hamilton, Scott and Blake Ives, "MIS Research Strategies," Information & Management 5 (1982): 339-347.

[18] Podsakoff, Philip M. and Dan R. Dalton, "Research Methodology in Organizational Studies," Journal of Management 13 . 2 (1987): 419-441.

In a survey of research methods utilized by IS researcher, Orlikowski and Baroudi[19] surveyed the empirical research articles in four primary MIS journals from 1983 to 1988. The primary research methods were virtually the same as those just mentioned for the organizational sciences; survey and laboratory experiments at forty nine and twenty seven percent respectively. The primary thrust of their discussion of the research in MIS, was that it is too one dimensional, in that it is almost all based on a philosophy of the positivistic tradition that has its roots in the natural sciences.

They describe the positivists philosophy in MIS research as assuming an: "...objective physical and social world that exists independent of humans, and whose nature can be relatively unproblematically apprehended, characterized and measured."[20]

They specifically propose that researchers in MIS expand their research to also encompass the interpretive and critical philosophy's. "Interpretivism asserts that reality, as well as our knowledge thereof, are social products and hence incapable of being understood independent of the social actors (including the researchers) that construct and make sense of that reality."[21] They consider as the most significant distinction of the critical philosophy: "More than either the positivist or the interpretive research perspectives, the critical researcher attempts to critically evaluate and transform the social reality under investigation. Where the other two research perspectives are content to

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[19] Orlikowski, Wanda J. and Jack J. Baroudi, "Studying Information Technology in Organizations: Research Approaches and Assumptions," Information Systems Research March, 1991: 1-28.

[20] ibid. 9.

[21] ibid. 13.

predict or explain the status quo, the critical perspective is concerned with critiquing existing social systems and revealing any contradictions and conflicts that may inhere within their structure."[22]

As of this date it does not appear that Orlikowski's and Baroudi's lamentations have had a significant impact on the directions taken by MIS researchers, except for perhaps the fact that O & B had interpreted a significant amount of the research they examined, as cloaked as positivists, that was in fact interpretive.

Further indicating that the field of IS research is still evolving, DeLone and McLean[23] in 1992, argue that after fifteen years of research the dependent variable, IS success, remains elusive to definition. This has resulted in an inability to build a cumulative tradition in IS research, a point made by Keen in 1980. They propose a taxonomy of six major dimensions;

System Quality

Information Quality

Use

User Satisfaction

Individual Impact

Organizational Impact

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[22] ibid. 18-19.

[23] DeLone, William H. and Ephraim R. McLean, "Information Systems Success: The Quest for the Dependent Variable," Information Systems Research March, 1992: 60-95.

They proposed a model for IS success (Figure 3) and organized one hundred and eighty articles according to the dimensions of the model. The model allows the researcher to view the construct being measured in the entire context of IS success, and either control or measure the other constructs that impact IS success, as for example users being dissatisfied with a system that does not meet their needs, even if they participated in its design.

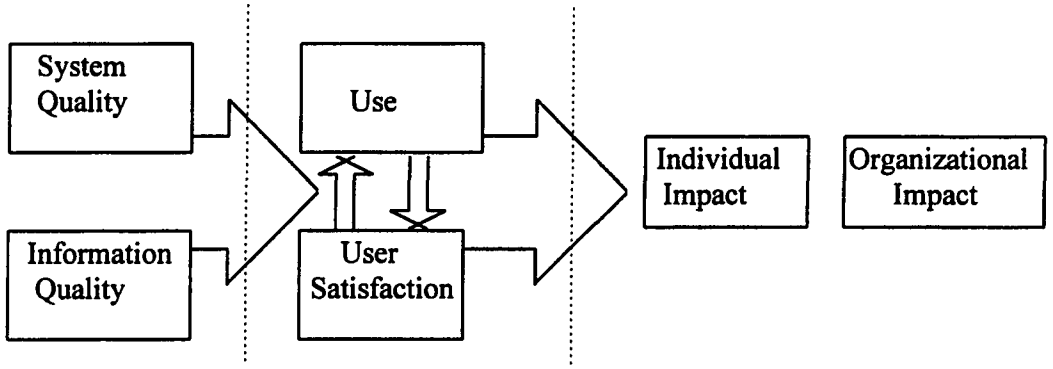

Figure 3: IS Success Model

Source: DeLone, William H. and Ephraim R. McLean. "Information Systems Success: The Quest for the Dependent Variable" Information Systems Research March, 1992: 87.

END-USER SATISFACTION RESEARCH

End-user satisfaction research was being conducted in the 1960's and 1970's; however, it began to flourish in the 1980's. The growth in the volume of research in end-user satisfaction was the result of the simple fact that end-users were becoming more involved in the development process as the problems in systems development began to be magnified. Additionally, end-users became more familiar and comfortable with computers and their use, and, as previously mentioned, the ubiquitousness of computers in the work environment resulting from the decrease in hardware costs.

The substantial majority of the research on end-users concerned their satisfaction with their involvement in the development process and satisfaction with the resulting system, and the appropriate way to determine the end-users satisfaction. As a result of the construct "end-user satisfaction," virtually all of the research conducted was based on the users' perceptions of success, rather than on an objective measure. Although, some researches did try to use system usage as an objective measure of development success. However, as will be noted in the following literature review, the majority of the research concerned the end-users perceptions of success.

While not designed for end-user computing research, Schultz and Slevin[24] in 1975, developed a survey instrument (Appendix G) that could be used by operations researchers/management scientists in evaluating the success of implementing

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[24] Schultz, Randall L. and Dennis P. Slevin, eds., Implementing Operations Research/Management Science (New York, American Elsevier Publishing Company, Inc., 1975) 153-182.

management science models in a variety of settings. This instrument and/or adaptations to it, was to serve as the basis for much[25] of the research evaluating end-user computing success.

In one of the earlier studies that distinguished between the phases of the systems development life cycle and the position of the end-user within the organization, Edstrom[26] in 1977, used structured interviews to conduct his research in the Paris area with sixty-four people in sixteen companies. The results of the research indicated that in those systems perceived as most successful, the high status actors were involved in the early stages of the development process and their involvement decreased as the development process moved into the more detail stages of specification and development.

In 1983, Bailey and Pearson[27] responding to the calls for more rigor in the MIS research field, developed a thirty-nine point validated survey instrument that could serve as the basis for future research. This instrument (Appendix H) is widely[28] used by researchers and servers as a base point for instruments other researchers developed. The

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[25] Pettingell, Karen, Thomas Marshall and William Remington, "A Review of the Influence of User Involvement on System Success," 228. in DeGross, Janice I. and Margrethe H. Olson, eds., Proceedings of the Ninth International Conference on Information Systems (International Conference on Information Systems 1988).

[26] Edstrom, Anders, "User Influence and the Success of MIS Projects: A Contingency Approach," Human Relations 30 . 7 (1977): 589-607.

[27] Bailey, James E. and Sammy W. Pearson, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction," Management Science May, 1983: 530-545.

[28] Pettingell, Karen, Thomas Marshall and William Remington, "A Review of the Influence of User Involvement on System Success," 228. in DeGross, Janice I. and Margrethe H. Olson, eds., Proceedings of the Ninth International Conference on Information Systems (International Conference on Information Systems, 1988).

instrument has had its validity both confirmed and disputed by subsequent researchers. However, even when disputed, it is generally praised as an initial effort in developing a validated instrument for research on end-user satisfaction. The confirmations/disputes will be acknowledged as this literature review progresses.

The instrument is based on the Wanous and Lawler satisfaction model, which suggests that satisfaction is the sum of an individuals positive and negative reactions to the set of factors under investigation. In order to arrive at the sum of the positive and negative factors a scaling is required, and the instrument utilizes the semantic differential technique to achieve this objective. The technique requires the subject to evaluate a concept or object using polar adjective pairs, such as; complete/incomplete, sufficient/insufficient, superior/inferior etc., the pairs also have an intensity component the subject must apply; for this instrument there is a seven point interval between the poles.

The thirty-nine factors were developed from a review of twenty-two studies of the computer/user interface, each factor contains four polar adjective pairs that the subject must evaluate on the seven point scale. There is also a question on the relative importance of the factor to the subject, also with the seven point scale. Various tests were performed to verify the validities of the instrument, the authors indicate that the instrument is valid to evaluate end-user satisfaction.

Ives, Olson and Baroudi[29] disputed the efficacy of the Bailey and Pearson instrument although they did acknowledge its contribution to the field and used it as the

base point for their development of two instruments. Their long form instrument eliminated six (* factors in Appendix H) of Bailey and Pearson's thirty-nine factors and utilized two polar adjective pairs per factor versus Bailey and Pearson's four. They also eliminated the question concerning the importance of the factor to the user. Additionally, they developed a four factor (Appendix I) short form to evaluate overall end-user satisfaction.

They surveyed eight hundred manufacturing production managers in the United States with the three instruments and received two hundred useable responses for comparison and analysis. They provide justification for the superiority of their instruments over the Bailey and Pearson instrument resulting from the survey and the comparisons made, in that their instruments achieve basically the same results as the Bailey and Pearson instrument, with theirs being easier and faster for subject to complete. To date, the Bailey and Pearson instrument has received more support as the instrument of choice for research in the end-user satisfaction field, although both continue to be evaluated/tested/validated. Additional instruments continue to be introduced, evaluated, tested and validated

Prior to 1984 it was virtually axiomatic in end-user satisfaction research that end-user involvement in systems development was a good thing and resulted in better systems and consequently increased systems usage. Ives and Olson[30] conducted a review

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[29] Ives, Blake and Margrethe H. Olson and Jack J. Baroudi, "The Measurement of User Information Satisfaction," Communications of the ACM October, 1983: 785-793.

[30] Ives, Blake and Margrethe H. Olson, "User Involvement and MIS Success: A Review of Research," Management Science May, 1984: 586-603.

of the literature on user involvement to that time, and found most of the research wanting, with their critique being divided in three general areas: theory, measurement and methodology. They noted the following:

> Theory
>
> Much of the research reviewed here is based on the commonly accepted notion that user involvement contributes to improved systems quality or acceptance. This atheoretic approach is understandable given the immaturity of the MIS field and the emphasis placed on "exploratory" research. However, research on user involvement now requires a unified and rigorous approach. Reference fields offer useful theories that pertain to user involvement; PDM (participate decision making) and planned organizational change are rich examples. The PDM literature suggests conditions under which user involvement may be appropriate, while literature of planned changes focuses on the interaction between user and designer in the system development process.
>
> Measurement
>
> *User Involvement.* Measurement problems with the user involvement construct include the following:
>
> 1. Measurers typically appraise subjects' general opinion rather than focusing on specific behaviors;
> 2. Questions of measurement validity and reliability are not normally addressed;
> 3. Measures are administered at the same time as measures of outcome variables;
> 4. Measures are administered after project implementation:
> 5. Measures generally do not differentiate between involvement in various stages of the systems development life cycle.
>
> *Outcome Measures.* Validity and reliability of outcome measures are also not generally addressed and the problems described above exist for simultaneous administration of multiple ex post facto measures. In addition:
>
> 1. Usage measures may be used inappropriately in setting where use is mandatory;
> 2. Usage and information satisfaction, though valuable indicators in their own right, may not be meaningful surrogates for systems quality;
> 3. The typical information satisfaction measure is not usually generalizable outside of the particular system for which it is developed;

4. There is no basis for comparing information satisfaction across systems, organizations, or research studies.

Methodology

Most of the studies reviewed are based on survey data collected after system development has been completed. Studies across multiple systems usually fail to adequately control sample selection; in no case was a random sample of respondents obtained. In many cases, type of system was also not under the researcher's control.

It has generally been assumed that user involvement "causes" the outcome variables, although threats to validity do not justify this assertion in the surveys and few controlled experiments have been conducted. The converse hypothesis, that a system may be implemented successfully without user involvement has been ignored. Furthermore, as Edstrom's research suggests, the causality may be reversed; poor systems quality may induce increased user involvement.[31]

While these problems had been generally acknowledged to one degree or another by various researchers, including those included in the review, Ives and Olson fail to present much guidance on how to mitigate or eliminate the problems they described. Indeed may of the problems persist today as the field continues to emerge and the study of the human interaction with specific technologies changes as rapidly as the technologies themselves.

In an effort to bring some clarity to the conflicting research results on whether or not user involvement influences system success, Pettingell et al[32] in 1988, conducted a

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[31] ibid. 599-600.

[32] Pettingell, Karen, Thomas Marshall and William Remington, "A Review of the Influence of User Involvement on System Success," 227-236. in DeGross, Janice I. and Margrethe H. Olson, eds., Proceedings of the Ninth International Conference on Information Systems (International Conference on Information Systems, 1988).

meta-analysis of the research that had taken place on user involvement and systems success.

Meta-analysis is a quantitative technique that allows the researcher to combine the results from various studies into one statistical construct, providing the individual studies conform to the requirements for meta-analysis. The researchers identified over two hundred and fifty studies that addressed some aspect of the end-user satisfaction relationship and identified forty-eight that conformed to the requirements for the use of meta-analysis. They found that most of the studies used either the Schultz and Slevin (Appendix G) or the Bailey and Pearson (Appendix H) instrument.

The results of the meta-analysis on the studies indicated that user involvement did positively influence systems success and that user involvement during the definition and design stages had a significant positive effect on systems success, when taken from the users perspective.

In 1988, Doll and Torkzadeh, utilized a twelve item (Appendix J) Lickert scale instrument to measure end-user satisfaction with a specific computer application as opposed to the overall end-user satisfaction that previous researchers had evaluated. For purposes of the research contemplated in this dissertation the Doll and Torkzadeh instrument is the appropriate tool to utilize and its use in this research is described in the methodology section, Chapter 3 of this dissertation. The development, testing and validation of the instrument by Doll and Torkzadeh is discussed more fully at the end of this section.

However, as the debate over the various survey research instruments continued and continues other researchers sought to broaden the debate. In 1990, Melone[33] argued that, although the user satisfaction construct had been used as a surrogate for IS effectiveness for over two decades, no comprehensive theoretical assessment of the construct had been conducted. After her evaluation, Melone concluded that the major problems of the construct, as being researched were:

> The body of work thus far has largely failed to help us answer basic questions about the structure of user attitudes, the conditions under which they form, the relationship between attitudes, cognition's and behaviors that contribute to effectiveness and the process leading to changes in attitudes given particular assumptions about structure. For this reason, user satisfaction in its current form may not offer as much as it could if there were a stronger theoretical foundation.[34]

Melone gives little guidance on the direction research should take to overcome the problems she delineates, except for some generalizations on the employment of behavioral observation, output-oriented criteria, latency measures and longitudinal design.

Also in 1990, Newman and Noble[35] presented the results of a case study of user involvement in systems development. Since user involvement is typically associated with systems success in the IS literature Newman and Noble were interested in the user involvement process, and how the involvement process contributed to systems success.

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[33] Melone, Nancy Paule, "A Theoretical Assessment of the User-Satisfaction Construct in Information Systems Research," Management Science January, 1990: 76-91.

[34] ibid. 80.

[35] Newman, Michael and Faith Noble, " User Involvement as an Interaction Process: A Case Study," Information Systems Research March, 1990: 89-113.

They compared four process models of user involvement with each other, and how each was appropriate to explain involvement at different stages of the development life cycle.

The case study involved one organization and the development of a system that affected different functional areas of the organization. There were strong power and political factors involved in the departmental interactions that lead to a system that was satisfactory for most users, but was not satisfactory for the organization as a whole. Consequently these influences, in a different organizational setting may lead to the applicability of alternative process models at different stages of the development life cycle.

Therefore, rather than the four process models, Newman and Noble, propose a two stage process model; (1) the first stage as the structuring of conflict and its development; and (2) the second stage described as conflict resolution. They point out that both practitioners and researchers should remain cognizant of the potential for conflict among users/user groups in evaluating the prospects for systems development success.

Also in 1990, Galletta and Heckman[36] proposed that role theory was a possible avenue for end-user research in that it might be useful in predicting individual or subgroup behavior. Based on their review of the literature, role theory consists of the following; (1) it is the study of the degree to which individual behavior and interactions are constrained/influenced by the social structure the individual is operating in, be it a

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[36] Galletta, Dennis F. And R. L. Heckman, Jr., "A Role Theory Perspective on End-User Development," Information Systems Research June, 1990: 168-187.

work environment or a social environment; and (2) the role is defined as the package of rights, obligations and privileges of the individual within the environment he/she is operating in at a particular time.

They believe role theory, while not explaining all of the variances in the behavior of the participants in a systems development project, would be a fruitful consideration for future research particularly in light of the significantly changing roles of users and developers resulting from the advances in user friendly software and computer technology.

Further expanding the area of end-user research Clement[37] in 1994, reported on three case studies of: "low-level" users -- telephone operators, library clerks and secretaries and the effect of their involvement or lack thereof, in systems development projects. The foundation of these case studies was the organizations perceived "empowerment" of the low-level users resulting from the increasingly competitive environment and the: "...vision of the flexible/virtual/intelligent/lean/networked /reinvented...organization. That involves flattening the organizational structure by reducing middle management and pushing decision making down the hierarchy."[38]

In all three of these organizations the low-level users faced similar problems and had similar results:

> ...In each case, woman office workers faced unnecessary hardships because of conventional ways in which computerization had been imposed

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[37] Clement, Andrew, "Computing at Work: Empowering Action by 'Low-level Users'," Communications of the ACM January, 1994: 53-63, 105.

[38] ibid. 53.

> on them. They had not been consulted about the introduction of the computer systems in the first place, and had initially tried to accommodate to the new conditions, in spite of experiencing considerable adverse effects -- effects that are commonly associated with the negative implications of computerization elsewhere. Coming from the lower reaches of rigid, strongly hierarchical organizations, attempts to voice concerns were met with fates typical of bottom-up initiatives. Only after pressure for change had grown considerably was any action taken.
>
> In each case, the clerical staffs' demands were not mainly for personal gain (e.g., pay increase), but to improve the functioning of the organization. ... They also sought to change the structure of the organization in ways that would give them greater influence. This pursuit of greater control, however, was not principally to challenge management, but to perform their jobs more effectively, to improve their working conditions and to enjoy greater respect than they had so far been granted.[39]

While these three case studies dealt with the introduction of new computer systems to the organizations and the effect of excluding those directly affected by the new system, from the implementation/decision process, it also provides larger lessons for organizations. It will require more than giving lip service to moving decision making down the hierarchy, but will require overt action on the part of management if "leaner/meaner" organizations are to operate effectively with flatter organizational structures.

In 1994, Barki and Hartwick[40] presented a fifty-nine item instrument (Appendix K) with a dichotomous scale (yes/no) that measured user participation, user involvement and user attitude. The purpose of the research was to evaluate the relationships between

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[39] ibid. 60.

[40] Barki, Henri and Jon Hartwick, "Measuring User Participation, User Involvement, and User Attitude," MIS Quarterly March, 1994: 59-82.

the three constructs, develop separate measures of the three constructs and to identify key dimensions of each construct. The researchers perceived participation, involvement and attitude as distinct constructs that required separate measurements. User participation was viewed as a more behavioral construct, in that it encompasses the activities performed by the user during the development process. User involvement was viewed as an attitudinal construct as it involved a belief concerning the importance and personal relevance of the system to the user. Whereas attitude was considered a psychological state reflecting the affective or evaluative feelings regarding the new system.

The research survey was conducted in two stages, systems predevelopment and postdevelopment, with one thousand fifty-nine surveys mailed out and one hundred and five being returned for both the pre and post development periods, which lasted from four to twenty-two months. The results indicated that initial levels of involvement and attitude had little influence on the levels of user participation. However, participation was found to influence subsequent levels of both involvement and attitude.

As is evidenced by the recent introduction of the Barki and Hartwick instrument, the field of end-user research continues to evolve; with the development of a survey research instrument that has wide support and applicability to the construct, an integral part of the development process.

An additional indication the field of end-user research is still in its evolutionary stages is evidenced by, Hufnagel and Conca[41] in 1994, presenting a discussion of the

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[41] Hufnagel, Ellen M. and Christopher Conca, "User Response Data: The Potential for Errors and Biases," Information Systems Research March, 1994: 48-73.

potential for errors and biases in user responses to surveys concerning information systems. It is unlikely that a paper on this subject would be accepted by a refereed journal for a field that had a solid theoretical grounding and well validated research methodologies and instruments. The authors discuss the potential areas for errors and biases, and actions survey instrument designers can take to mitigate against the errors and biases.

While not necessarily totally germane to this dissertation there are some interesting parallels and one major difference in the end-user satisfaction construct in the IS field and the customer satisfaction construct in the marketing field. The major difference is that in marketing research, expectation has driven theory and practice[42] as a predictor of satisfaction, with satisfaction being the end result. However, in IS research, satisfaction has driven both theory and practice as a predictor of systems success, with systems success being the end result.

As indicated in the previous paragraph both areas have had one main driver, both areas have had alternatives to the main driver proposed, however, research on the main driver continues to predominate in the field. Both fields appear to be experiencing the same growing pains for the satisfaction construct.

The chronological development in both areas has been similar with early research in the 1950's and 1960's both areas expanding significantly in the late 1970's early

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[42] Woodruff, Robert B., D. Scott Clemons, David W. Schumann, Sarah F. Gardial and Mary Jane Burns, "The Standards Issues in CS/D Research: A Historical Perspective," Journal of Consumer Satisfaction, Dissatisfaction and Complaining Behavior 4 (1991): 103-109.

1980's. Two of the pioneers in customer satisfaction research were Day and Hunt, among the early major contributors to the field still active in customer satisfaction research are Oliver, Woodruff et al and Westbrook.

DOLL & TORKZADEH

END-USER COMPUTING SATISFACTION INSTRUMENT

As previously indicated, in 1988, Doll and Torkzadeh[43] (D&T) utilized a twelve item Lickert scale instrument (Appendix J) to measure end-user satisfaction with a specific computer application as opposed to the overall end-user satisfaction that previous researchers had evaluated. They felt their instrument was a more useful tool for evaluating end-user satisfaction, as by focusing on a single application rather than overall satisfaction, the researcher would be able to focus on the components that generated satisfaction/dissatisfaction. With this determination the researcher would be able to isolate those areas of a particular application that required improvement, thereby increasing
end-user satisfaction.

In their explanation of the development, testing and validation of their instrument D&T began with a review of the existing instruments and research. From this they developed an initial forty item instrument to measure the various constructs of end-user

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[43] Doll, William J. and Gholamreza Torkzadeh, "The Measurement of End-User Computing Satisfaction," MIS Quarterly June, 1988: 258-274.

computing satisfaction determined from their research. A pilot study that included five firms and ninety-six end-users was conducted. In the pilot study open-ended structured interviews with the end-users were conducted prior to administration of the instrument. The purpose of the interviews was to:

> ...assess whether the instrument was capturing the phenomenon desired by the researchers and to verify that important aspects of satisfaction were not omitted, qualitative comments from the structured interviews were compared with the responses to the 40 questions. The end-users' overall level of satisfaction and the specific aspects that satisfied or dissatisfied end-users supported the instrument. This also enabled the researchers to verify that the respondents knew what the items were asking.[44]

After evaluating the construct and criterion-related validity, the instrument was reduced to eighteen items that measured five constructs of end-user computing satisfaction: content, accuracy, format, ease-of-use and timeliness. To evaluate the eighteen item instrument the same procedures as the initial pilot study were followed at forty-four firms with six hundred and eighteen end-users participating. The analysis and validating of the results from that research concluded with the final twelve item instrument, that is used with slight modifications in this research.

In a 1991 article, Etezadi-Amoli and Farhoomand[45] praised the D&T research and resulting instrument for its contribution to highlighting the importance of end-user computing satisfaction, but took exception to the instrument for various methodological and conceptual problems. D&T[46] responded to the concerns expressed by Etezadi-Amoli

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[44] ibid. 264.

[45] Etezadi-Amoli, Jamshid and Ali F. Farhoomand, "Issues and Opinions: On End-User Computing Satisfaction," MIS Quarterly March, 1991: 1-4.

and Farhoomand and demonstrated the theory behind their research and the validity of the instrument.

D&T continued to test the validity of the instrument and in 1991 reported on the test-retest reliability[47] of the instrument. The testing consisted of a short range interval test of two hours and a long range interval test of two weeks. The subjects were forty-one MBA students with considerable work experience who had experience with specific applications that averaged seven hours per week. The results of the test-retest supported the stability of instrument in the short and long range intervals investigated. In the article D&T note that while the instrument was developed for end-user computing they believed its wording made it appropriate for most computer-based applications.

Glorfeld and Cronan[48] utilized the D&T instrument to validate the satisfaction measure of the Ives, Olson and Baroudi's short form (Appendix I) instrument, that was utilized in a longitudinal study of end-user computing management in a large public organization. Glorfeld and Cronan felt the D&T instrument had been satisfactorily validated and was appropriate for their research. Their study concerned an information center that was developed in the IS department of the firm and measured end-user computing satisfaction before and after implementation of the center. For this particular

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[46] Doll, William J. and Gholamreza Torkzadeh, "Issues and Opinions: The Measurement of End-User Computing Satisfaction: Theoretical and Methodological Issues," MIS Quarterly March, 1991: 5-10.

[47] Torkzadeh, Gholamreza and William J. Doll,. "Test-Retest Reliability of the End-User Computing Satisfaction Instrument," Decision Sciences Winter, 1991: 26-37.

[48] Glorfeld, Kristy, D. and Timothy Paul Cronan, "Computer Information Satisfaction: A Longitudinal Study of Computing Systems and EUC in a Public Organization," Journal of End User Computing Winter, 1993: 27-36.

organization the results indicated little change in the level of end-user satisfaction as a result of the implementation of the center.

The test-retest reliability of the D&T instrument was extended in connection with the continuation[49] of the Glorfeld and Cronan (G&C) longitudinal study reported above. The D&T instrument was readministered two years (1992) after the initial (1990) G&C use of the instrument. Both the 1990 and 1992 administrations of the instrument utilized a two week test-retest period, in addition to the two year interval. Based on their analysis and evaluation of the results of the test-retests the authors concluded that the there were significant correlation's between the test-retest scores and the stability of the instrument could be relied upon.

CASE/I-CASE RESEARCH

1989

Norman and Numamaker[50] conducted a study of ninety-one management information systems professionals. The study used psychometric scaling methods on a personal computer based survey instrument. The study investigated the functional and

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[49] Hendrickson, Anthony R., Kristy Glorfeld and Timothy Paul Cronan, "On the Repeated Test-Retest Reliability of the End-User Computing Satisfaction Instrument: A Comment," Decision Sciences July/August 1994: 655-665.

[50] Norman, Ronald J. and Jay F. Nunamaker, Jr., "CASE Productivity Perceptions of Software Engineering Professionals," Communications of the ACM September, 1989: 1102-1108.

behavioral aspects of CASE technology that the software engineers perceived to provide the most favorable increases in their productivity over manual systems development methods (all subjects utilized the same CASE tool, to eliminate variances caused by different tools). Productivity was based on each individuals perceptions of what constituted productivity, which was not defined for the subjects.

The study showed that the software engineers perceived that the CASE tool increased their productivity. It also provided a ranking of the functional parts (17 items) of the CASE tool the software engineers perceived as contributing the most and least to productivity increases. The two most significant contributors to productivity were the Data Flow Diagram and the Data Dictionary, as both of these activities are extremely labor intensive and time consuming, with manual development methods.

The two least significant contributors to productivity were the fact the tool worked on both PC's and mainframes and the tool supported use on a local area network (LAN.) This research was reported in 1989, when CASE PC tools and LAN support were not as prevalent as they are today. As a result the rankings may change if the survey were conducted currently.

Necco et al[51] conducted a survey of one hundred computer executives (sixty-three responses) on the extent of their organizations use of CASE tools. Twenty-four percent of those responding were using CASE tools, of those using the tools all felt that productivity and quality of systems development had improved, that communications

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[51] Necco, Charles R., Nancy W. Tsai and Kreg W. Holgeson, " Current Usage of CASE Software," Journal of Systems Management May, 1989: 6-11.

between technical and user personnel had improved either significantly or moderately. However, there was no indication of how these conclusions were determined by the respondents. There was no description of the survey instrument or if it had any type of validity testing.

Norman et al[52] conducted a case study on CASE implementation at a firm with one hundred thousand employees and two hundred and eighty MIS professions in the unit studied. They approached the study as one of organizational change, due to the extensive body of research in the organizational change field, and the fact the introduction of CASE tools would indeed change the work process of the systems development personnel.

They utilized the Chin and Benne model of three basic strategies for effecting change; (1) rational-empirical is the most widely used of the strategies in IS, because of the inherent rationality of IS foundations and of the model. The model proposes that informational techniques, such as training and explanations on the benefits of the tools will ensure acceptance; (2) normative-educational adds to the rational-empirical model the fact attitudes will have to be changed. It accomplishes this by first determining the affected attitudes and developing a group strategy for change of the attitudes that might inhibit acceptance; and (3) power-coercive relies on implicit or explicit threats as to the consequences of failure to utilize the tools, and/or mandates their use.

The researchers concluded that there were a number of reasons for the implementation failure in this instance, among them; (1) failure of the project manager to

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[52] Norman, Ronald J., Gail F. Corbitt, Mark C. Butler and Donna McElroy, "CASE Technology Transfer: A Case Study of Unsuccessful Change," Journal of Systems Management May, 1989: 33-37.

select a change strategy appropriate to the organization. Instead he used elements from all three strategies which operate from different assumptions, and consequently send mixed rather than consistent signals; (2) failure to communicate the competitive pressures on the organization that were forcing the change; (3) failure to adequately communicate the benefits of the tools; (4) the lack of user involvement in the implementation process; and (5) the perception of a lack of management commitment.

1990

Zagorsky[53], on the other hand reported a case study of successful CASE implementation at New York Life Insurance Company. In this instance a methodology was in place and in use based on Yourdon's structured techniques and Chen's data modeling. The tool selected complimented the existing techniques, with the initial impetus for acquisition of CASE tools coming from applications developers. This impetus resulted from the tedium involved with manually preparing the various structured diagrams required by the methodology and the time consumed with revisions.

While the existence of these factors were positive for the successful implementation of CASE tools, the initial implementation ran into early problems when the implementation plan was circumvented. A staged implementation was envisioned using moderate size pilot projects that were just commencing. However, due to various

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[53] Zagorsky, Carol, "Case Study: Managing the Change to CASE," Journal of Information Systems Management Summer, 1990: 24-32.

pressures and salesmanship, the tool was applied to some major projects that were in progress. These major projects were also using a new data base management system and fourth-generation language for the first time. Needless to say, this resulted in serious consequences for CASE tool implementation, that had to be subsequently overcome.

CASE tools were eliminated from those major projects, and the initial implementation plan was reinstituted, with the tools being successfully introduced to the organization. A critical caveat the author points out, is that the initial benefits of CASE tools will come from improved systems quality, rather than reduced development costs. These conclusions are consistent with virtually every other study conducted on CASE tools.

Granger[54] believes her study was the first (my research has found nothing to indicate otherwise) to use control groups in evaluating programmer effectiveness utilizing CASE tools in systems development, and the resulting systems quality. The research consisted of two groups of students majoring in Information Systems at the University of Cincinnati that took the same Software Engineering course. Both groups were given the same project to develop, the group taking the course in the 1989 spring quarter did not use CASE tools while the group taking the course in the following autumn quarter utilized a CASE tool.

Data on programmer effectiveness consisted of manual logs maintained by the student teams and automatically collected data when the student teams were logged on

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[54] Granger, Mary J., The Impact of Computer-Aided Software Engineering on Programmer Productivity and Systems Quality (University of Cincinnati: Doctoral Dissertation, 1990).

the computer system to work on the project. Data on program quality was based on a review of the code generated for the project. A number of variables were measured from each of the sources. The results indicated that the use of CASE tools did increase programmer effectiveness and the quality of the final program based on the criteria utilized.

Hughes and Clark[55] developed a five stage model of the path of CASE implementation along with the trigger points that signal the movement from one stage to the next. They presented the model to nineteen senior IS executives (seven of whom responded) at large firms, the validation consisted of eight yes/no questions with the opportunity to elaborate on the responses. These responses were then incorporated in the model.

The five stages are:

(1) Disenchantment: tools are purchased without adequate information or training, and they become shelfware.

(2) Resignation: even with poor initial results firms continue to struggle with the tool as a result of their promise. It becomes understood that adoption and enforcement of a methodology is necessary for success.

(3) Commitment: firm selects a tool that meets it methodological requires and realizes that all CASE tools are not alike.

(4) Implementation: CASE tools and the appropriate methodology are used successfully on large projects.

(5) Maturity: alternative methodologies and tools are used depending on the requirements of individual projects.

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[55] Hughes, Cary T. and Jon D. Clark, "The Stages of CASE Usage," Datamation February, 1990: 41-44.

The authors conclude that their model if utilized by practitioners, will allow them to avoid some of the implementation problems of CASE adoption, such as the realization that the firms methodology must be first understood and the CASE tool that compliments the methodology should be selected.

Hayley and Lyman[56] report on a survey of twenty-two hundred IS departments (five hundred and sixty-eight responses) on CASE usage and implementation. One third of the respondents were utilizing a CASE tool(s), organizations utilizing the tools had departmental budges that averaged almost forty-eight million dollars versus non-users whose budgets averaged almost seventeen million dollars.

The perceived benefits of the tools in order of importance were:

Higher-quality systems.
Less or easier systems maintenance.
Better documentation.
Clearer communication with users.
Accelerated development life cycle.
Improved user satisfaction.
Reduced systems development costs.

It is interesting to note that the quality of the system was the highest perceived benefit with reduced development cost being the lowest perceived benefit. The lack of a perceived benefit with reduced development costs is evidenced by the fact that seventy-five percent of the respondents had been using CASE tools for less than three years. It was not until almost the third year of use that development cost overruns were lower than the overruns occurring prior to CASE tool adoption.

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[56] Hayley, Kathryn J. and H. Thaine Lyman, "The Realities of CASE," Journal of Information Systems Management Summer, 1990: 18-23.

The authors conclude that the organizations most talented people should be involved in early CASE pilot projects, including the development of data and process model foundations, before attempting major projects with large numbers of staff.

1991

Banker and Kauffman[57] conducted a case study on an I-CASE tool developed by First Boston Corporation that emphasized software reusability as an important/integral component of the tool and its implementation within First Boston. As a result of increasing competitive pressures in the investment banking industry and the need for systems to be operationally available virtually all day/night every day due to the global nature of the business, it was realized that traditional systems development methods were inadequate. After investigating various tools available on the market First Boston, felt their best option was in-house development.

This study was specifically undertaken to determine if the reuse built into the tool did indeed result in increased productivity. Function points were selected to serve as the basis of measurement as they are widely recognized and supported and enable comparisons across different programming languages. A model was developed to specifically measure productivity improvements at First Boston; although the authors believe the model can serve as a base for other organizations measurements of

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[57] Banker, Rajiv D. and Robert J. Kauffman, "Reuse and Productivity in Integrated Computer-Aided Software Engineering: An Empirical Study," MIS Quarterly September, 1991: 375-401.

productivity improvements. Information, for twenty projects of various sizes that were developed using the tool, was secured.

The model includes the following factors; (1) person days of effort for the project; (2) maturity of the I-CASE tool set (the longer the tool was in use the more reusable code would be in the library); (3) binary variable for on-line or batch process (more reusable code was available for the on-line programs); and (4) the new object percent or number of new objects built for the application divided by the number of objects in the application. They found that with use of the tool the number of function points produced increased from an average of sixteen per person month to one hundred and twenty-two per person month between the first and second year of the tools use. Under traditional systems development methods function points per month are generally considered to average eight to ten.

While not an integral component of their study they mention a factor that appears to be universal in organizations that implement CASE tools, i.e., experienced developers have a more difficulty adapting to the tool than less experienced developers

Lin and Chung[58] discussed their suppositions on the application of CASE to end-users, noting that at that time CASE was used almost exclusively by IS professionals, a situation that continues to exist. They contended, that due to the inherent nature of the tools user involvement is increased. They also contended that users could and should be trained on the use of the tools for small applications within the work unit, ad hoc query

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[58] Lin, Chang-Yang and Chen-Hua Chung, "End-User Computing in a CASE Environment," Journal of Information Systems Management Spring, 1991: 17-21.

routines and report routines, to help alleviate the systems development backlogs within most organizations. They also felt that due to the nature of the tools available at that time complex interdepartmental applications would have to be developed by IS professionals, with users participating completely on the development team.

1992

The Proceedings of the Fifth International Workshop on Computer-Aided Software Engineering,[59] held in Montreal contained the results of four research studies; two experiments, one preliminary analysis of CASE tool efficiency and one structured/in-depth interview. Most of the other papers presented at the conference contained descriptions of various methodologies and tools that had been developed for use in software engineering. (Page numbers refer to page number in proceedings.)

Osterle (p 142) in his experiment compared the results from five different methodologies for information systems development. Song and Osterweil (p 225) in their experiment also compared various systems design methodologies, in this case 6, and compared the results of each. Freeman (p 254) is in the pilot test stage of developing a study using function points to determine the effectiveness of CASE tools, versus traditional development methodologies. Trienekens and van Reeken (p 258) conducted

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[59] Forte, Gene, Nazim H. Madhavji and Hausi A Muller, eds., Proceedings Fifth International Workshop on Computer-Aided Software Engineering (Los Alamitos, CA: IEEE Computer Society Press, 1992).

structured/in-depth interviews at sixteen major Dutch firms to determine the problems and needs of practitioners in the use of structured methods and automated tools for systems development. For the firms studied it was determined that the tools being utilized were too limited, particularly in the first two phases of the development life cycle. It was also determined that for the various interest groups within the organizations none was interested in all phases of the development life cycle.

1993

Banker et al[60] reported on an update to their initial study of reuse at First Boston Corporation, the update included another firm that was using the same CASE tool. The follow-up was conducted twenty months after the first development success with the new tool. Contrary, to their expectations, reuse did not increase as the repository of reusable objects increased. After initial high levels of reuse their was a decline and then a relatively consistent level of reuse, even as the repositories grew significantly.

Their other primary expectation was confirmed, in that they expect familiarity to be a strong driver of reuse, they found that eighty-five percent of all reuse was within an individual system and that sixty percent of reuse was programmers reusing software they had developed. Additionally, there was moderate support for increased levels of reuse within larger systems, as there were larger pools of familiar software.

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[60] Banker, Rajiv D., Robert J. Kauffman and Dani Zweig, "Repository Evaluation of Software Reuse," IEEE Transactions on Software Engineering April, 1993: 379-389.

Of interest was the fact that five percent of the programmers created twenty percent of the reusable software and accounted for over fifty percent of total reuse, which reinforces the familiarity expectation. Also, reinforcing the familiarity expectation was their finding that the keyword search mechanism for locating reusable software could be time consuming and cumbersome. In many instances the programmers found it less burdensome to write new code.

The initial thrust of the reuse drive was technical, in that the firms felt all that was necessary for successful reuse was a large repository of reusable software. Both firms had begun to examine the organizational/personnel impacts of encouraging reuse, as their initial expectations had not been fulfilled. They were also examining improvements to the search mechanism.

Browdy[61] through the use of twelve interviews at four field sites attempted to determine if all four of his theoretical propositions had to be in place for successful (as defined by the subjects) implementation of CASE developed systems. The propositions were:

(1) Top level management must be well informed about the technology and involved in the decision making for it to be judged successful for the organization.

(2) An organization must have a standard systems development methodology before CASE will be successful.

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[61] Browdy, Thomas A., Computer Aided Software Engineering (CASE) Technology Transfer in Organizations (St. Louis, MO: Washington University, Doctoral Dissertation, 1993).

(3) CASE technology will fail if the technology users are not involved in the technology selection process.

(4) Benefits of CASE technology must be clearly spelled out ahead of time for it to be successful.

The successful sites did not conform to all of the propositions, and the sites with partial success did conform to some of the propositions. Indeed one site which was only partially successful conformed to more of the propositions than the site which was considered most successful. The four propositions were disconfirmed as being requirements for successful technology transfer to CASE tools within the organizations studies.

Everest and Alanis[62] conducted a survey of the IS departments in` nineteen large organizations in the Twin Cities of Minnesota to secure information on organizational characteristics, IS development methodologies utilized and their experiences with CASE tools and the development methodologies. The results of the survey indicated that the primary reasons for the acquisition of CASE tools were improved systems quality and improved communications between end-users and designers/developers. Both of these objectives were reportedly occurring to one degree or another. However, most of the organizations were still in the early stages of implementation and could not determine if use of the tools would be a success or not.

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[62] Everest, Gordon C. and Macedonio Alanis, "Survey of CASE User Experiences" in Bergin, Thomas J., ed., Computer-Aided Software Engineering" Issues and Trends for the 1990's and Beyond (Harrisburg, PA: Idea Group Publishing, 1993).

Rowe[63] reported on a survey sent to one hundred and fifty-one IS departments (seventy-six usable responses, thirty-nine of those used a CASE tool) to determine the effect an enforced preexisting development methodology had on CASE acceptance. The results indicated a strong relationship between a preexisting enforced development methodology and CASE acceptance. However, there was no significant difference if the methodology utilized after CASE implementation was the same or different than the preexisting methodology.

The Proceedings of the Sixth International Workshop on Computer-Aided Software Engineering,[64] held in Singapore contained the results of seven research studies; four of the studies were surveys, one a combination surveys/interviews, one interviews and one consisted of two experiments. (Page numbers refer to page number in proceedings.)

The four surveys were as follows: Kusters & Wijers (p 2) conducted a survey in the Netherlands of experienced CASE tool users that covered satisfaction with the tool being used, if the tools had provided the desired results, impact on the organization and future directions of use. Selamat, et al (p 11) surveyed CASE tool users in Malaysia to determine if the firms had adopted transition plans prior to CASE adoption, and a comparison of the results for those that did/did not adopt transition plans. Bailer, et al (p 36) present the results of structured reports prepared by thirteen Swiss firms that report on

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[63] Rowe, Joyce M., "Can Enforced Standardization Affect CASE Usage," Journal of Systems Management March, 1993: 29-33.

[64] Lee, Hing-Yan, Thomas F. Reid and Stan Jarzabek, eds., Proceedings of the Sixth International Workshop on Computer-Aided Software Engineering (Los Alamitos, CA: IEEE Computer Society Press, 1993).

their experiences with CASE tools. Aaen (p 66) reports on the results of surveys of Danish and Finnish firms on their general experiences with CASE tools.

The combination surveys/interviews were conducted by Stobart, et al (p 81) in Australia, England and the Netherlands. This research was a general evaluation of CASE tools and firms expectations and experiences with the tools. The interview study by McCreay and Yin (p 240) was conducted in the US Internal Revenue Service and concerned the results of utilizing CASE tools to reengineer three major IRS systems. Reengineering was defined as "A combination of tools and techniques that facilitate the analysis, improvement, redesign and reuse of existing software systems to support changing information requirements."[65]

The research on the two experiments conducted by Isoda, et al (p 48) in Japan consisted of having two groups develop the same system, one group using CASE tools and the other traditional methods, in the second experiment a CASE tool was introduced at various stages in the development of actual systems to determine the result on the development of the systems. In the first experiment comparing the two methods IS department personnel were utilized in both cases, in the second experiment, project development teams were used.

Orlikowski[66] performed an empirical study of two organizations and their

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[65] ibid. 241.

[66] Orlikowski, Wanda J., "CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development," MIS Quarterly September, 1993: 309-340.

experiences with the adoption of CASE tools. The results of the study indicated that researchers need to consider the social context of systems development, intentions and actions of key players, and the implementation process within the organization when conducting future research on CASE adoption in organizations. Additionally, managers need to realize that the adoption of CASE tools are not simply the adoption of a new technology, but a process of organizational change, over time.

Ngwenyama[67] tests a concept called "Collaborative Action Learning" (CAL) as a means of allowing end-users to improve their effectiveness in systems development. CAL has two primary components an action learning process and self organized collaborative discourse. The main purpose of the research was to test the CAL concept, through the use of two case studies in systems development one an order processing system and the other a distribution management system.

However, both systems were developed utilizing I-CASE tools, inherent in the use of which are user involvement and an iterative discourse through-out the development process. Consequently, it is difficult to determine if the favorable end-user response to the developed systems, results from the use of the I-CASE tools, the CAL concept or a combination of the two.

[67] Ngwenyama, Ojelanki K., "Developing End-Users' Systems Development Competence: An Exploratory Study," Information & Management December, 1993: 291-302.

1994

Rai and Howard[68] conducted a mail survey to determine the impact on CASE implementation, of five categories of factors identified in previous IT implementation research. The five categories are; organizational environment, user characteristics, organizational process, organizational structure and task characteristics. A random selection of twenty-seven hundred MIS managers at firms with MIS budgets exceeding $250,000 and total firm sales exceeding $50 million were surveyed. The response rate was fifteen percent, the mean MIS staff size for the respondents was 75.7 staff members.

Perhaps the most significant finding was the low mean usage level of CASE tools for the thirteen development tasks investigated by the study. For the five categories of factors examined the conclusions based on the responses were:

Organizational Environment -- perceived threats to the existence of the IS department are associated with lower levels of CASE tool usage,

User Characteristics -- methodological expertise among programmer/analysts was positively associated with CASE tool usage,

Organizational Structure -- the size of the MIS department was positively associated with increased levels of CASE tool usage up to a point, after which the degree of usage diminishes,

Organizational Process -- the degree of CASE technical support was positively related to the level of CASE tool usage,

[68] Rai, A. and G. S. Howard, "Propagating CASE Usage for Software Development: An Empirical Investigation of Key Organizational Correlates," Omega March, 1994: 133-147.

Task Characteristics -- the degree of job/role rotation among programmer/ analysts was found to be positively related to the amount of CASE tool usage.

King and Galliers[69] utilized three CASE tool information systems development projects to determine if the existing information systems development models remained relevant in light of the increase in CASE tool usage for information systems development. Based on the three projects included in their study they determine that the existing waterfall, transform and evolutionary models could be used to describe CASE based development, but the spiral model was not appropriate.

Selamat et al[70] reported on the failure of CASE tools to achieve success in the Malaysian organizations investigated, that have attempted to develop information systems utilizing a CASE tool. They then compared the experiences of the Malaysian organizations with the reported results of organizations in the United States and the United Kingdom. They concluded that the main reasons for the lack of success in Malaysia are human oriented rather than technical. The results for the Malaysian firms were similar to those reported for the United Kingdom with the lack of success due more to human oriented problems rather than the technically oriented problems reported in the United States.

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[69] King, Stephen and Robert Galliers, "Modeling the CASE Process: Empirical Issues and Future Directions," Information and Software Technology 36 . 10 (1994): 587-596.

[70] Selamat, M. H., C. Y. Choong, A. T. Othman and M. M. Rahim, "Non-use Phenomenon of CASE Tools: Malaysian Experience," Information and Software Technology 36 . 9 (1994): 531-537.

CONCLUSIONS

IS and End-User Research

During its advent in the 1950's and early 1960's computer research was based on the scientific method that included observable objective measures, replicability etc. This foundation in the scientific method is easily understood as all IS research at that time was being conducted in the engineering and science disciplines. They were the only ones who had knowledge of what computers were about and the researchers backgrounds and training were in the scientific method.

However, as computers became more ubiquitous in the 1960's and more individuals began to interact with them, it became apparent that an important element was missing from the research. Thus began the movement towards including the individual, group and organization in the equation with the computer. During the early 1970's research on information systems with a strong emphasis on the human factors began to ascend. The emphasis on the human factors has resulted in a predominate emphasis on the behavioral aspects of the information system rather than the machine and its inputs/outputs that predominated in the 1950's and early 1960's.

This emphasis on the human aspects of the information system has lead to a more subjective type research in the IS field. Due to the relative youth of the IS research field, it is still involved in a discourse with itself on where it is and where it should be going.

CASE/I-CASE Research

From the research that has been conducted on CASE/I-CASE tools to date the following conclusions can be drawn, which support the need for the research contemplated by this dissertation:

(1) The majority of the research has been done from the perspective of IS department personnel.

(2) The research that has involved user personnel has been geared towards the strategic level of the organization on the overall impact of CASE/I-CASE tools of the organization. As opposed to the tactical level of the organization where personnel interact with the firms computerized information system on a daily basis in the accomplishment of their responsibilities.

(3) Due to the still exploratory nature of research in the area, the field research interview is a critical tool in the investigation of the impact of CASE/I-CASE tools on organizations and their employees.

(4) There is a need for additional research from the perspective of the tactical end-user on the impact of CASE/I-CASE tools on this group of a firms employees.

CHAPTER 3

METHODOLOGY

The field of information systems research is still in an evolutionary process due to its relatively recent addition to the academic landscape. It has only been ten years since some early colloquia (1984) were held to discuss the issue, one at the Manchester Business School (Mumford, ed.) in England and the other at the Harvard Business School (McFarlan, ed.) in the United States. A lifetime in the systems world but hardly noticeable in the world of research. Since that time additional colloquia have been held among them, a 1988 colloquium at the University of British Columbia (Benbasat, ed.) that was a follow-on to the earlier colloquium at the Harvard Business School.

The earlier colloquia were a general review of research methodology in the IS field, while the latter colloquium was specifically aimed at the preparation of a document in experimental methods that "would offer guidance to doctoral students, junior faculty and other IS faculty who might wish to consider the use of experimental methods."[1] It was noted in the 1988 colloquium that IS research in the late 1950's and during the

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[1] Benbasat, Izak, ed., The Information Systems Research Challenge: Experimental Research Methods Volume 2 (Boston: Harvard Business School Press, 1989) Forward.

1960's focused primarily on technological issues. It was during the 1970's the focused shifted from computers, to information and to people and organizations.[2]

GENERAL IS RESEARCH METHODOLOGY

In the 1988 colloquium Mason quotes Locke concerning laboratory studies and the need for field research by noting that laboratory studies are artificial and

> ...are plagued by "demand characteristics" which induce ready cooperation and conformity to the expectations of the experimenter whereas in "real life" getting cooperation may be the main problem: that lab studies last only a few minutes or hours whereas real tasks last for weeks, months, or years: that lab groups are small and well defined whereas real groups tend to be larger and loosely defined: that lab subjects get clear feedback whereas real participants receive ambiguous feedback: that performance does not hold much significance for lab subjects whereas it may be crucial for real participants: and that lab tasks tend to be simple with few inter-relationships whereas real tasks tend to be highly interdependent[3]

In what is one of the most famous/infamous studies demonstrating the manifestation of obedience to authority in general and to respected laboratory researchers in particular, Milgram[4] reported in 1963, on his studies conducted at Yale University. In

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[2] Mason, Richard O., "MIS Experiments: A Pragmatic Evaluation," in Benbasat, Izak ed., The Information Systems Research Challenge: Experimental Research Methods Volume 2 (Boston: Harvard Business School Press, 1989) 21.

[3] Mason, Richard O., "MIS Experiments: A Pragmatic Perspective," in Benbasat, Izak, ed., The Information Systems Research Challenge: Experimental Research Methods Volume 2 (Boston: Harvard Business School Press, 1989) 9.

[4] Milgram, Stanley, "Behavioral Study of Obedience," Journal of Abnormal and Social Psychology 67 . 4 (1963): 371-378.

this study forty subjects were secured to participate in what was termed a learning experiment. They were to question a collaborator of the researcher and if incorrect or no response was given to a question, the naive subjects were to inflict increasingly higher levels of electrical shock, thirty grades ranging from fifteen to four hundred and fifty volts.

The naive subjects were unaware that the researchers collaborator was reacting to a prepared script, and the machine was a dummy. As the level of shock increased, the collaborator actor began to show increased manifestations of pain and at three hundred volts he began to pound on the wall, etc. Twenty six of the naive subjects continued the experiment to the maximum level of shock while fourteen discontinued the experiment as the collaborator actor began to evidence increased levels of pain.

While this experiment was not repeated due to the severe distress caused to many of the naive subjects, it does perhaps demonstrate that the desire to "obey/please" could influence responses in a controlled laboratory setting.

At the Manchester University colloquia in 1984 Mumford pointed out the validity of observational data in appropriate circumstances as follows:

> Some years ago a piece of research that was not based on careful statistical analysis would be regarded as unscientific by certain academics. Today when it is increasingly recognized that good statistics can be applied to very poor research data, and that the purpose of research is understanding, explanation and prediction, less formal methods are increasingly recognized as respectable, and as often superior in the quality of information they provide. Observational techniques tend to look for patterns of behavior and for insights into why this kind of behavior is taking place. It is not easy to apply statistics to this kind of data and they

> may be less useful than written descriptions of what has taken place and why.[5]

The thrust of the Manchester colloquia was the need for pluralism in the research methods employed when dealing with human activity, however, there was concern expressed that this would occur as the roots of IS research are in engineering which is more concerned with the technical aspects of systems as opposed to the human aspects. Fitzgerald[6] et al point this out in their introduction to the debate:

> ...the researchers we are training, the Ph.D. students, are not being adequately prepared to address the areas where the real problems exist. The data collection and analysis of the scientific method are not adequate on their own in areas involving human activity. Karl Weich illustrates this very elegantly: he is amazed at the power of the measurable to dwarf the nonmeasurable. He quotes Vickers as saying, "I recall times when I have criticized some forecast or estimate for omitting some variable which must obviously be relevant to the result and have been answered - 'We couldn't include that: we couldn't put a value on it.' And if I objected - 'But by omitting it you have valued it at zero; and you know that is the only value it cannot have.' The answer, given in the patient voice which the professional keeps for the amateur, would be - 'No, we haven't valued it; we have only omitted it.' And then triumphantly - 'Look, one of the footnotes says so.'".

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[5] Mumford, Enid, "Researching People Problems: Some Advice to a Studen,t" in Mumford, Enid, ed., IFIPWG 8.2 Colloquium (1984: Manchester Business School): Research Methods in Information Systems (Amsterdam: Elsevier Science Publishers B.V., 1984) 318.

[6] Fitzgerald, G., et al, "Information Systems Research Methodology: An Introduction to the Debate," in Mumford, Enid, ed., IFIP WG 8.2 Colloquium (1984: Manchester Business School) Research Methods in Information Systems (Amsterdam: Elsevier Science Publishers B. V., 1984) 5.

THE SEMI-STRUCTURED FIELD INTERVIEW

The results of the colloquia discussed above support the need for field research in the IS area, in addition to supporting the need of a plurality of research methods when dealing with the human element in the use of computerized information systems. This section will discuss the viability and the limitations of the semi-structured field interview in achieving the objectives of this research.

In an early investigation, commissioned in 1947, into the sources of error that may be introduced to research based on interview techniques Hyman[7] points out the pervasiveness of the interview technique in social research:

> Interviewing as a method of inquiry is universal in the social sciences. ...The periodic censuses of the United States and other countries are monuments to the interview method, and the thousands of students making use of these historical archives, whether conscious of it or not, cannot ignore their ultimate dependence on interview data. New applied fields cutting across the classic disciplines--human relations, industrial relations, communications research, area studies--all make use of interview data.

While the purpose of this research on end-users and CASE tools is not as grandiloquent as that indicated by Murray's comments below, the quotes are compelling and contain some of the elegance lacking in much of today's writing:

> If he continues to hold rigidly to the scientific ideal, to cling to the hope that the results of his research will approach in accuracy and elegance the formulations of the exact disciplines, he is doomed to failure. He will end his days in the congregation of futile men, of whom the greater number, contractedly withdrawn from critical issues, measure trifles with sanctimonious precision.

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[7] Hyman, Herbert H., et al, Interviewing in Social Research (Chicago: The University of Chicago Press, 1954) 1.

> We tried to design methods appropriate to the variables which we wished to measure; in case of doubt, choosing those that crudely revealed significant things rather than those that precisely revealed insignificant things. [8]

RESEARCH DESIGN

Research Model

This research utilizes the DeLone and McLean, IS Success Model (Figure 3) as a framework for design of the research procedures. The model considers the primary aspects of information systems and their interactions in arriving at conclusions regarding the success or lack thereof, of a particular system. The components; systems quality, information quality, use, user satisfaction, individual and organizational impact will be discussed in subsequent portions of this research design section.

Research Sites

As a result of the relative newness of CASE/I-CASE tools in the field, sites were selected by a variety of means to provide strategic information concerning end-users and CASE/I-CASE tools. To accomplish this research, sites were required that had

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[8] ibid. 14-15.

substantially completed development and testing of systems utilizing an I-CASE tool. The definition of substantially completed was based on the organizations evaluation of the systems investigated. By having substantially completed with development and testing, both the end-user and IS personnel would be able to provide information concerning their experiences and expectations for the systems developed with the I-CASE tool versus other systems development projects they had been involved with.

This research originally contemplated utilizing sites that had implemented systems developed with an I-CASE tool. However, as the various sites were visited it became apparent that some of the subjects interviewed felt that while the majority of development and testing for the systems development projects they were involved with had been completed, it had not been completed to the development teams satisfaction before systems were made operational. In some instances the systems were made operational prior to the development teams completion due to the various exigencies of the organizations studied and their operational requirements. Consequently, it was determined that with development and testing substantially completed for the systems investigated the appropriate information could be obtained for this exploratory research.

Specifically, the sites utilized the Texas Instruments - Information Engineering Facility (TI-IEF) I-CASE tool for the systems developed that were investigated in this research. A single I-CASE tool was selected for use in this exploratory research to eliminate variability in the research results that might have resulted from different

methodologies or system/developer interfaces utilized by the various I-CASE tools available in the market.

TI's-IEF was selected as the I-CASE tool to utilize for this research as it appeared to receive the most prominence in the general practitioner literature. Additionally, a 1992 Computerworld survey[9] of I-CASE tool users gave IEF the highest rating, with IEF the most widely used tool with forty-three responses or thirty-three percent of the total, with three other I-CASE vendors comprising the remainder of the survey responses. However, this research is not designed to evaluate TI's-IEF, the sole criterion for its' selection was its' apparent market penetration, consequently the potential availability of research sites.

The method of site selection is analogous to Glaser and Strauss' strategy of theoretical sampling which they contrast to statistical sampling:

> Theoretical sampling is done in order to discover categories and their properties, and to suggest the interrelationships into a theory. Statistical sampling is done to obtain accurate evidence on distributions of people among categories to be used in descriptions or verification.[10]

The research was conducted at four field sites. For exploratory field research the number of sites is typically somewhat limited in order to allow for more depth in the investigatory process. In his exploratory research of CASE technology transfer in organization Browdy[11] utilized four sites and in his exploratory investigation of service response logistics Manrodt[12] utilized four sites. Both of these exploratory investigations

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[9] Slater, Derek, "PacBase, IEF Lead Rising CASE Satisfaction," Computerworld August 3, 1992: 81-82.

[10] Glasser, Barney G. and Anselm L. Strauss, The Discovery of Grounded Theory: Strategies for Qualitative Research (Chicago: Aldine Publishing Co., 1967) 62.

were conducted utilizing in-depth field interviews, as will the research being conducted in this dissertation.

The specific procedure in finding the sites consisted of locating the names of potential sites from colleagues, faculty, business contacts, publications, etc. After the name

of a potential site was obtained an explanatory letter (Appendix A) was sent to the firm requesting their participation. It should be noted that over twenty of the approximately thirty firms contacted did not use TI's-IEF, in most of these instances the firms used no CASE tools, this shotgun approach to site selection helped to provide some degree of randomness to the selection process.

Of the eventual four sites, one was obtained through a blind letter sent to an executive vice president of the largest employer in the researchers home town, Publix Super Markets. A lead obtained at Publix resulted in the Florida Department of Transportation's participation, a lead from the Florida DOT lead to the Missouri Department of Highways and Transportation participation and one site came from a lead provided by the chairman of the researchers dissertation committee, Martin-Marietta.

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[11] Browdy, Thomas A., Computer Aided Software Engineering (CASE) Technology Transfer in Organizations (St. Louis, MO: Washington University, Doctoral Dissertation, 1993).

[12] Manrodt, Karl, Service Response Logistics: A Case Study of Financial, Health Care, and Contract Logistics Organizations (Knoxville, TN: University of Tennessee, Doctoral Dissertation, 1993).

Subjects

Utilizing the Cotterman and Kuman end-user taxonomy the focus of this research was the "User - Operator/Developer/Controller" (U-ODC) and the "User - Operator/Developer" (U-OD). These individuals are at the tactical level of the organizational structure, and typically interacted with the firms IS on a virtually daily basis in the accomplishment of their responsibilities. These groups were selected from the taxonomy for inclusion in the research, as the thrust of the research is not only to determine if systems developed utilizing CASE/I-CASE tools are satisfactory but how the development process had been altered through the use of the tools, as opposed to the organizations traditional systems development methods. Both of these groups were involved in the development process and used the resulting systems in the accomplishment of their responsibilities.

The in-depth interviews were conducted with four end-user subjects and four IS subjects at each site. The IS subjects were questioned regarding their evaluation of what the end-uses thought, rather than what the IS subjects thought of the process and its results. The IS subjects responses will be used for comparison with the results from the end-user subjects. The number of subjects is consistent with the Browdy and Manrodt exploratory research. Browdy interviewed three individuals at each site and Manrodt interviewed between four and eight individuals at each site.

Research Method and Instruments

The field semi-structured interview was the primary tool of this research. The research instrument (Appendix B) has been designed to secure information concerning the end-users experiences and perceptions of systems developed utilizing an I-CASE tool, versus other systems development projects they had been involved with utilizing the firms traditional systems development methods.

In order to obtain information on the end-users level of awareness of the use of the I-CASE tool for systems development the tool itself was not specifically mentioned until the last quarter of the interview. Rather, the names of the specific I-CASE tool projects the end-users participated in were obtained from IS management, the end-users were then asked to compare their experiences with these projects to other IS development projects they had been involved with. Depending on the end-users level of awareness of the use of the I-CASE tool in the particular systems development project under investigation, the particulars of the level of awareness or lack thereof were probed, as appropriate.

IS personnel were also interviewed to obtain their perceptions of what they thought the end-users experiences and satisfaction were. The IS personnel were not asked what they thought of the tool usage and its results, but how they thought the end-users would respond to the questions. The IS Personnel Interview Research Instrument (Appendix C) contained virtually the same questions as the end-user instrument, with the

exception that the IS instrument couched the questions in terms of how the IS personnel thought the end-users would respond.

All of the interviews were conducted by this researcher and the results of the interviews were written on the instruments during the course of the interview, with further elucidation added subsequent to the interview when required. Prior to departure from the field site the results of the interviews were reviewed for major divergence's between individual interviewees. Any significant divergence's were explored with senior level staff in order to obtain some explanation or resolution. The divergence's were not discussed with the interviewees, as it was felt they might merely adjust their response, in order to avoid any perceived "hassle" from the researcher, or to give the researcher what he wanted.

The use of a mechanical device to record the interviews was contemplated and discarded. The researcher felt this might lead to less candid interviews, particularly as it may relate to negative aspects of the use of the I-CASE tool within a particular organization.

The opening comments of the interview covered the following areas:

(1) Appreciation for the interviewees time and participation.

(2) Confidentiality of responses, total number of people within firm being interviewed, total number of firms in study and the total number of people being interviewed.

(3) Availability of a copy of a summary of the results of the completed study if the interviewee desired.

(4) Explanation of the purpose of the study, to obtain a comparison of the individuals experiences on various systems development projects.

In addition to the field interview all of the subjects were requested to complete a twelve question survey instrument (Appendix D -- End-Users, Appendix E -- IS Personnel) and return it to the researcher. The survey instrument is based on the Doll and Torkzadeh end-user computing satisfaction instrument (Appendix J). The Doll and Torkzadeh instrument and its validity are discussed more fully in Chapter 3, the Literature Review chapter of this dissertation.

The Doll and Torkzadeh instrument was selected for this research as it is one of the few validated and tested instruments available designed to gather end-user computing satisfaction information concerning a specific system. The objective of this research is to obtain information concerning a specific comparison of systems developed with an I-CASE tool versus systems developed with the firms traditional systems development methods.

As a result of a review of the various instruments available, that are discussed more fully in Chapter Two the Literature Review section of this dissertation the Doll and Torkzadeh instrument was deemed the most appropriate for this research. The instruments measures five aspects of end-user computing satisfaction that are sub-components of the DeLone and McLean, IS Success model (Figure 3 pg. 40), which is the framework for this research.

Two modifications were made to the Doll and Torkzadeh instrument:

1. The original instrument contained a five point Lickert scale, where 1 = almost never; 2 = some of the time; 3 = about half of the time; 4 = most of the time; and 5 = almost always. Since this research involved a comparison of two systems development methods the

mid-point, 3 = about half the time was changed to 3 = no difference.

2. The questions were changed to ask for the subjects observations concerning a comparison of the results from the two development methods, rather than the subjects observations concerning a single system.

Compilation of Results

Upon completion of the field interviews the comments from each subject for each question were combined by firm and then combined for all of the firms for each question or subject area. While the interview instruments were designed to solicit an array of information the combined results were analyzed *in toto*, to obtain information on trends or the lack thereof concerning the specific propositions under investigation by this research, specifically:

1. Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?

2. If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in

increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

The Doll and Torkzadeh instrument information was obtained primarily as a method to verify and confirm/disconfirm the information obtained during the interview process, concerning the two major propositions investigated by this research. Additionally as the instrument measures five constructs of end-user computing satisfaction, the data was analyzed to determine how the use of the I-CASE tool versus the firms traditional systems development methods impacted each of the five constructs.

The next chapter in this dissertation contains an analysis and discussion of the results of this research. The final chapter contains conclusions and areas for future research.

CHAPTER 4

RESULTS

This chapter contains the results of the research to determine if end-users are more fully involved in the information systems development process utilizing an I-CASE tool versus other systems development projects in which they have been involved. Secondly, if this involvement resulted in an information system that was more responsive to the end-users needs and requirements in enabling them to meet the duties and responsibilities of their position. This chapter begins with a description of the sites included in the research followed by an analysis and discussion of the results for each site. The combined results and conclusions will be discussed in Chapter 5.

In order to provide anonymity to the participants each site has been randomly assigned a code of Company A, Company B, etc. Additionally, as two of the sites are governmental transportation departments, all of the discussion and analysis will utilize business related terminology that would be analogues to the related governmental terminology. Thus, further enhancing the anonymity of the sites, which was an understandable condition for the organizations' participation in this research.

The analysis and discussion for each site will focus on the two primary questions to be investigated by this research:

1. Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?
2. If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

The analysis required to respond to the first question posited by this research will rely on the subjects responses to the semi-structured field interviews conducted by the researcher. The analysis required to respond to the second question posited by this research will involve a combination of the semi-structured field interviews and the subjects responses to the adjusted D&T research instrument.

The analysis and discussion for each company will begin with the IS personnel's perceptions of end-user responses to their pre I-CASE tool experiences with the organizations information systems. These will be compared to the end-users responses concerning their pre I-CASE experiences and satisfaction with the firms information systems. The same sequence will be followed for the end-users experiences and satisfaction with the I-CASE tool process and results.

For each of the questions posited by the adjusted D&T instrument the mean and individual responses are shown, for the constructs the means are shown. As previously noted the purpose of utilizing the adjusted D&T instrument in this exploratory research is to secure additional confirmation/disconfirmation of the subjects responses to the in-depth field interviews.

As will be noted throughout the analysis and discussion to follow, the comments and results for all four of the firms included in the research are quite consistent as to both the IS personnel's and end-users statements and experiences pre I-CASE tool and their experiences and satisfaction with their I-CASE tool involvement.

SITE DESCRIPTIONS

This researcher would like to express his appreciation for all of the organizations and individuals within the organizations who participated in this research. The organizations for providing the time of their personnel to participate and the individuals for their cooperation and forthrightness in providing the information necessary to make this research possible.

Florida Department of Transportation: Tallahassee, FL

The Florida Department of Transportation with eleven thousand employees and an annual budget of over three billion dollars is responsible for the maintenance and

enhancement of the state's transportation infrastructure. It has primary responsibility for the maintenance and repair of the existing twelve thousand centerline and thirty-nine thousand lane miles of the state highway system, plus the five thousand six hundred bridges associated with the state maintained portion of the highway system. The department has maintenance, repair and storage facilities located throughout the state in seven operating districts.

(Source: Florida Department of Transportation -- Agency Overview: January, 1995
United States Department of Transpiration: 1994 -- Highway Statistics 1992)

Martin Marietta Energy Systems, Inc.: Oak Ridge, TN

Energy Systems represents a service response logistics organization in that it does not deal with the tangible products traditionally associated with logistics operations. Rather it is responsible for the coordination, gathering, analysis and dissemination of information for the various contracts that are its responsibility. It is the managing contractor for the United States Department of Energy research, development and environmental management operations. Energy Systems is a wholly-owned subsidiary of Martin Marietta Corp. which had over nine billion dollars of revenue in 1993 and over fifty-five thousand employees of which Energy Systems had over twenty thousand.
(Source: Martin Marietta Corp. December 31, 1993, SEC 10K Annual Report)

Missouri Highway and Transportation Department: Jefferson City, MO

The Missouri Highway and Transportation Department with over six thousand employees has a budget of almost one billion dollars per year and is responsible for the maintenance and enhancement of the state's transportation infrastructure. It has primary responsibility for the maintenance and repair of the existing thirty-two thousand centerline and seventy-one thousand lane miles of the state highway system, plus the nine thousand seven hundred bridges associated with the highway system. The department has maintenance, repair and storage facilities located throughout the state in the ten operating areas.

(Source: Missouri Highway and Transportation Department Fast Facts
United States Department of Transportation: 1994 -- Highway Statistics 1992)

Publix Super Markets, Inc.: Lakeland, FL

Publix operates a chain of over four hundred and twenty-five retail grocery stores, located primarily in Florida, and has annual revenues of approximately eight billion dollars and eighty-two thousand employees. Publix has a classic logistics operation in that it acquires, manufactures, stores, handles and distributes the products sold in its retail stores utilizing the firms own fleet of tractor trailers in addition to commercial transportation firms. Publix has seven strategically located distribution centers in its market areas in addition to assorted manufacturing facilities.

(Source: Publix Super Markets, Inc. December 25, 1993, SEC 10K Annual Report)

COMPANY A RESULTS -- ANALYSIS & DISCUSSION

Company A has had the I-CASE tool since mid-1992 and after some early successful pilot projects, commenced a complete business analysis to define the critical aspects of their operations and prioritize their systems development efforts. Upon prioritization of the projects, development was begun and continues on fundamental and critical operational information systems of the business. While these systems have not yet become operational, end-user participation has been substantially completed in the process except for systems testing and modification.

The IS subjects interviewed had between three and seven years with the firm, two were programmer/analysts, one was a mid-level manager and one was a senior level manager. The end-user subjects had between four and twenty years with the firm, two were mid-level managers and two were supervisors.

Pre I-CASE Systems Development and Satisfaction

IS PERSONNEL -- This organization utilized the traditional life cycle development method for information systems development. Whether a new system was being developed or enhancements or modifications were required on existing systems, the extent of end-user involvement was at the minimal level required by IS to secure the

basic information necessary to be able to meet the end-users request. (This was also the case at the other firms included in this research, as it was the case in the research conducted by others that was reviewed in the preceding chapters of this dissertation.)

IS would generally conduct individual interviews with the end-user to secure clarification on the system or changes that were required. In many cases where major changes or new systems were required, this led to confusion in IS as different end-users at different levels within the organization had varying requirements. The typical reaction to this by IS was to discuss among themselves the track to follow without securing clarification or consensus from the affected end-user community.

The consequence of lack of end-user involvement was a lack of satisfaction with the delivered systems. In addition to the problems associated with systems enhancements, there was a lack of satisfaction in general perceived by IS among the end-user community. IS attributed this to the fact most of the systems were mainframe based legacy systems that were installed over a number of years and required a significant amount of manual data manipulation by the end-users in order to accomplish their duties and responsibilities.

END-USERS -- For this organization (as well as the others included in this research) IS personnel generally have the correct perceptions of the end-users experiences and satisfaction or lack thereof with the pre I-CASE information systems within the firm.

The end-users felt the systems were not responsive to their needs, with the most pervasive complaint by all of the end-users interviewed being the significant amounts of

manual data manipulation required in order to accomplish their duties and responsibilities. As a result of that complaint and the backlog of information systems requirements in the IS department, many of the end-user departments began to acquire and develop their own PC based systems. This resulted in additional difficulties as data and the resulting information in the different departments became inconsistent as PC based systems proliferated within the end-user community.

I-CASE Systems Development and Satisfaction

IS PERSONNEL -- The initial IS perception of the end-users attitude was that the end-users were not interested in participating in the information systems development effort utilizing the I-CASE tool as the end-users did not want to commit the time that would be required to the development effort. IS felt this resulted in large part from the fact end-users had been involved in many major task forces in the past that were to rectify the information systems problems of the firm. However, after much analysis, discussion, time and effort, there were no resulting systems improvements visible to the end-users. The attitude perceived by IS of the end-users was that they had been down this path before and did not have the inclination to travel it again.

As the development efforts progressed, IS personnel perceived a change in the attitude of the end-users from, "I really don't have time for this," to a feeling that the process was useful, well organized and would result in an information system that would meet the end-users requirements. Additionally, IS perceived a change in the attitude of

systems ownership among the participants from a sense that information systems belonged to IS to a sense that the systems belonged to the end-users. IS felt this manifestation from a number of factors:

(1) a change in end-user enthusiasm for participation in the process,

(2) end-user participation in presentations to management and supervisory groups on the development efforts changed in that end-users would take the lead in responding to concerns about the time involvement of the participants,

(3) the increased level of end-user expectations as to the completed systems ability to meet their needs, and

(4) the participation by end-user departments in the cost justification efforts by IS to continue the process.

The development process itself involved two major changes for the end-users and IS from previous systems development efforts. (1) The end-users were more completely involved in the entire development effort. (2) Additionally, information gathering changed from individual meetings with end-users to scheduled project team meetings. The project teams included a facilitator, and generally three IS and three end-user participants for each project team with the participants selected based on their knowledge of and daily use of the information systems process under development.

For this firm the end-users participated in a three day orientation prior to commencement of the project. IS felt the end-users believed the amount and content of the training were adequate to meet end-user needs to participate effectively and efficiently in the process.

Other points raised by IS concerning the development effort were that IS became more aware of the firms business requirements as a result of the process forced by the I-CASE tool. Also, end-users were forced to communicate among themselves more completely than in past systems development efforts as the individual IS/end-user meetings of the past gave way to project team meetings. In addition to the systems development benefits, the process reduced the confusion and ambiguity IS dealt with in the past as the end-user community was forced to come to consensus on requirements before the project could continue, which resulted from the structure forced by the I-CASE tool.

END-USERS -- IS personnel were generally correct in their assessment of the end-users reactions to the development process and their expectations for the resulting systems, except IS personnel underestimated the end-users enthusiasm for the process and their expectations for the resulting systems.

The initial end-user response to the idea of a major systems development project was that it would be another waste of time and effort. However, as they became engaged in the process, the end-user attitude changed to that of being proponents of the process and having high expectations for the information systems that would result from the development effort.

The major complaint of the end-user participants was the manner in which the individual projects were set as to scope and development time requirements. The end-user participants attributed this to the fact that the initial systems reviews and

specifications were set by individuals who had upper level responsibilities in the organization. Consequently, the upper level personnel were not familiar enough with the details of the end-user participants responsibilities and the amount of data gathering and manual data manipulation required to secure information upon which to make decisions. End-users additionally attributed the initial scope and time estimate problems to the consideration of just the mainframe based reporting and information systems. Cognizance was not taken of the PC based applications that had proliferated in the different departments over the years as a result of the systems requirements backlogs in the IS department.

During the course of the interviews with the end-users, all were extremely enthusiastic about the process and have high expectations for the systems that they believe will evolve from the I-CASE development process. All of the end-users expressed a great deal of satisfaction with the process and most explicitly stated they felt it was time well spent. The groups met each afternoon four days per week for a period of three to six months, depending on the project they were involved with. The facilitator was given a significant amount of credit by the end-users for the profitable use of the groups time.

The end-users felt the technique was well structured and organized to secure the information that was necessary to develop information systems that would meet their needs and requirements. The new systems would eliminate all of the manual data manipulation that had been required in the past in order to secure information for decision making. In addition to the benefit to be gained from the systems to be developed, the

end-users also felt participation in the development process provided them a better understanding of their particular business area and the relationships and inter-relationships with the other business areas in the firm.

The end-users expectations for the systems are extremely high and most expressed the feeling that if the systems do not perform as expected it will be due to the fact they did not do their job of development properly. They have explicitly assumed ownership of the systems and have accepted the onus of responsibility if the systems do not perform as they expect. A constant theme among the end-user participants was that if they had done their jobs the systems would perform. This is in marked contrast to the existing information systems in the firm, where the end-user feeling is one of indifference, "The systems are just there."

During the development process the end-user participants would update the remaining end-users on the progress of the project and solicit feedback to enhance the development effort. The consensus among the end-user participants is that the remaining end-users are generally waiting to see the systems operational before they buy into the ownership concept of the systems belonging to the end-users as opposed to the systems just being there or belonging to IS.

The IS personnel were also correct in their assessment of the end-users reaction to the three day orientation on the I-CASE tool and the process in which they would participate. The end-users felt the three day orientation gave them the information they needed to perform in the project and they could probably not handle any more information than what they received in the orientation. It took anywhere from two weeks

to a month for the end-users to feel comfortable with the process and the terminology. Except for one group that had two facilitator changes in the first two months of the process, the comfort level took longer to achieve in that group.

SYSTEMS DEVELOPMENT COMPARISON
END-USER COMPUTING SATISFACTION SURVEY RESULTS

ACCURACY:

4(A1). Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.25 4.50

IS 5 4 5 4 EU 4 3 5 5

2(A2). Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.25 4.50

IS 4 4 5 4 EU 5 4 4 5

Accuracy Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^ IS & EU
4.375

CONTENT:

11(C1). Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.50 4.75

IS 4 4 5 5 EU 5 4 5 5

12(C2). Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.50 4.75

IS 4 4 5 5 EU 5 4 5 5

8(C3). Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS & EU
4.75

IS 5 4 5 5 EU 5 4 5 5

5(C4). Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.50 4.75

IS 5 4 5 5 EU 5 4 4 5

Content Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.63 4.69

EASE OF USE:

10(E1). Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.50 4.75

IS 5 5 5 4 EU 4 4 5 5

9(E2). Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.50 4.75

IS 5 5 5 4 EU 4 4 5 5

Ease of Use Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.50 4.75

FORMAT:

1 (F1). Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.25 4.50

IS 4 4 5 4 EU 4 4 5 5

3(F2). Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.75 5.0

IS 4 5 5 5 EU 5 5 5 5

Format Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.50 4.75

TIMELINESS:

7(T1). Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.50 4.75

IS 5 5 5 4 EU 4 4 5 5

6(T2). Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS & EU
4.75

IS 5 5 5 4 EU 5 4 5 5

Timeliness Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
4.63 4.75

SUMMARY: COMPANY A

For the first question posited by this research:

Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?

For Company A we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses, that the use of the I-CASE tool did result in increased end-user participation in the information systems development process.

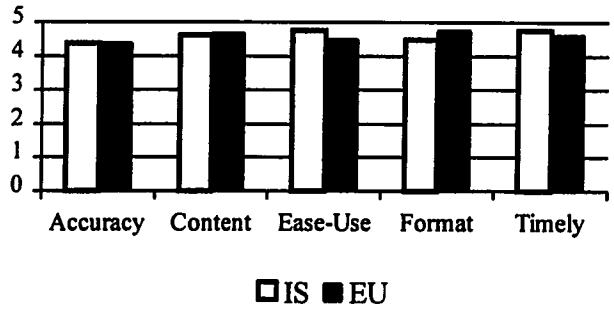
For the second question posited by this research:

> If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

For Company A we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument, that the end-users have high expectations for satisfaction with the information systems to result from the systems development effort with the I-CASE tool.

As can be seen on the adjusted D&T instrument, end-user responses are at the upper end of the five point Lickert scale for each construct. Thereby, demonstrating their high expectations for the information systems that should result from their efforts compared to the previous systems they utilized in the accomplishment of their duties and responsibilities. The following graph also demonstrates the high level of end-user

satisfaction for each of the constructs and shows the relative accuracy of the IS personnel's perceptions of end-user satisfaction.



Other major points brought out in the interviews at Company A were:

(1) Initial Skepticism -- The initial skepticism and reluctance of end-users to participate in the I-CASE development process due to their previous disappointments with the lack of results from major systems development efforts, was quickly overcome. End-user became enthusiastic participants in the development process and felt the investment of their time would be rewarded with information systems that met their requirements.

(2) Systems Ownership -- The perception of systems ownership changed dramatically among the end-user participants in that the systems were acknowledged as being the end-users. This is in marked contrast to the previous perceptions of systems ownership in that the systems were tolerated or perceived as just being there. The changed attitude towards systems ownership has resulted in the realization and acknowledgment that if the information systems did not meet their expectations, it would be the end-user participants responsibility and not the responsibility of IS.

(3) Initial Estimation Difficulties -- The end-user participants felt the initial scoping of their projects was underestimated due to the failure to include those with an in-depth knowledge of the business operations early enough in the process. This led to a compounding of the underestimate by the failure to consider the proliferation of PC based systems that had evolved over time. This combination of underestimates resulted in expansions of the areas each project was concerned with, which resulted in increased time requirements.

(4) Increased Business Area Understanding -- As a result of their in-depth participation in the systems development process the end-user participants have a greater understanding of their business areas and the relationships and inter-relationships with the other business areas of the firm. They felt this was a significant unexpected benefit of their participation.

COMPANY B RESULTS -- ANALYSIS & DISCUSSION

Company B has had the I-CASE tool since early 1990 and completed its first major system in mid-1993 and continues development with the tool on major business systems for the firm. However, for all of the subjects at this site, a constant theme was the fact they felt the initial major system was brought up too quickly. In their opinion, both IS and end-users, the problem was caused by an initial underestimate of the complexity and number of interfaces involved with the first major system developed with the I-CASE tool. After the initial high level analysis of the business areas for the

organization, one business area was selected for further analysis as it was deemed to provide the most initial benefit for a rapid return on the firms investment in the I-CASE tool. One moderately complex area was selected for the initial development effort with the I-CASE tool, as it was felt the moderate complexity of the area would provide an effective learning experience to apply towards the more complex systems efforts to follow. It was felt that a very simple project would not provide the experiences that would be required for the subsequent complex projects.

The initial estimate for this project was six months, however, it was still not completed after two years of concentrated effort by both end-users and IS personnel. As a result of organizational requirements, the systems was made operational prior to inclusion and testing of all of the development teams specifications. Both the IS and end-user participants were opposed to the premature implementation, however, due to organizational exigencies forced by corporate management the systems were implemented prior to completion and implementation of all specifications.

The underestimate occurred for a number of reasons, however, the most significant was the number of interfaces required to other systems that were not initially understood. The systems in the business area selected had evolved over the years as organizational requirements changed with new linkages among and between the systems put in place over the entire lifetime of the systems.

Additionally, IS personnel did not have an adequate knowledge base of the underlying business area requirements when they performed their initial evaluations. This may be due in large part to the fact virtually all of the staff time of IS was devoted to

maintenance of the existing legacy systems. As a result it was not a requirement that IS personnel have an in-depth cross functional knowledge of the business area only that they understood enough to correct the systems problems as they arose. As will be pointed out in the analysis and discussion to follow, IS personnel found one of the main benefits of the interactions involved with the end-users during the development project to be their increased understanding of the business area requirements and operations. IS personnel indicated that the underlying business area knowledge gained on this project will be of significant benefit on the future development efforts they undertake.

The early implementation of the system led to much dissatisfaction among the end-users that participated in the development effort. However, the universal feeling among the end-users was that as soon as the continued effort on the remainder of the specifications were completed, the system would be of significant benefit in the accomplishment of their duties and responsibilities.

The IS subjects interviewed had between three and seventeen years with the firm, one was a programmer/analysts, one was a supervisor and two were mid-level managers. The end-user subjects had between one and twenty-two years with the firm, two were senior level clerical employees and two were supervisors.

Pre I-CASE Systems Development and Satisfaction

IS PERSONNEL -- The general consensus among IS personnel was that

end-users were not happy with the existing systems as end-users perceived the existing systems as being "shoved down their throats." Or, that the systems were tolerated as the end-users did not feel they could affect the existing systems one way or the other. End-users were required to perform a significant degree of manual data manipulation from various systems in order to convert the data from the systems to the information they required to accomplish their duties.

For changes or enhancements to the existing systems a block of time was allocated by IS on an annual basis for each of the major systems. Time estimates for the requests from end-users for changes or enhancements to the systems would be prepared by IS. Based on this budget developed by IS, the end-users would then prioritize the changes to ensure the most critical were at the front of the queue. During the change process contact from IS with the end-user would be minimal except for clarifications that might be required by IS.

END-USERS -- The major concern of the end-users was the significant amount of manual intervention and manipulation required to secure data from a number of systems before they could begin to convert the data to the information they require to effectively perform their duties and responsibilities. The general attitude of the end-users was a tolerance for the existing systems as they did not believe they could influence the existing systems situation. However, the end-users did express satisfaction with the contacts made by IS when end-users did request systems changes during the annual time allotment.

I-CASE Systems Development and Satisfaction

IS PERSONNEL -- IS personnel are quite cognizant of the problems encountered with their first major systems development effort with the I-CASE tool and the lack of satisfaction to date of the end-users with the system as implemented. IS does believe that the lessons learned on the effort and the increased knowledge of business systems gained will ensure that, in the future, major systems development efforts will progress more expeditiously. IS expects the result will be increased levels of end-user satisfaction with the information systems that will be developed.

IS personnel indicated the level of end-user involvement in the I-CASE systems development process was more significant than any system development efforts they had been involved with in the past. The level of end-user participation was high during all stages of the development effort except the coding stage. As a result of the two groups high level of interaction during the development effort, IS believes both groups have a better appreciation for the problems and constraints both must function within. IS also believes the end-users were pleased with the process, but are unsure of the end-users level of satisfaction with the end product of the development effort due to the premature implementation.

END-USERS -- IS personnel were once again generally accurate in their perceptions of the end-users reactions to the process and resulting information system. As previously mentioned, the overriding comment by the end-users was the premature

implementation of the system. Although they could understand the pressure IS was under to implement the system, they felt the early implementation demonstrated a lack of appreciation for the time and effort they had invested in the development process. All of the end-users attributed the problems encountered in the process to the lack of adequate front-end understanding of the complexities involved with their business area and the significant amount of manual data manipulation and intervention necessary to change the data to information to accomplish their duties and responsibilities.

All of the end-users indicated they were more involved in the development and decision making on the systems requirements and definition for this major system than any in their past experience with the firm and that the process was very useful in achieving their systems objectives. They indicated that the system still leaves a lot to be desired due to the early implementation but that it is a significant improvement over the systems it replaces. More information is available on line and the amount of manual data manipulation and intervention required have decreased significantly as a result of the new systems implementation. However, the new system does not meet the expectations that had been built during the end-users participation in the I-CASE systems development process.

For this firm the end-users were given no initial training or orientation on the I-CASE tool. They became aware of the tool from comments made by IS personnel during the early stages of the development process. All felt some training or orientation would have been helpful before beginning the project.

SYSTEMS DEVELOPMENT COMPARISON
END-USER COMPUTING SATISFACTION SURVEY RESULTS

ACCURACY:

4(A1). Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
1.66 2.5
IS - 3 - 2 EU 2 2 1 -

2(A2). Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
1.5 2.33
IS 2 3 - 2 EU 2 2 1 1

Accuracy Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
1.57 2.4

CONTENT:

11(C1). Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU 2.0 IS 2 3 - 4

^IS 3.0 EU 4 2 1 1

12(C2). Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU 2.33 IS 2 4 - 4

^IS 3.33 EU 4 2 1 -

8(C3). Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU 1.25 ^IS 2.0 IS 1 3 - 2 EU 2 1 1 1

5(C4). Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU 2.0 IS 2 3 - 4

^IS 3.0 EU 4 1 1 2

Content Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU 1.87 ^IS 2.83

EASE OF USE:

10(E1). Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
2.75 3.33
IS 4 4 - 2 EU 4 2 3 2

9(E2). Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
2.67 2.75
IS 2 4 - 2 EU 4 3 2 2

Ease of Use Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
2.75 3.0

FORMAT:

1 (F1). Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
2.0 2.75
IS 2 2 - 2 EU 3 4 3 1

3(F2). Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
2.25 2.66
IS 2 4 - 2 EU 4 2 1 2

Format Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
2.33 2.5

TIMELINESS:

7(T1). Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
2.67 2.75

IS 2 4 - 2 EU 2 4 3 2

6(T2). Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
2.75 3.66

IS 4 3 - 4 EU 4 2 3 2

Timeliness Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
2.75 3.17

SUMMARY: COMPANY B

For the first question posited by this research:

Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?

For Company B we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses, that the use of the I-CASE tool did result in increased end-user participation in the information systems development process.

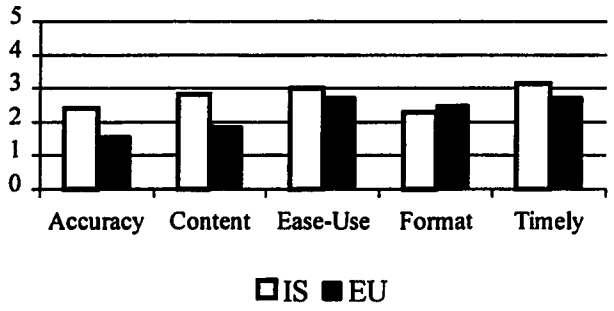
For the second question posited by this research:

If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

For Company B we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument, that the end-users do not have an increased level of satisfaction with the system, as it exists today, developed with the I-CASE tool. However, the comments of the end-user group indicated that they expect the system, when completed, to meet all of their needs and requirements.

For each construct examined in the adjusted D&T instrument the end-user responses demonstrate their lack of satisfaction with the information system as it exists. However, as previously noted the end-users have high expectations for the system when all of their specifications are incorporated. On the five point Lickert scale the end-users

responses for each construct are at the lower end of the scale. The following graph demonstrates the low level of end-user satisfaction for each of the constructs and shows the relative accuracy of the IS personnel's perceptions of the end-users lack of satisfaction with the information system developed with the I-CASE tool.



Other major points brought out in the interviews at Company B were:

(1) Early Implementation -- As previously note the most salient point permeating the interviews at Company B, from both the IS and end-user participants, was the premature systems implementation. During the interviews end-users expressed confidence that when all of the specifications that had been identified during the development process with the I-CASE tool had been implemented the system would provide accurate, timely and useful information. Their comments also indicated that the system developed with the I-CASE tool was an improvement over the existing systems. However, the early implementation significantly colored the end-users perceptions of the information systems success as evidenced by the end-users responses to the adjusted D&T instrument questions.

(2) Initial Skepticism -- As with the other firms included in this research, the initial skepticism of the end-users for participation in the project was replaced with enthusiasm and an expectation that their involvement would result in an information systems that met their requirements. However, in this instance the empowerment experienced by the end-users during the project was replaced by their perception of disempowerment with the forced early implementation of the information system.

(3) Increased IS Business Area Knowledge -- IS perceived as one of the major benefits of the process their increased level of knowledge of the underlying business systems. The IS participants believed that the major source of the problems encountered by the project was their lack of knowledge of the underlying business systems in the departments. The IS participants believe that the knowledge gained will facilitate and enhance the development efforts of the other major business systems to be undertaken.

COMPANY C RESULTS -- ANALYSIS & DISCUSSION

Company C has had the I-CASE tool since early 1991 and has completed a number of major systems development projects with the tool since completion of their initial pilot projects. The major systems have become operational and are critical components of the firms information infrastructure. An experienced upper level IS manager of the firm, who was not a subject of the detail interviews, stated that he did not believe the firm could have developed the major systems they did, in the time taken, without the use of the I-CASE tool.

The IS subjects interviewed had between three and six years with the firm, all were systems analysts. The end-user subjects had between seven and fourteen years with the firm, three were mid-level managers and one was a supervisor.

Pre I-CASE Systems Development and Satisfaction

IS PERSONNEL -- Company C's IS department was organized by functional teams with responsibility for particular business areas and its related information systems. When an end-user required assistance from IS, they would contact the appropriate team leader to secure the necessary assistance. Depending on the extent of the request a telephone call or e-mail message might suffice, or for more extensive requirements, a formal request would have to be submitted that would go through the firms approval and prioritization process. If a project was approved, the inclination of IS was to develop a solution from the information on the request document and discuss problems among themselves. There would be little end-user contact until the change had been made and testing and acceptance were required of the end-user.

Due to the assignment of IS personnel to specific business areas and the rotation of end-user personnel through IS on a temporary basis, the lack of contact with end-users by IS in solutions development was somewhat mitigated for most of the assistance requested by end-users. IS felt the end-users were generally satisfied with the results returned from systems change requests.

The general feeling of IS concerning end-user satisfaction with the existing systems was one of acceptance by the end-users. End-users lived with what they had because they didn't have much choice due to the systems request backlog. However, for mid and upper level managers, there was much dissatisfaction with the existing information systems fixed structures. The fixed structure limited the managers options in responding to changing business requirements. However, with a great deal of manual data manipulation and work-arounds the managers would be able secure the necessary information. Although, this was viewed as a tedious and time consuming process.

END-USERS -- IS's perceptions of the end-users feelings are again correct. End-users have a tolerant and accepting attitude towards the existing systems, i.e., they are just there. End-users had little contact with IS as most of the communications were written. There were brief verbal contacts from IS if clarification of a request was required. However, contact from IS generally did not occur until final testing and acceptance of a modification were required of the end-user.

I-CASE Systems Development and Satisfaction

IS PERSONNEL -- As a result of the I-CASE tool systems development process, IS believes both the end-users and IS have a greater appreciation and understanding of each others areas of responsibility and the problems and constraints each group must function within. From the IS perspective this has lead to a greater understanding among

the end-users of the time required by IS to make various types of systems changes. As a result of this understanding, end-users are in a better position to adjust their priorities based on the assets available to undertake systems changes or enhancements.

IS personnel noted that end-user involvement had significantly increased at all stages of the systems development process utilizing the I-CASE tool with the exception of the coding stage. This is in marked contrast to the previous development methods. As indicated, IS personnel view the increased end-user involvement as positive and a benefit to both groups.

A major component of the changed involvement is the early and intense participation of all levels of end-users in the development process. This gives the clerical level end-users an opportunity to have an influence on the portions of the systems that will affect their ability to effectively and efficiently perform their duties and responsibilities. This participation by the clerical level end-user was a rarity in past systems development efforts.

Another major benefit of the I-CASE tool perceived by IS for end-users is the ability to develop test systems that allow the end-users to preview and modify the system, as it exists, at virtually any point in the development effort. The interaction with the test system allows end-users to clarify their thinking regarding the system and make any modifications that are necessary. Previously, testing of systems was not possible until development had been completed by IS, which was generally not conducive to after-the-fact changes by end-users.

IS felt end-users were initially resistant to participation in the systems development effort with the I-CASE tool due to the time commitment required. However, as with the other firms included in this research, the initial end-user hesitance was seen to change by IS as the project progressed, with the process and resulting systems receiving full end-user support.

As a result of the use of the I-CASE tool and the associated process, the IS mind set has undergone a change to viewing the end-users as customers to be served rather than a group to be tolerated. IS believes the end-user mind set has also changed to viewing the systems as theirs, rather than as IS's systems.

As a result of the flexibility available with the new systems, IS feels the mid and upper level manager are very pleased with the information systems that have resulted from the development process. Management is able to be more proactive in meeting changing business requirements without all of the manual work-arounds and manipulation that may have been required in the past. However, IS believes this flexibility has resulted in decreased satisfaction among the clerical level end-users. This is due to the fact clerical level end-users are also required to be more flexible and adaptive to changing requirements as opposed to the routines of the previous fixed structure systems.

END-USERS -- As with the previous firms included in this research IS underestimated the end-users level of satisfaction with the process and the resulting information systems. End-users did participate more completely throughout the systems

development process with heavy front end involvement by all levels of end-users. This led to the view among the participants that they received the system they wanted and not the system IS thought they needed. The level and degree of involvement were significantly higher for the I-CASE systems project than for any other systems project the end-users had been involved with in the past.

The end-users indicated that IS went to extraordinary lengths compared to previous development efforts to understand the business processes that would be affected by the systems under development. These extraordinary lengths included time spent with end-users as they performed their duties and responsibilities and working with the various user groups to ensure that screens were understandable and easy to follow. One of the major benefits noted by clerical end-users was the consistency of screens between systems which had not been the case in the past. Previously, when moving between systems, formats and response keys would vary which could cause unnecessary problems for the clerical end-users.

While both end-users and IS personnel felt end-user involvement had increased, IS personnel viewed the involvement as more continuous after the projects completion and implementation, compared to the end-users perception of decreased involvement with IS. A possible explanation for this divergence of views is the fact that end-users typically have one contact in IS they dealt with after implementation. An end-user would only contact that individual when a question or problem arises. Conversely, an IS staff member would have a number of end-users contacting them with questions or problems resulting in more total contacts for an individual in IS as opposed to an individual end-

user. Consequently, the perception in IS is of more continuous involvement with end-users after a systems implementation.

The level of end-user satisfaction with the information systems is also higher than estimated by IS. End-users find the systems flexible and responsive to their needs with much of the paperwork and manual manipulation previously required to make the systems work having been eliminated. This has resulted in the ability to utilize data that had been previously available, but unusable, without significant manual intervention for decision making purposes.

As a result of the development process, end-users have more of an understanding of how their segment of the business relates to the other business areas of the firm and are more cognizant of the need for the totality of information in the system, even if not required by their business area. End-users also feel more of a sense of systems ownership as a result of the development process. This enhanced sense of systems ownership was also attributed to the fact the systems were developed and designed by the end-users to meet their business requirements for flexible responsive information systems.

All of the end-users received a two to three day orientation on the I-CASE tool and the process that would be followed during the systems development effort. The end-users found the training useful and felt they would not have been as effective early in the development process without the training.

SYSTEMS DEVELOPMENT COMPARISON
END-USER COMPUTING SATISFACTION SURVEY RESULTS

ACCURACY:

4(A1). Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
2.75	3.50
IS 3 3 2 3	EU 5 3 3 3

2(A2). Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
2.50	3.25
IS 3 3 2 2	EU 4 3 3 3

Accuracy Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
2.63	3.38

CONTENT:

11(C1). Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	3.0	4.25
IS 4 3 1 4	EU 5 3 4 5	

12(C2). Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^EU	^IS
	3.75	4.50
IS 5 4 5 4	EU 4 3 4 4	

8(C3). Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	3.25	4.00
IS 4 4 2 3	EU 4 3 4 5	

5(C4). Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	3.75	4.50
IS 5 4 2 4	EU 4 5 5 4	

Content Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
3.63	4.13

EASE OF USE:

10(E1). Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 2.50

IS 3 3 1 3

^EU 4.25

EU 5 4 3 5

9(E2). Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 2.00

IS 2 3 1 2

^EU 4.25

EU 5 4 3 5

Ease of Use Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 2.25

^EU 4.25

FORMAT:

1 (F1). Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 2.75 ^EU 4.75

IS 2 4 2 3 EU 5 5 4 5

3(F2). Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 3.25 ^EU 3.75

IS 4 3 2 4 EU 4 4 4 3

Format Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS 3.00 ^EU 4.25

TIMELINESS:

7(T1). Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.50 3.75

IS 4 4 2 4 EU 4 3 5 3

6(T2). Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.75 4.50

IS 5 4 2 4 EU 5 3 5 5

Timeliness Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.63 4.13

SUMMARY: COMPANY C

For the first question posited by this research:

Does the use of an I-CASE tool in information systems development result in increased levels of end-user involvement in the information systems development process?

For Company C we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses, that the use of the I-CASE tool did result in increased end-user participation in the information systems development process.

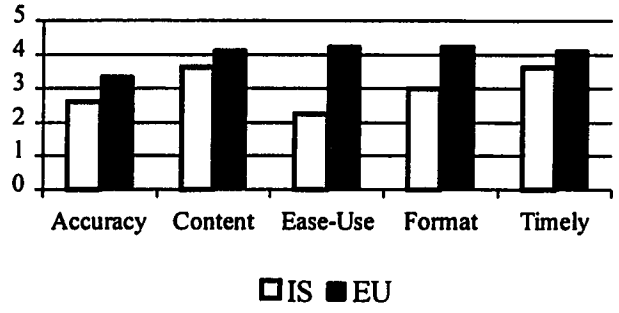
For the second question posited by this research:

> If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

For Company C we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument that the end-users have a high level of satisfaction with the information systems resulting from their systems development effort with the I-CASE tool.

For each construct measured by the adjusted D&T instrument, the end-user responses demonstrate their high level of satisfaction with the information systems resulting from their development efforts compared to the previous systems they utilized in the accomplishment of their duties and responsibilities. On the five point Lickert scale the end-users responses for each construct are at the upper end of the scale. The graph

below also demonstrates the level of end-user satisfaction for each of the constructs and shows that IS tended to underestimate the end-users level of satisfaction.



Other major points brought out in the interviews at Company C were:

(1) IS/EU Understanding -- Both the IS and end-users report that as a result of the information systems development process with the I-CASE tool and the extensive interactions required there is a greater appreciation and understanding of the responsibilities, problems and constraints each must function within.

(2) Interim Testing -- The end-users found the ability to test and modify the system during the early stages of the development effort to be a major benefit. This ability allowed them to clarify and enhance the systems results to an extent that had not been possible in the past.

(3) End-User Customers -- The IS mind set has changed as a result of the increased end-user involvement in the development process to one that views the end-users as customers with the end-users as owners the systems. This is a major change from the past when end-users were basically tolerated.

(4) Systems Ownership -- End-users have embraced the feeling of systems ownership and now believe they receive the systems they want and design, not the systems IS thinks they need.

(5) Business Systems -- As a result of the interactions involved with the systems development effort between and among the different end-user groups and IS all have a better sense of the total business systems requirements, not just their segment of the whole.

COMPANY D RESULTS -- ANALYSIS & DISCUSSION

Company D has had the I-CASE tool since early 1992 and has completed a number of major systems development projects with the tool since completion of its initial pilot projects. These systems have become operational and are critical components of the firms information infrastructure.

The IS subjects interviewed had between five and seventeen years with the firm, three were lead analysts and one was a mid-level manager. The end-user subjects had between ten and twenty-seven years with the firm, one was a mid-level manager, one was a supervisor and two were technical experts.

Pre I-CASE Systems Development and Satisfaction

IS PERSONNEL -- IS personnel had the same perceptions of end-users involvement and satisfaction with existing information systems as at the other firms included in this research. End-users were thought to be generally accepting of the existing systems as they felt they did not have much of an opportunity to influence the existing systems as there was a significant backlog of requests in the development queue. If an end-user request did arrive at the beginning of the queue and the end-user still desired the change, after some initial clarification by IS on the request, the end-user would probably not have contact with IS until the change was made and testing and acceptance were required. If IS did require clarification on some aspect of the request, they would conduct individual interviews rather than conduct group meeting with all of the affected parties. This at times resulted in varying specifications in which IS would generally make the decisions, rather than securing end-user confirmation of the IS interpretation of the varying requests.

END-USERS -- End-users did not have the tolerant, accepting attitude towards the existing information systems as perceived by IS. Rather, end-users were dissatisfied with the existing information systems and felt they required inordinate amounts of manual intervention and manipulation in order to secure information upon which to make informed decisions. Also, due to the inflexibility of the mainframe based systems, end-

users developed many PC based applications upon which to manipulate data to meet their information requirements.

Additionally, end-users were dissatisfied due to the lack of consistency between the various mainframe based systems which were developed over time by different individuals -- each with their own idiosyncrasies. The end-user perception of their involvement in systems development or enhancement efforts was of a minimal investment of time, but this could vary depending on the complexity of the particular project.

I-CASE Systems Development and Satisfaction

IS PERSONNEL -- IS perceived a significant change in end-users feelings of systems ownership after the I-CASE development effort to one where the end-user participants and the end-user departments no longer view the systems as belonging to IS, but viewed the system as theirs. According to IS, the manifestations of the changed attitude were:

(1) comments by the end-users in which they refer to the systems as "their" system,

(2) statements by end-users who did not participate in the development process referring to the system by the name of the end-user developers,

(3) the lead taken by end-user participants in presentations to management and other end-users as to development progress and feedback solicitation, and

(4) the proprietary attitude of end-user participants to criticism of the system by other end-users.

Systems development utilizing the I-CASE tool involved group participation by all of the business areas affected by particular systems with a primary end-user being assigned to head the development team. This is in marked contrast to the previous methods where end-user participation and involvement would be minimal and be conducted on an individual basis when required. IS views the participation and involvement as positive for both groups with each having a more complete understanding of the duties and responsibilities of the other, which permits more effective completion of the project requirements. As a result of the understanding gained by each group, IS has a more complete concept of the business requirements and the end-users have a knowledge of systems development procedures that they did not possess in the past. This knowledge and understanding of the other groups processes and procedures results in more effective communications thereby facilitating the development process and subsequent modifications that may be required.

IS believes the end-users find as major benefits of the I-CASE tool the visuals (entity relationship diagrams, entity hierarchy diagrams, process hierarchy diagrams, etc.) utilized by the tool in the development process as well as the prototyping that can be performed at virtually any stage of the process thereby allowing the end-users to take a "test ride" on the system and make changes and modifications as the process progresses. This ability to take a "test ride," plus the early in-depth participation by the end-users,

sets up an effective cooperative atmosphere that lasts through the development effort and results in a more complete system that requires little modification after implementation.

END-USERS -- These end-users found the visuals and the prototyping capabilities provided by the I-CASE tool as particularly useful in their development efforts. The ability to see and adjust the various entity, data and process relationships enabled the end-users to adjust their requirements to the way they thought things should be, rather than the way they were. Additionally, the prototyping capability was seen to be significant as changes and modifications could be easily incorporated into their requirements at virtually any stage of the development effort. This was seen as critical, as in the past, specifications were locked in at the beginning of the development process and end-users did not see the system until it was completed by IS at which time changes and modifications were virtually impossible to incorporate in the system.

There was some initial reluctance by end-users to commit the time required on the project, as was the case at the other firms that participated in this research. As with the other firms, the end-users perceptions and satisfaction with the process improved as the development effort continued and the end-users could see they were going to receive the systems they needed and desired. The end-users stated their attitudes changed early in the process as a result of the prototypes that were available, allowing them to secure a better perception of the system that had been developed to that point, and to see the modifications they required incorporated into the system on a timely basis. This was seen by the end-users as a dramatic change in IS attitudes from past efforts in which IS was

reluctant to make changes, to an IS attitude of providing the end-users with just about anything they wanted as long as the end-users could decide among themselves what exactly they did desire.

The end-user developers felt a definite sense of systems ownership, but did not perceive this sense of ownership as pervasive among others within their departments. The end-user developers believe that as the departments become more familiar with the systems and realize that most of the manual manipulation and paperwork have disappeared that the remainder of the department will develop the sense of systems ownership. The end-user participants found the initial skepticism of their co-workers perplexing since, in their opinion, they had kept their co-workers up to date and continuously sought feedback during the development process.

The end-user participants are pleased with the data and information that are readily available from the systems that have been developed. They view the systems as more user friendly, as systems they developed and believe they are receiving from the systems, what they put into the development effort, not a black box computer nightmare that was thrust upon them.

The end-users at this firm received training on the I-CASE tool and the development process after they were well into the effort. There were mixed views among the end-users as to the timing of the training with some feeling it had come at the correct time and others feeling it should have been earlier.

SYSTEMS DEVELOPMENT COMPARISON
END-USER COMPUTING SATISFACTION SURVEY RESULTS

ACCURACY:

4(A1). Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	4.25	4.67

IS 5 4 5 3 EU - 5 4 5

2(A2). Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
4.25	5.00

IS 4 5 5 3 EU - 5 5 5

Accuracy Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
4.25	4.83

CONTENT:

11(C1). Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.25 4.33

IS 4 4 5 4 EU - 4 4 5

12(C2). Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU & ^IS
4.25

IS 4 4 5 4 EU 4 4 5 4

8(C3). Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.00 3.75

IS 3 3 3 3 EU 3 3 4 5

5(C4). Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
4.00 4.50

IS 4 5 3 4 EU 3 5 5 5

Content Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.88 4.20

EASE OF USE:

10(E1). Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.00 3.75

IS 3 2 5 2 EU 5 2 4 4

9(E2). Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.25 4.33

IS 3 3 5 2 EU 5 4 - 4

Ease of Use Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU

3.13 4.00

FORMAT:

1 (F1). Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

1. Almost never	2. Some of the time	3. No difference	4 Most of the time	5 Almost always

	^IS	^EU
	3.00	4.00
IS 2 3 5 2	EU 4 4 4 4	

3(F2). Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never	2. Some of the time	3. No difference	4 Most of the time	5 Almost always

	^IS	^EU
	3.75	4.25
IS 2 4 5 4	EU 4 4 4 5	

Format Construct:

1. Almost never	2. Some of the time	3. No difference	4 Most of the time	5 Almost always

^IS	^EU
3.38	4.13

TIMELINESS:

7(T1). Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	3.00	3.67
IS	3 4 3 2	EU - 3 4 4

6(T2). Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

	^IS	^EU
	3.50	3.67
IS	3 5 3 3	EU - 3 4 4

Timeliness Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS	^EU
3.25	3.67

SUMMARY: COMPANY D

For the first question posited by this research:

Does the use of an I-CASE tool in information systems development, result in increased levels of end-user involvement in the information systems development process?

For Company D we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses, that the use of the I-CASE tool did result in increased end-user participation in the information systems development process.

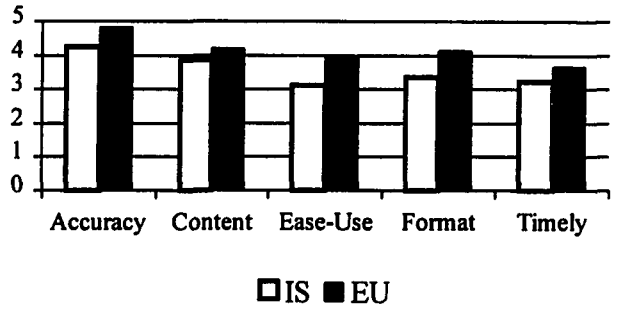
For the second question posited by this research:

> If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

For Company D we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument that the end-users have a high level of satisfaction with the information systems resulting from their systems development effort with the I-CASE tool.

Additionally, for each construct the end-user responses demonstrate their high level of satisfaction with the information systems resulting from their development efforts compared to the previous systems they utilized in the accomplishment of their duties and responsibilities. On the five point Lickert scale the end-users responses for each construct are at the upper end of the scale. The following graph also demonstrates the

high level of end-user satisfaction for each of the constructs and shows the relative accuracy of the IS personnel's perceptions of end-user satisfaction.



Other major points brought out in the interviews at Company D were:

(1) Visuals and Prototyping -- A major benefit perceived by the end-users were the visuals and prototyping provided by the I-CASE tool. The visuals included various diagramming tools that permitted the end-users to see different objects, functions, processes, data, etc. and how they related to each other. As a result, they were more easily able to adjust and readjust the relationships to a method that appeared to provide the most effective business processes.

Based on these adjusted relationships the end-users were able to experiment with the system at an early stage of the development process. Thereby clarifying and enhancing the system through the interaction allowed by the prototyping. This was facilitated by the relatively easy manner the various diagramming visuals could be modified to reflect the information gathered during the prototyping process.

(2) Systems Ownership -- There was a significant change in the perception of systems ownership by the end-user participants to the systems being theirs and the fact the end-users would get out of the development process what they had put into the effort.

(3) IS/EU Understanding -- The understanding of each others processes and procedures developed by the IS and end-user groups was seen to be a significant improvement in communications that facilitated the development efforts.

(4) Initial Reluctance -- The initial reluctance of end-users to participate in the project was significantly mitigated as a result of the prototype systems that were available during the early stages of the development process.

(5) IS Responsiveness -- IS attitudes were seen to be significantly changed by the end-users to ones in which IS was more flexible and responsive to the end-users requirements.

CHAPTER 5

CONCLUSIONS

The purpose of this research was to determine:

(1) If the use of an I-CASE tool in information systems development results in increased levels of end-user involvement in the information systems development process?

(2) If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems compared to the other information systems of the end-user?

In order to conduct this exploratory research in-depth field interviews were conducted at four sites that had utilized the Texas Instruments -- Information Engineering Facility I-CASE tool. At each location four end-users and four IS personnel who had been involved in I-CASE development projects were interviewed. End-users were

interviewed to determine their experiences during the development process compared to other information systems development projects they had been involved with and to evaluate their level of satisfaction with the information systems that resulted from the development effort compared to other information systems developed without the use of the I-CASE tool.

IS personnel were interviewed to determine their perception of how end-users would respond to the interview concerning their experiences with the I-CASE systems development process and the information systems resulting from the I-CASE development process.

Additionally, to further evaluate the level of end-user satisfaction with the information systems resulting from the I-CASE development effort, the end-user and IS personnel completed an adjusted D&T End-User Computing Satisfaction Instrument.

CONCLUSIONS

For the first question posited by this exploratory research:

Does the use of an I-CASE tool in information systems development result in increased levels of end-user involvement in the information systems development process?

For the four firms included in this research we can conclude, based on the responses of the end-users to the research questions posed during the interviews and

confirmed by the IS personnel's perceptions of the end-users responses, that the use of the I-CASE tool did result in increased end-user participation in the information systems development process.

For the second question posited by this research:

If the use of an I-CASE tool in the information systems development process does result in increased levels of end-user involvement in the information systems development process, does this increased involvement result in increased levels of end-user satisfaction with the resulting systems, compared to the other information systems of the end-user?

For three of the four firms included in this research we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument, that the end-users have a high level of satisfaction with the information systems resulting from their systems development effort with the I-CASE tool.

For each construct measured by the adjusted D&T instrument the end-user responses for the three firms demonstrate their high level of satisfaction with the information systems resulting from their development efforts compared to the previous systems they utilized in the accomplishment of their duties and responsibilities. On the

five point Lickert scale the end-users responses for each construct are at the upper end of the scale.

For Company B we can conclude, based on the responses of the end-users to the research questions posed during the interviews and confirmed by the IS personnel's perceptions of the end-users responses and the completed adjusted D&T instrument, that the end-users do not have an increased level of satisfaction with the system, as it exists, developed with the I-CASE tool. However, the comments of the end-user group indicated that they expect the system, when completed, to meet all of their needs and requirements.

For each construct examined in the adjusted D&T instrument the end-user responses, for Company B, demonstrate their lack of satisfaction with the information system as it exists. However, as previously noted, these end-users have high expectations for the system when all of their specifications are incorporated. On the five point Lickert scale the end-users responses for each construct are at the lower end of the scale.

Figure 4 presents a combined comparison of the construct results from the adjusted D&T instrument for the four firms included in this research. It also presents a comparison of the combined construct results for the firms excluding Company B. As can be noted, the differences for IS with and without Company B are not significant. However, the differences for the combined results for the end-users with and without Company B are more significant on the five point Lickert scale, all being in the half point

range. The end-user results for the five constructs, excluding Company B, are all above four (= Most of the Time) on the five point Lickert scale.

The magnitude of differences was to be expected, as for Companies A - C & D IS personnel underestimated the end-users level of satisfaction with the results of the process. Whereas, for Company B IS personnel overestimated the end-users level of satisfaction. Consequently the more convergence of the IS results with/without Company B verses the larger divergence of the end-users results with/without Company B.

	Accuracy	Content	Ease-Use	Format	Timely
IS Comb. w/o B	3.75	4.04	3.38	3.63	3.88
IS Combined	3.57	3.95	3.32	3.46	3.79
Difference	.18	.09	.06	.17	.09
EU Comb. w/o B	4.14	4.34	4.26	4.38	4.18
EU Combined	3.52	3.74	3.87	3.91	3.80
Difference	.62	.60	.39	.47	.38

1 = Almost Never 2 = Some of the Time 3 = No Difference
4 = Most of the Time 5 = Almost Always

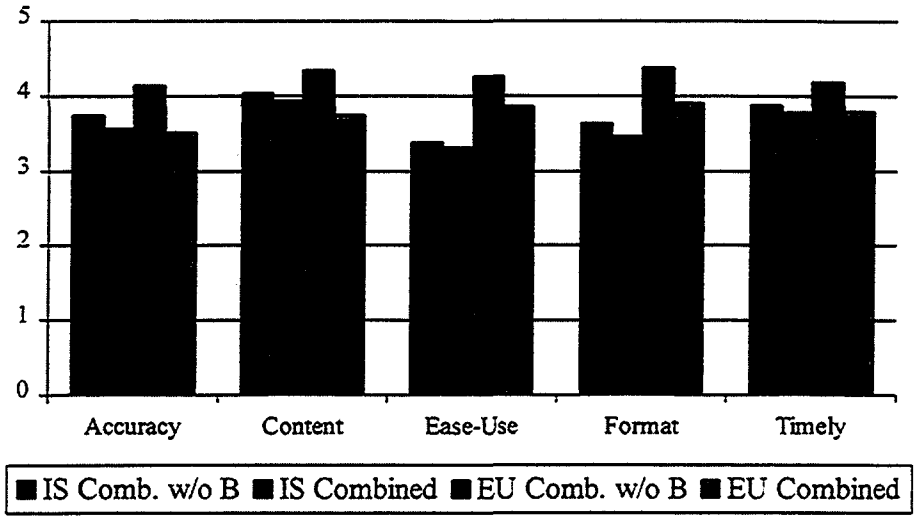


Figure 4. Comparison of Construct Results from the Adjusted Doll and Torkzadeh End-User Computing Satisfaction Instrument.

Information Systems Personnel and End-Users for Companies A-B-C & D.
Information Systems Personnel and End-Users for Companies A-C & D

COMBINED RESULTS -- SYSTEMS DEVELOPMENT COMPARISON
END-USER COMPUTING SATISFACTION SURVEY RESULTS

ACCURACY:

4(A1). Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.57 3.64

	A	B	C	D
IS	4.50	2.50	2.75	4.25
EU	4.25	1.66	3.50	4.67

2(A2). Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.47 3.50

	A	B	C	D
IS	4.25	2.33	2.50	4.25
EU	4.50	1.50	3.25	5.00

Accuracy Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.44 3.50

	A	B	C	D
IS	4.38	2.40	2.63	4.25
EU	4.38	1.57	3.38	4.83

CONTENT:

11(C1). Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.80 3.86

	A	B	C	D
IS	4.50	3.00	3.00	4.25
EU	4.75	2.00	4.25	4.33

12(C2). Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.87 4.36

	A	B	C	D
IS	4.50	3.33	4.50	4.25
EU	4.75	2.33	3.75	4.25

8(C3). Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.44 3.50

	A	B	C	D
IS	4.75	2.00	3.25	3.00
EU	4.75	1.25	4.00	3.75

5(C4). Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.88 4.07

	A	B	C	D
IS	4.75	3.00	3.75	4.00
EU	4.50	2.00	4.50	4.50

Content Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^EU ^IS
3.74 3.95

	A	B	C	D
IS	4.63	2.83	3.63	3.88
EU	4.69	1.87	4.13	4.20

EASE OF USE:

10(E1). Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.36 3.81

	A	B	C	D
IS	4.75	3.33	2.50	3.00
EU	4.50	2.75	4.25	3.75

9(E2). Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.29 3.93

	A	B	C	D
IS	4.75	2.67	2.00	3.25
EU	4.50	2.75	4.25	4.33

Ease of Use Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.32 3.87

	A	B	C	D
IS	4.75	3.00	2.25	3.13
EU	4.50	2.75	4.25	4.00

FORMAT:

1 (F1). Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.14 4.00

	A	B	C	D
IS	4.25	2.00	2.75	3.00
EU	4.50	2.75	4.75	4.00

3(F2). Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.79 3.81

	A	B	C	D
IS	4.75	2.66	3.25	3.75
EU	5.00	2.25	3.75	4.25

Format Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.46 3.91

	A	B	C	D
IS	4.50	2.33	3.00	3.38
EU	4.75	2.50	4.25	4.13

TIMELINESS:

7(T1). Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.64 3.67

	A	B	C	D
IS	4.75	2.67	3.50	3.00
EU	4.50	2.75	3.75	3.67

6(T2). Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS & EU
3.93

	A	B	C	D
IS	4.75	3.66	3.75	3.50
EU	4.75	2.75	4.50	3.67

Timeliness Construct:

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

^IS ^EU
3.79 3.80

	A	B	C	D
IS	4.75	3.17	3.63	3.25
EU	4.63	2.75	4.13	3.67

AREAS FOR FUTURE RESEARCH

AND

SUPPLEMENTARY INFORMATION

This research indicated that communications between end-users and IS department personnel were increased in systems developed with this I-CASE tool versus other systems development projects in which both groups had been involved. Additionally, there was an increased level of satisfaction from the end-users for the system developed with the I-CASE tool as opposed to other systems projects with which they had been involved.

However, this research was not designed to determine the reasons for this increased level of involvement and the resulting increased level of satisfaction with the systems developed with the I-CASE tool versus other systems development projects the individuals had been involved with. Additionally, in developing the primary focus of this research ancillary and supplemental information was developed.

Consequently, while this exploratory research provides an initial focus for research concerning end-user experiences and satisfaction with information systems developed utilizing I-CASE tools, it does represent a first step on research in this area. The remainder of this dissertation will discuss the potential areas for future research resulting from the primary focus of this investigation as well as the areas for future research that might be developed from the supplemental information developed.

PRIMARY FOCUS

Considering the fact it has been virtually axiomatic that end-user participation in systems development is beneficial, there is no reason end-users could not have been more fully involved in the systems development process prior to the adoption of the I-CASE tool by the firms investigated. Conversely, it is possible that IS could have limited the end-user involvement in the systems developed with the I-CASE tool. However, for all four sites investigated there was a significant increase in end-user involvement with the systems developed with the I-CASE tool.

Consequently, the fundamental question is: Why did this increased level of involvement occur? Some possible explanations that might be investigated are:

(1) Does the tool itself forced the increased level of end-user involvement?

(2) This research involved one I-CASE tool to eliminate any variability that might result from the use of different tools. Therefore, it would be appropriate to investigate other I-CASE tools available to determine if the increased involvement found with this tool, is applicable only to this I-CASE tool or I-CASE tools in general or just specific I-CASE tools.

(3) Additionally, the various I-CASE tools have a variety of methodological foundations. Consequently, it may be appropriate to investigate the various I-CASE tools based on their methodological foundation, to determine the impact of the underlying tool methodology on increased end-user involvement.

(4) Is the fact that one of the selling points to upper management for the acquisition of the tool was an increased level of end-user involvement, does IS now feel forced to increase the participation of end-users?

(5) Are there other external forces such as the path for advancement in IS being those individuals within IS who have a knowledge of the business area operations, and IS personnel view the inclusion of end-users in the development process as a means to obtain increased levels of knowledge concerning the business operations and requirements from the end-users perspective?

SUPPLEMENTAL INFORMATION

As previously noted supplemental information was developed during the course of this investigation. These supplemental findings and the implications for future research are discussed below in the approximate sequence of the importance placed on the items by the participants in the research:

(1) The information systems development process utilizing the I-CASE tool resulted in increased levels of end-user participants understanding of their business areas and the relationships and inter-relationships with the other business areas of the firm. This was viewed as a positive, albeit unexpected benefit of the process.

Possible Research -- Does this result in improved operational performance as a result of the increased level of knowledge and what, if any, is the effect on subsequent systems development efforts?

(2) There is a greater appreciation and understanding between IS and

end-user departments for each others areas of responsibility and the problems and constraints each must function within. In this instance both groups view this as a positive unexpected benefit of the process.

Possible Research -- Does this result in improved operational performance as a result of the increased level of knowledge and what, if any, is the effect on subsequent systems development efforts?

(3) The ability to test and modify systems at any time during the development effort is a major improvement over past abilities when the system could only be tested upon completion of development. End-users felt this ability enabled them to more completely evaluate and modify the system as the interactions with the prototype brought to light situations and requirements that in the past would not have been encountered until the system had become operational.

Possible Research -- What effect does this ability have on the total systems development effort, from both the cost and results perspective.

(4) There was a significant amount of initial skepticism and reluctance of end-users to participate in the I-CASE development process due to their previous disappointments with the lack of results from major systems development efforts. This reluctance was significantly mitigated during the early stages of the development process as a result of the early availability of prototype systems.

Possible Research -- Is it possible and desirable within an organization to overcome end-user reluctance to participate prior to commencement of the project, or is participation the most effective method to secure commitment?

(5) Prior to the information systems development project with the I-CASE tool, information systems were basically viewed as something that existed in the end-users world and had to be tolerated and worked around in order to accomplish their responsibilities. However, as a result of the development process end-users attitudes changed materially and they began to assume ownership of the systems. This assumption of ownership manifested itself in a number of ways perhaps the most significant being the end-users acknowledgment that if the system did not perform to expectations, that result would be their responsibility.

Possible Research -- Is there a discernible point during the development process that the change in ownership perception occurs, and does this result in an improvement in the development effort and commitment? If so what is the operational result of the improved effort and commitment?

(6) From the end-users perspective, IS attitudes were also seen to be significantly changed to one in which IS was more flexible and responsive to the end-users needs and requirements. It is possible that this results in large part from the fact the IS project members were released from the "burden" of performing maintenance on the existing

legacy systems. As a consequence of that release they were able to engage in the more "exciting" task of systems development, with a tool that encouraged/required interaction.

Possible Research -- What is/are the causes of the changed IS attitude, and does the more flexible attitude transfer to increased operational productivity?

(7) The primary problems encountered by the development teams resulted from the failure to include those with an in-depth knowledge of the business operations in the initial specifications of the project, and the failure to consider the proliferation of PC based systems in determining the time and scope requirements for the different segments of the development projects.

Possible Research -- As most I-CASE tools take a top down approach to business analysis, at what point in the process is it appropriate to include those with an in-depth knowledge of the business operations to help mitigate the myriad of problems that evolve within an organization when time and cost budgets are exceeded?

(8) For Company B, the early implementation of the information system over the objections of the project participants, both IS and end-user, turned what had been a positive "empowering" experience into a mixed attitude towards the system developed. The in-depth field interviews indicated the end-user participants felt the system was an improvement over their existing systems. However, their responses to the adjusted D&T instrument for all of the constructs examined was negative.

Possible Research -- This item is a direct result of problems discussed in (7) above, and has its possible solution in resolving item (7). However, in those instances where a system is implemented prior to the project teams acquiescence, is it possible to mitigated the negative effects of the early implementation in order to retain end-user commitment to systems development utilizing the I-CASE tool in order for the organization to recoup its investment.

(9) The firms in this study had varying philosophies for training of the end-user participants in the information systems development process utilizing the I-CASE tool.

Possible Research -- What is the effect of end-user training on the development process and what is the effect of the timing and detail of the training?

(10) The end-user participants in this investigation developed a sense of systems ownership during the development process. However, this sense of ownership does not appear to transfer to the remainder of the end-users.

Possible Research -- Is it necessary to have this sense of ownership transferred in order to develop effective and efficient use of information systems developed with the I-CASE tool, or is the perception among the remainder of the end-users immaterial as regards effective and efficient systems utilization?

SUMMARY

While this exploratory research accomplished its two primary objectives of determining if the use of an I-CASE tool in information systems development resulted in increased end-user involvement in the information systems development process, and if the involvement resulted in an increased level of satisfaction with the resulting information system. It also uncovered a significant amount of supplementary information that would be of benefit to other researchers as they pursue investigation of the field and practitioners as they consider information systems development utilizing an I-CASE tool.

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APPENDICES

on UNIVERSITY OF TENNESSEE
LETTERHEAD

Dear ,

I am presently involved in the dissertation phase of obtaining my Ph.D. in Logistics and Information Management from the University of Tennessee. The dissertation concerns a comparison of computer systems users satisfaction; with systems developed utilizing Computer Aided Systems Engineering (CASE) tools (specifically Texas Instruments - Information Engineering Facility tool) versus systems developed utilizing the firms traditional systems development techniques. The systems users satisfaction or lack thereof, will then be compared to the IS departments perceptions of the systems users satisfaction.

One of the main benefits advanced for the use of CASE tools is that they involve the systems user more completely in the entire systems development process. The result of this involvement and interaction should be a system that more fully satisfies the users requirements versus systems developed utilizing traditional systems development methods. However, the increased level of user involvement and the increased level of systems satisfaction have not been investigated from the systems users perspective. Hence, the dissertation topic.

I would like to include in my study. While I will have to describe the general background of in an annual report, 10-K type style in the dissertation, all of the analysis and discussion of the results of the research will be anonymous. In the analysis and discussion section of the dissertation the companies in the study will be identified as Company A, Company B, etc. The only individuals who will be aware of identity in the analysis section will be myself and the four members of my dissertation committee.

In order to complete the study, it will be necessary to interview approximately eight individuals (four end-users and four IS personnel) at who have been involved in systems development projects utilizing CASE tools and systems developed utilizing your firms traditional systems development methods. The interviews will take approximately one hour (+/-) per individual.

For permitting me to include in my study I will provide your firm with a summary of the results from the interviews (maintaining the interviewees anonymity) that will help provide information on whether or not the CASE tool and development methodology being utilized are resulting in improved and timely systems from the end-users perspective. I will also send a summary of all of the sites included in my study to provide a frame of reference with which to judge the relative success of the CASE tools implementation in your firm versus others. Each firm will only be able to specifically identify their results in the summary.

In addition to the academic rigor and independence that I will bring to the study and interviews at your organization, I also bring twenty years of practical business experience. I am a CPA and my most recent position before returning to school to get my Ph.D. was as the Senior Vice President - Purchasing and Distribution for a half billion dollar NYSE building products retailer. I believe this combination of experience will enable me to conduct effective interviews and provide your firm with valuable information in helping to evaluate your firms investment in CASE tools.

Thank you very much for your consideration of my request, I will call you towards the beginning of next week to provide any further information you may require, and hopefully arrange a time for me to conduct interviews at . Thanks again for your consideration of this request.

Sincerely,

Kevin Fitzgerald

_____

END-USER RESEARCH INSTRUMENT

Date: _____ Time:
Began: _____ Ended: _____

Company: _____ Department: _____

Interviewee: _____ Position: _____

Time: In Position: _____ With Company: _____

From IS Dept. TI-IEF projects this interviewee was involved with:

_____
_____
_____
_____

1. Would you please describe the responsibilities and duties associated with your position.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

2. What are your main interactions with your firms computer information systems?

A. Approximately how frequently do these interactions occur?

B. Do any particular type interactions predominate?

3. Excluding (read the list of TI's-IEF systems above) systems could you please describe the process involved when you required -

A. Enhancements or changes to systems? Could you please describe representative examples of the process.

B. New systems. Could you please describe representative samples of the process.

4. In general, excluding (read the list of TI's-IEF systems above) how would you describe your level of satisfaction with the quality of the systems you utilize in the accomplishment of your responsibilities?

The timeliness of new systems delivery, excluding (read the list of TI's-IEF systems above)?

5. When you were involved with the development of (read the list of TI's-IEF systems above) did you notice any differences from other systems development projects you have been involved with? If so, what differences?

6. For (read the list of TI's-IEF systems above) are your main interactions with your firms computer information systems different than for other systems you utilize in the accomplishment of your duties. If so, how are they different?

A. If YES. Has the frequency of interactions increased? Decreased?

To what do you attribute the change and why?

B. Has the predominate type of interaction action changed?

If YES, how, to what, and to what do you attribute the change and why?

7. For (read the list of TI's-IEF systems above) could you please describe the process involved when you require enhancements or changes to these systems? Is this different than for other systems you utilize in the accomplishment of your duties. If so, how?

8. For (read the list of TI's-IEF systems above) could you please tell me if your level of involvement when you required enhancements or changes to these systems is different than for other systems you utilize in the accomplishment of your duties. If so, how?

Could you please describe representative examples of the involvement process for (read the list of TI's-IEF systems above) and for other systems you utilize in the accomplishment of your duties.

9. For (read the list of TI's-IEF systems above) how would you describe your level of satisfaction with the quality of those systems versus other systems you utilize in the accomplishment of your duties?

The timeliness of the systems delivery?

10. Do you notice any difference in the feeling of satisfaction or accomplishment when using (read the list of TI's-IEF systems above) versus the other systems you utilize in the accomplishment or your responsibilities?

If so. What are the differences? To what do you attribute the differences?

Note: Questions 11 - 12 - 13 depend on interviewees level of awareness of the use of TI's-IEF for the development of the systems listed at the beginning of this form.

11. For (read the list of TI's-IEF systems above) were you aware that these systems were developed with a computer aided software engineering tool (CASE) called Texas Instruments - Information Engineering Facility? The purpose of these tools is to automate the systems development process, get the end-user more involved in the development process thereby resulting in faster development of a system that more completely meets the end-users requirements.

For (read the list of TI's-IEF systems above) how would you react in general to the experiences in developing those systems as compared to other systems development efforts you have been involved in?

12. Were you given any introduction or training to the Texas Instrument - Information Engineering Facility tool before you began development of (read the list of TI's-IFE systems above) ? If so, what did the training consist of?

A. When did you receive the training?

B. Based on your experiences in developing the systems with the Texas Instrument - Information Engineering Facility tool do you think the introduction and training were adequate? Why or why not?

C. If NO. What changes do you think are necessary?

13. While you and your colleagues were involved in developing (read the list of TI's-IEF systems above) were there any general type comments or trends in comments on the differences in developing these systems as opposed to other systems development efforts you and your colleagues had been involved with?

14. For (read the list of TI's-IEF systems above) versus other systems you utilize in the accomplishment of your responsibilities are there any other observations or comments that you think would be useful for me to be aware of?

IS _____

IS PERSONNEL RESEARCH INSTRUMENT

Date: _____ Time:
Began: _____ Ended: _____

Company: _____ Department: _____

Interviewee: _____ Position: _____

Time: In Position: _____ With Company: _____

1. Would you please describe the responsibilities and duties associated with your position.

_____
_____
_____
_____
_____
_____
_____
_____

2. What are your main interactions with end-users of the firms computer information systems?

_____
_____
_____
_____
_____
_____

A. Approximately how frequently do these interactions occur?

B. Do any particular type interactions predominate?

3. Prior to your firms adoption of TI's-IEF could you please describe the process involved when end-users required -

A. Enhancements or changes to existing systems? Could you please describe representative examples of the process.

B. New systems? Could you please describe representative samples of the process.

4. How would you evaluate the end-users level of satisfaction with the quality of the systems developed under your firms prior systems development method? Did the level of satisfaction vary by level of responsibility, i.e., upper management, middle management and clerical? If so, how?

The timeliness of the systems delivery?

5. Are there any other observations or comments concerning systems development in your firm prior to the adoption of TI's-IEF that you think would be useful for me to be aware of? Particularly as it relates to end-users and their perceptions.

6. Could you please describe the introduction and training you were given on TI's-IEF.

When did you receive the training?

How many systems projects have you been involved with since receiving the training? What were they?

7. Based on your experiences to date with end-users involved with TI's-IEF do you think their introduction and training were adequate?

If NO. What changes do you think are necessary?

8. Have your interactions with end-users changed since the adoption of TI's-IEF for systems development? If Yes. How?

A. If YES. Has the frequency of interactions increased? Decreased?

To what do you attribute the change and why?

B. Has the predominate type of interaction action changed? If YES to what and how?

9. For systems developed with TI's-IEF could you please describe the process involved when end-users require -

A. Enhancements or changes to existing systems? Could you please describe representative examples of the process.

B. New systems? Could you please describe representative samples of the process.

10. Since your firms adoption of TI's-IEF could you please tell me if the end-users level of involvement has changed between the systems developed with and without TI's-IEF when they required -

A. Enhancements or changes to existing systems? Could you please describe representative examples of involvement under both processes?

B. New systems? Could you please describe representative examples of involvement under both development methods?

C. Did the amount of time of the end-users involvement change between the different phases of the development cycle for the two methods? If so, how?

11. How would you evaluate the end-users level of satisfaction with the quality of the systems developed using TI's-IEF versus systems developed without TI's-IEF? Does the level of satisfaction vary by level of responsibility, i.e., upper management, middle management and clerical? If so, how?

The timeliness of the systems delivery?

12. Are there any other observations or comments concerning end-users perceptions or satisfaction or lack there-of since the adoption of TI's-IEF that you think would be useful for me to be aware of?

Researchers Name
Researchers Phone #

_____

SYSTEMS DEVELOPMENT COMPARISON

SATISFACTION SURVEY

The purpose of this survey is to obtain a comparison of your level of satisfaction with the systems you use, that were developed with the Texas Instrument - Information Engineering Facility (TI-IEF) CASE tool versus other systems you use, that were developed without the use of the TI-IEF. The systems developed with the TI-IEF are those we discussed during our interview.

INSTRUCTIONS:

Please read each statement and circle the words that most clearly describe your feeling about the question. Remember -- all questions regard a comparison with the system(s) that were developed utilizing the TI-IEF versus other systems you use, that were developed without the use of the TI-IEF.

QUESTIONS

1. Do you think the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems you use?

   1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

2. Are you more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems you use?

   1. Almost never 2. Some of the time 3. No difference 4. Most of the time 5 Almost always

3. Is the information from the system(s) developed with the TI-IEF clearer than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

4. Is the system(s) developed with the TI-IEF more accurate than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

5. Does the system(s) developed with the TI-IEF provide sufficient information compared to the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

6. Does the system(s) developed with the TI-IEF provide more up-to-date information than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

7. Do you get the information you need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

8. Do the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what you need compared to the reports from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

9. Is the system(s) developed with the TI-IEF easier to use than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

10. Is the system(s) developed with the TI-IEF more user friendly than other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

11. Does the system(s) developed with the TI-IEF provide the precise information you need more fully than the information from other systems you use?

1. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

12. Does the information content from the system(s) developed with the TI-IEF meet your needs more than that from other systems you use?

. Almost never 2. Some of the time 3. No difference 4 Most of the time 5 Almost always

COMMENTS OR OBSERVATIONS YOU MAY WISH TO MAKE:

Please return to: Researchers Name and Address, in the envelope provided.
Thank you very much for your time and assistance.

Researchers Name
Researchers Phone #

IS _____

INFORMATION SYSTEMS PERSONNEL

SYSTEMS DEVELOPMENT COMPARISON

SATISFACTION SURVEY

The purpose of this survey is to obtain your PERCEPTION OF THE END-USERS level of satisfaction with the system(s) that were developed with the Texas Instrument - Information Engineering Facility (TI-IEF) CASE tool versus the previous systems THEY used, that were developed without the use of the TI-IEF. The system(s) developed with the TI-IEF are those we have just finished discussing.

INSTRUCTIONS:

Please read each statement and circle the words that most clearly describes HOW YOU THINK THE ND-USERS WOULD ANSWER THE QUESTION. The purpose of this survey is NOT to find out what you think about systems developed with the TI-IEF versus previously developed systems, but how you think the end-users would respond to each of the questions. All questions regard a comparison with the system(s) that were developed utilizing the TI-IEF versus the previous systems utilized by the end-users, that were developed without the use of the TI-IEF.

QUESTIONS

1. Do you think the end-users will say they find that the output from the system(s) developed with the TI-IEF is presented in a more useful format than the output from other systems they have used?

   1. Almost never 2. Some of the time 3. They find no difference
   4 Most of the time 5 Almost always

2. Do you think the end-users will say they are more satisfied with the accuracy of the system(s) developed with the TI-IEF than the accuracy from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

3. Do you think the end-users will say the information from the system(s) developed with the TI-IEF is clearer than the information from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

4. Do you think the end-users will say the system(s) developed with the TI-IEF is more accurate than other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

5. Do you think the end-users will say the system(s) developed with the TI-IEF provides sufficient information compared to the information from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

6. Do you think the end-users will say the system(s) developed with the TI-IEF provides more up-to-date information than the information from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

7. Do you think the end-users will say they get the information they need in a more timely manner from the system(s) developed with the TI-IEF, than from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

8. Do you think the end-users will say the reports from the system(s) developed utilizing the TI-IEF seem to be just about exactly what they need compared to the reports from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

9. Do you think the end-users will say the system(s) developed with the TI-IEF is easier to use than other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

10. Do you think the end-users will say the system(s) developed with the TI-IEF is more user friendly than other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

11. Do you think the end-users will say the system(s) developed with the TI-IEF provides the precise information they need more fully than the information from other systems they have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

12. Do you think the end-users will say the information content from the system(s) developed with the TI-IEF meets their needs more than that from other systems hey have used?

1. Almost never 2. Some of the time 3. They find no difference
4 Most of the time 5 Almost always

COMMENTS OR OBSERVATIONS YOU MAY WISH TO MAKE:

Please return to: Researchers name and address, in the envelope provided.
Thank you very much for your time and assistance.

ZAND & SORENSEN RESEARCH INSTRUMENT

Source: Zand, Dale E., and Richard E. Sorensen. "Theory of Change and the Effective Use of Management Science" Administrative Science Quarterly December, 1975.

Respondents were requested to select two projects they participated on, one successful the other unsuccessful. They were requested to rate each item on a five point scale from:

(1) the statement accurately depicts what occurred; to
(5) the statement accurately depicts the opposite of what occurred

Representative Items of Questionnaire

Favorable to Unfreezing
The problem was significant to the company's future.
Top management of the company initiated the study.
We persuaded management of the division to redefine former assumptions.

Unfavorable to Unfreezing
The top management of the company was afraid to get involved in a large-scale project.
Management of the division initially looked on the project as a chore.
Management of the division did not have confidence in us.

Favorable to Moving
Management examined alternative courses of action.
Top management was adviser of the various options available.
We uncovered alternatives that had not been considered before.

Unfavorable to Moving
The study was concluded too quickly.
Management of the division did not provide the requested data.
We couldn't educate the management of the division.

Favorable to Refreezing
The new solution has been shown to be superior to the old through utilization.
Management of the division now also uses this solution in other areas.
After the solution was initially implemented, we made sure managers got positive feedback.

Unfavorable to Refreezing
The measurement of results in this area is difficult.
Top management of the company did not encourage other divisions to utilize this solution.
After the solution was initially implemented, we didn't try to reinforce new procedures.

Level of Success
Profitability of the project.
1. The project caused a large loss for the company.
2. The project did not cover its cost.
3. The project paid for itself.
4. The project provided an acceptable return on investment.
5. The project provided higher than usual return on investment.

Survey Results: indicating forces favorable/unfavorable to change

Forces in Unfreezing, Moving, and Refreezing

Favorable	Unfavorable
Unfreezing	
1. Top and unit managers felt the problem was important to company.	1. Unit managers could not state their problems clearly
2. Top managers became involved.	2. Top managers felt the problem was too big.
3. Unit managers recognized a need for change.	3. Unit managers did not recognize need for change.
4. Top managers initiated the study.	4. Unit managers felt threatened by the project.
5. Top and unit managers were open, candid.	5. Unit managers resented the study.
6. Unit managers revised some of their assumptions.	6. Unit managers lacked confidence in the management scientists.
	7. Unit managers felt they could do the study alone.
Moving	
1. Unit managers and management scientists gathered data jointly.	1. Management scientists could not educate the unit managers.
2. Relevant data were accessible, available.	2. Needed data were not made available.
3. New alternatives were devised.	3. Unit managers did not help develop a solution.
4. Unit managers reviewed and evaluated alternatives.	4. Unit managers did not understand the solution of the management scientists.
5. Top managers were advised of options.	5. Management scientists felt the study was concluded too quickly.
6. Top managers helped develop a solution.	
7. Proposals were improved sequentially.	
Refreezing	
1. Unit managers tried the solution.	1. Management scientists did not try to support new managerial behavior after the solution was used.
2. Utilization showed the superiority of the new solution.	2. Management scientists did not try to reestablish stability after the solution was used.
3. Management scientists initiated positive feedback after early use.	3. Results were difficult to measure.
4. Solution was widely accepted after initial success.	4. Standards for evaluating results were lacking.
5. Unit managers were satisfied.	5. Top managers ignored the solution recommended by the management scientists
6. Solution was used in other areas.	6. Solution incompatible with the needs and resources of the unit.
7. The change improved the performance of the unit.	7. Top managers did not encourage other units to use the solution.

SCHULTZ AND SLEVIN RESEARCH INSTRUMENT

Source: Schultz, Randall L. and Dennis P. Slevin, eds., Implementing Operations Research/Management Science New York: American Elsevier Publishing Company, Inc., 1975.

COMPLETE DESCRIPTION OF IMPLEMENTATION ATTITUDES QUESTIONNAIRE

This appendix contains a complete description of both the Likert and semantic differential instruments.

LIKERT INSTRUCTIONS

Instructions for Part 1

You are asked to read each statement carefully and to circle one of the words from each following line that describes most clearly how you feel about the statement, e.g.,

I find the FORECAST interesting.

Strongly Disagree	Disagree	Uncertain	(Agree)	Strongly Agree

This would indicate that you agree with the statement.

Please keep in mind that what is important is your own opinion.

The FORECAST is a technique that is presently being considered for implementation. Remember, this questionnaire is asking for *your opinion about the FORECAST.*

Each item implies ". . . after the implementation," that is, this questionnaire is concerned with how you feel about each statement as it applies to the situation *after the FORECAST is operational.*

Each item implies that changes will occur *after the FORECAST* is in use. For example, statement 2

"My job will be more satisfying."

implies

My job will be more satisfying . . . *after the FORECAST is in use.*

Factor 1.
PERFORMANCE

Effect of Model on Manager's Job Performance and Performance Visibility

Loading	Item	Description
.63	2	My job will be more satisfying.
.39	3	Others will better see the results of my efforts.
.59	7	It will be easier to perform my job well.
.44	11	The accuracy of information I receive will be improved by the FORECAST.
.73	14	I will have more control over my job.
.69	22	I will be able to improve my performance.
.53	27	Others will be more aware of what I am doing.
.73	28	The information I will receive from the FORECAST will make my job easier.
.64	31	I will spend less time looking for information.
.47	49	I will be able to see better the results of my efforts.
.53	59	The accuracy of *my* forecast will improve as the result of using the FORECAST.
.40	60	My performance will be more closely monitored.
.36	63	The division/department will perform better.

Factor 2.
INTERPERSONAL

Interpersonal Relations, Communication, and Increased Interaction and Consultation with Others

Loading	Item	Description
.43	1	I will need to communicate with others more.
.73	29	I will need the help of others more.
.61	44	I will need to consult others more often before making a decision.
.71	46	I will need to talk with other people more.
.77	48	I will need the help of others more.

Factor 3.
CHANGES

Changes Will Occur in Organizational Structure and People I Deal with

Loading	Item	Description
.49	12	The individuals I work with will change.
.58	24	The management structure will be changed.
-.42	30	The FORECAST will not require any changes in division/department structure.
.40	36	I will have to get to know several new people.

Factor 4.
GOALS

Goals Will Be More Clear, More Congruent to Workers, and More Achievable

Loading	Item	Description
.33	20	Individuals will set higher targets for performance.
.46	25	The use of the FORECAST will increase profits.
.68	26	This project is technically sound.
.47	32	Company goals will become more clear.
.42	42	My counterparts in other divisions/departments will identify more with the organization's goals.
46	45	The patterns of communication will be more simplified.
.59	62	My goals and the company goals will be more similar than they are now.
.50	66	The aims of my counterparts in other divisions/departments will be more easily achieved
.43	67	My personal goals will be better reconciled with the company goals.

Factor 5.
SUPPORT/RESISTANCE

Model Has Implementation Support-Adequate Top Management, Technical, and Organizational Support and Does Not Have Undue Resistance

Loading	Item	Description
.38	4	Top management will provide the resources to implement the FORECAST.
.56	10	People will accept the required changes.
.35	21	Top management sees the FORECAST as being important.
-.43	33	Implementing the FORECAST will be difficult.
-.59	39	Top management does not realize how complex this change is.
.67	40	People will be given sufficient training to utilize the FORECAST.
.45	41	This project is important to top management.
.67	43	There will be adequate staff available to successfully implement the FORECAST.
.52	55	My counterparts in other divisions/departments are generally resistant to changes of this type.
.36	64	Personal conflicts will not increase as a result of the FORECAST.
.67	65	The developers of the FORECAST will provide adequate training to users.

Factor 6.
CLIENT/RESEARCHER

Researchers Understand Management Problems and Work Well with Their Clients

Loading	Item	Description
-.21	13	The developers of these techniques don't understand management problems.
.79	51	I enjoy working with those who are implementing the FORECAST.
.81	52	When I talk to those implementing the FORECAST, they respect my opinions.

Factor 7.
URGENCY

Need for Results, Even With Costs Involved; Importance To Me, Boss, Top Management

Loading	Item	Description
.39	5	The FORECAST costs too much.
.42	6	I will be supported by my boss if I decide not to use this model.
.55	8	Decisions based on the FORECAST will be better.
.60	9	The results of the FORECAST are needed now.
.61	15	The FORECAST is important to me.
.58	16	I need the FORECAST.
.71	18	It is important that the FORECAST be used soon.
.57	23	This project is important to my boss.
.71	34	The FORECAST should be put into use immediately.
.58	47	It is urgent that the FORECAST be implemented.
.80	56	The sooner the FORECAST is in use the better.
.49	61	Benefits will outweigh the costs.

LIKERT ITEMS THAT DID NOT LOAD SIGNIFICANTLY ON A FACTOR OR WERE NOT INTERPRETABLE

17. The developers of these techniques seldom consult with the people who use them.
19. Implementing the FORECAST will take a lot of my time.
35. I will see less of my friends in the organization.
37. I will report to a different boss.
38. Many other people in the company will be affected.
50. People will realize that the FORECAST is an improvement.
53. I will be in a better position to reach my goals.
54. Others do not see the FORECAST as being important.
57. The FORECAST is worth the time required to implement it.
58. I will play an important role in the implementation of the FORECAST.

DEPENDENT VARIABLES
(Questions 68–72)

1. Please circle the number on the scale below that indicates the probability that you will use the FORECAST.

0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

2. Please circle the number on the scale below that indicates the probability that other managers will use the FORECAST.

0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

3. Please circle the number on the scale below that indicates the probability that the FORECAST will be a success.

0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0

4. On the 10-point scale below indicate your evaluation of the worth of the FORECAST.

Not useful at all — Moderately useful — Excellent

1 2 3 4 5 6 7 8 9 10

5. Please circle the number on the scale below that indicates the level of accuracy you expect from the FORECAST.

Not accurate at all — Moderately accurate — Extremely accurate

1 2 3 4 5 6 7 8 9 10

SEMANTIC DIFFERENTIAL INSTRUCTIONS

Instructions for Part 2

The purpose of this study is to measure the *meanings* of certain things to various people by having them judge them against a series of descriptive scales. In taking this test, please make your judgments on the basis of what these things mean *to you.* On each page of this handout you will find a different concept to be judged and beneath it a set of scales. *You are to rate the concept on each of these scales in order.*

Here is how you are to use these scales:

If you feel that the concept at the top of the page is *very closely related* to one or the other end of the scale, you should place your check mark as follows:

important ___√___:___:___:___:___:___ unimportant
important ___:___:___:___:___:___:___√___ unimportant

If you feel that the concept is *quite closely related* to one or the other end of the scale (but not extremely), you should place your check mark as follows:

good ___:___√___:___:___:___:___:___ bad
good ___:___:___:___:___:___√___:___ bad

If the concept seems *only slightly related* to one side as opposed to the other side (but is not really neutral), then you should check as follows:

beneficial ___:___:___√___:___:___:___:___ harmful
beneficial ___:___:___:___:___√___:___:___ harmful

The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic of the thing you're judging. If you consider the concept to be *neutral* on the scale, both sides of the scale *equally associated* with the concept, or if the scale is *completely irrelevant*, unrelated to the concept, then you should place your checkmark in the middle space:

useful ___:___:___:___√___:___:___:___ useless

Important:

(1) Place your check marks in the middle of spaces, not on the boundaries:

correct incorrect
___:___√___:___:___:___√___:___

(2) Be sure you check every scale for every concept -*do not omit any*.
(3) Never put more than one check mark on a single scale.

Sometimes you may feel as though you've had the same item before on the test. This will not be the case, so *do not look back and forth* through the items. Do not try to remember how you checked similar items earlier in the test. ***Make each item a separate and independent judgment.*** Work at fairly high speed through this test. Do not worry or puzzle over individual items. It is your first impressions, the immediate "feelings" about the items, that we want. On the other hand, please do not be careless, because we want your true impressions.

Please mark all of the following scales in the same manner as shown in the examples on the previous page. REMEMBER, all concepts listed at the top of the scales refer to the FORECAST.

SEMANTIC DIFFERENTIAL CONCEPTS

1. The chance of success using this technique
2. Confidence in the developers of the FORECAST
3. Changes in executive decision making
4. Changes in the communication system
5. The effects on relationships with others
6. The FORECAST
7. The importance of this project to you
8. The amount of support being given to this project
9. The urgency of this project to the company
10. The technical complexity of this project
11. The amount of your personal participation required to implement this project

SEMANTIC DIFFERENTIAL ADJECTIVE PAIRS

	(7)	(6)	(5)	(4)	(3)	(2)	(1)	
good	:	:	:	:	:	:	:	bad
beneficial	:	:	:	:	:	:	:	harmful
optimistic	:	:	:	:	:	:	:	pessimistic
hopeful	:	:	:	:	:	:	:	hopeless
harmonious	:	:	:	:	:	:	:	dissonant
comfortable	:	:	:	:	:	:	:	uncomfortable
fortunate	:	:	:	:	:	:	:	unfortunate
important	:	:	:	:	:	:	:	unimportant
useful	:	:	:	:	:	:	:	useless
wise	:	:	:	:	:	:	:	foolish

Scoring

The semantic differential is scored by assigning the values shown in parentheses to the locations on the scale. In the list above, the high scoring side of the scale is at all times on the left. The values checked are summed and divided by 10 to compute the final score.

BAILEY AND PEARSON RESEARCH INSTRUMENT

Source: Bailey, James E. and Sammy W. Pearson. "Development of a Tool for Measuring and Analyzing Computer User Satisfaction" Management Science May, 1983.

*Indicates items deleted by Ives, Olson & Baroudi for their instrument. Also, they used two polar adjective pairs versus the Bailey and Person four shown in the instrument.

1. *Top management involvement*: The positive or negative degree of interest, enthusiasm, support, or participation of any management level above the user's own level toward computer-based information systems or services or toward the computer staff which supports them.

strong vs weak
consistent vs inconsistent
good vs bad
significant vs insignificant

* 2. *Organizational competition with the EDP unit*: The contention between the respondent's organizational unit and the EDP unit when vying for organizational resources or for responsibility for success or failure of computer-based information systems or services of interest to both parties. .

productive vs destructive
rational vs emotional
low vs high
harmonious vs dissonant

3. *Priorities determination*: Policies and procedures which establish precedence for the allocation of EDP resources and services between different organizational units and their requests.

fair vs unfair
consistent vs inconsistent
just vs unjust
precise vs vague

* 4. *Charge-back method of payment for services*: The schedule of charges and the procedures for assessing users on a pro rata basis for the EDP resources and services that they utilize.

just vs unjust
reasonable vs unreasonable
consistent vs inconsistent
known vs unknown

5. *Relationship with the EDP staff*: The manner and methods of interaction, conduct, and association between the user and the EDP staff.

harmonious vs dissonant
good vs bad
cooperative vs uncooperative
candid vs deceitful

6. *Communication with the EDP staff*: The manner and methods of information exchange between the user and the EDP staff.

harmonious vs dissonant
productive vs destructive
precise vs vague
meaningful vs meaningless

7. *Technical competence of the EDP staff*: The computer technology skills and expertise exhibited by the EDP staff.

current vs obsolete
sufficient vs insufficient
superior vs inferior
high vs low

8. *Attitude of the EDP staff*: The willingness and commitment of the EDP staff to subjugate external, professional goals in favor of organizationally directed goals and tasks.

user-oriented vs self-centered
cooperative vs belligerent
courteous vs discourteous
positive vs negative

9. *Schedule of products and services*: The EDP center timetable for production of information system outputs and for provision of computer-based services.

good vs bad
regular vs irregular
reasonable vs unreasonable
acceptable vs unacceptable

10. *Time required for new development*: The elapsed time between the user's request for new applications and the design, development, and/or implementation of the application systems by the EDP staff.

short vs long
dependable vs undependable
reasonable vs unreasonable
acceptable vs unacceptable

11. *Processing of change requests*: The manner, method, and required time with which the EDP staff responds to user requests for changes in existing computer-based information systems or services.

fast vs slow
timely vs untimely
simple vs complex
flexible vs rigid

12. *Vendor support*: The type and quality of the service rendered by a vendor, either directly or indirectly, to the user to maintain the hardware or software required by that organizational status.

skilled vs bungling
sufficient vs insufficient
eager vs indifferent
consistent vs inconsistent

13. *Response/turnaround time*: The elapsed time between a user-initiated request for service or action and a reply to that request. Response time generally refers to the elapsed time for terminal type request or entry. Turnaround time generally refers to the elapsed time for execution of a program submitted or requested by a user and the return of the output to that user.

fast vs slow
good vs bad
consistent vs inconsistent
reasonable vs unreasonable

14. *Means of input/output with EDP center*: The method and medium by which a user inputs data to and receives output from the EDP center.

convenient vs inconvenient
clear vs hazy
efficient vs inefficient
organized vs disorganized

15. *Convenience of access*: the ease or difficulty with which the user may act to utilize the capability of the computer system.

convenient vs inconvenient
good vs bad
easy vs difficult
efficient vs inefficient

16. *Accuracy*: The correctness of the output information.

accurate vs inaccurate
high vs low
consistent vs inconsistent
sufficient vs insufficient

17. *Timeliness*: The availability of the output information at a time suitable for its use.

timely vs untimely
reasonable vs unreasonable
consistent vs inconsistent
punctual vs tardy

18. *Precision*: The variability of the output information from that which it purports to measure.

sufficient vs insufficient
consistent vs inconsistent
high vs low
definite vs uncertain

19. *Reliability*: The consistency and dependability of the output information.

consistent vs inconsistent
high vs low
superior vs inferior
sufficient vs insufficient

20. *Currency*: The age of the output information.

good vs bad
timely vs untimely
adequate vs inadequate
reasonable vs unreasonable

21. *Completeness*: The comprehensiveness of the output information content.

complete vs incomplete
consistent vs inconsistent
sufficient vs insufficient
adequate vs inadequate

22. *Format of output*: The material design of the layout and display of the output contents.

good vs bad
simple vs complex
readable vs unreadable
useful vs useless

23. *Language*: The set of vocabulary, syntax, and grammatical rules used to interact with the computer systems.

simple vs complex
powerful vs weak
easy vs difficult
easy-to-use vs hard-to-use

24. *Volume of output*: The amount of information conveyed to a user from computer-based systems. This is expressed not only by the number of reports or outputs but also by the voluminousness of the output contents.

concise vs redundant
sufficient vs insufficient
necessary vs unnecessary
reasonable vs unreasonable

25. *Relevancy*: The degree of congruence between what the user wants or requires and what is provided by the information products and services.

useful vs useless
relevant vs irrelevant
clear vs hazy
good vs bad

26. *Error recovery*: The methods and policies governing correction and rerun of system outputs that are incorrect.

fast vs slow
superior vs inferior
complete vs incomplete
simple vs complex

27. *Security of data*: The safeguarding of data from misappropriation or unauthorized alteration or loss.

secure vs insecure
good vs bad
definite vs uncertain
complete vs incomplete

28. *Documentation*: The recorded description of an information system. This includes formal instructions for the utilization of the system.

clear vs hazy
available vs unavailable
complete vs incomplete
current vs obsolete

29. *Expectations*: The set of attributes or features of the computer-based information products or services that a user considers reasonable and due from the computer-based information support rendered within his organization.

pleased vs displeased
high vs low
definite vs uncertain
optimistic vs pessimistic

30. *Understanding of systems*: The degree of comprehension that a user possesses about the computer-based information systems or services that are provided.

high vs low
sufficient vs insufficient
complete vs incomplete
easy vs hard

31. *Perceived utility*: The user's judgment about the relative balance between the cost and the considered usefulness of the computer-based information products or services that are provided. The costs include any costs related to providing the resource, including money, time, manpower, and opportunity. The usefulness includes any benefits that the user believes to be derived from the support.

high vs low
positive vs negative
sufficient vs insufficient
useful vs useless

32. *Confidence in the systems*: The user's feelings of assurance or certainty about the systems provided.

high vs low
strong vs weak
definite vs uncertain
good vs bad

33. *Feeling of participation*: The degree of involvement and commitment which the user shares with the EDP staff and others toward the functioning of the computer-based information sytems and services.

positive vs negative
encouraged vs repelled
sufficient vs insufficient
involved vs uninvolved

34. *Feeling of control*: The user's awareness of the personal power or lack of power to regulate, direct or dominate the development, alteration, and /or execution of the computer-based information systems or services which serve the user's perceived function.

high vs low
sufficient vs insufficient
precise vs vague
strong vs weak

35. *Degree of training*: The amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the computer capability that is unavailable.

complete vs incomplete
sufficient vs insufficient
high vs low
superior vs inferior

36. *Job effects*: The changes in job freedom and job performance that are ascertained by the user as resulting from modifications induced by the computer-based information systems and services.

liberating vs inhibiting
significant vs insignificant
good vs bad
valuable vs worthless

37. *Organizational Position of the EDP Function*: The hierarchical relationship of the EDP function to the overall organizational structure.

appropriate vs inappropriate
strong vs weak
clear vs hazy
progressive vs regressive

38. *Flexibility of Systems*: The capacity of the information system to change or to adjust in response to new conditions, demands, or circumstances.

flexible vs rigid
versatile vs limited
sufficient vs insufficient
high vs low

39. *Integration of systems*: The ability of systems to communicate/transmit data between systems servicing different functional areas.

complete vs incomplete
sufficient vs insufficient
successful vs unsuccessful
good vs bad[1]

[1]Research reported here was conducted by Dr. Pearson as part of his dissertation requirements. He has copyrighted the measurement instrument. Use of the instrument for other than research purposes should be preceded by permission from him.

IVES, OLSON & BAROUDI

SHORT FORM USER SATISFACTION INSTRUMENT

Source: Ives, Blake and Margrethe H. Olson and Jack J. Baroudi. "The Measurement of User Information Satisfaction" Communications of the ACM October, 1983.

How adequately do you feel the data processing group meets the information processing needs of your area of responsibility?

Very well Adequately Marginally Poorly

How adequately do you feel the data processing group meets the needs of the broader class of users they serve?

Very well Adequately Marginally Poorly

Data processing support can be judged on two criteria; efficiency and effectiveness. Efficiency deals with how well they do what they do. Are reports on time? Are projects developed within budget? Effectiveness takes a broader focus. Are they doing the right things? Are critical "life-blood" applications being developed? Are new computer technologies being successfully integrated into the organization?

How *efficient* do you feel the data processing group is?

Very efficient Fairly efficient
Somewhat inefficient Very inefficient

How *effective* do you feel the data processing group is?

Very effective Fairly effective
Somewhat ineffective Very ineffective

DOLL AND TORKAZADEH RESEARCH INSTRUMENT

Source: Doll, William J. And Gholamreza Torkzadeh. "The Measurement of End-User Computing Satisfaction" MIS Quarterly June, 1988.

* Indicates items included in the final instrument. A five point Likert scale was utilized ranging from: (1) almost never to (5) almost always.

Measures of End-User Computing Satisfaction — Forty Items Used in Pilot Study

1. Is the system flexible?
2. Does the system provide out-of-date information?
3. Is it easy to correct the errors?
4. Do you enjoy using the system?
5. Do you think the output is presented in a useful format?
6. Is the system difficult to operate?
7. Are you satisfied with the accuracy of the system?
8. Is the information clear?
9. Are you happy with the layout of the output?
10. Is the system accurate?
11. Does the system provide sufficient information?
12. Does the system provide up-to-date information?
13. Do you trust the information provided by the system?
14. Do you get the information you need in time?
15. Do you find the output relevant?
16. Do you feel the output is reliable?
17. Does the system provide too much information?
18. Do you find the information up-to-date?
19. Does the system provide reports that seem to be just about exactly what you need?
20. Is the system successful?*
21. Is the system easy to use?
22. Is the system user friendly?
23. Are the reports complete?
24. Does the system provide the precise information you need?
25. Is the system efficient?
26. Is the output easy to understand?
27. Is the system troublesome?
28. Is the system convenient?
29. Is the system difficult to interact with?
30. Does the system provide comprehensive information?
31. Do you think the system is reliable?
32. Would you like more concise output?
33. Does the information content meet your needs?
34. Does the information you receive require correction?
35. Do you find the system dependable?
36. Would you like the system to be modified or redesigned?
37. Do you think the reports you receive are somewhat out-of-date?
38. Are you satisfied with the system?*
39. Would you like the format modified?
40. Do you get information fast enough?

* Criterion question.

BARKI AND HARTWICK RESEARCH INSTRUMENT

Source: Barki, Henri and Jon Hartwick. "Measuring User Participation, User Involvement, and User Attitude" MIS Quarterly March, 1994.

Responses to all questions were on a dichotomous scale -- yes/no.

1	Were you a member of the team that developed this system?
2	Were you the leader of the project team?
3	Was the time that you spent on the project team charged to the systems development budget?
4	Was your performance on the project team evaluated by the management of your own department?
5	Did you have responsibility for estimating development costs of the new system?
6	Did you have responsibility for estimating the benefits of the new system?
7	Did you have responsibility for requesting additional funds to cover unforeseen time/cost overruns?
8	Did you have responsibility for selecting the hardware and/or software needed for the new system?
9	Did you have responsibility for the success of the new system?
10	For the development of this system, analysts from the Information Systems/Data Processing Department were assigned to and located in our department.
11	For the development of this system, a member of the Information Systems/Data Processing staff acted as "formal liaison" between my department and Information Systems/Data Processing.
12	For the development of this system, a member of my department acted as "formal liaison" between my department and Information Systems/Data Processing.
13	Evaluation of the Information Systems/Data Processing staff's performance has been or will be influenced by my own personal evaluation of the new system's success.
14	Evaluation of the Information Systems/Data Processing staff's performance has been or will be influenced by my department's evaluation of the new system's success.
A1	I had main responsibility for the development project (during system definition/during physical design/during implementation). [An average of items 15, 16, and 17.]
A2	Information Systems/Data Processing staff drew up a formalized agreement of the work to be done (during system definition/during physical design/during implementation). [An average of items 18, 19, and 20.]
A3	I was able to make changes to the formalized agreement of work to be done (during system definition/during physical design/during implementation). [An average of items 21, 22, and 23.]
A4	The Information Systems/Data Processing staff kept me informed concerning progress and/or problems (during system definition/during physical design/during implementation). [An average of items 24, 25, and 26.]
A5	I formally reviewed work done by Information Systems/Data Processing staff (during system definition/during physical design/during implementation). [An average of items 27, 28, and 29.]
A6	I formally approved work done by the Information Systems/Data Processing staff (during system definition/during physical design/during implementation). [An average of items 30, 31, and 32.]
A7	I signed off a formalized agreement of the work done by the Information Systems/Data Processing staff (during system definition/during physical design/during implementation). [An average of items 33, 34, and 35.]

Participation Items for the System Definition Phase

Item Number	Question
15	I had main responsibility for the development project during system definition.
18	Information Systems/Data Processing staff drew up a formalized agreement of the work to be done during system definition.
21	I was able to make changes to the formalized agreement of work to be done during system definition.
24	The Information Systems/Data Processing staff kept me informed concerning progress and/or problems during system definition.
27	I formally reviewed work done by Information Systems/Data Processing staff during system definition.
30	I formally approved work done by the Information Systems/Data Processing staff during system definition.
33	I signed off a formalized agreement of the work done by the Information Systems/Data Processing staff during system definition.
36	I was interviewed by the Information Systems/Data Processing staff during the system definition phase.
37	I responded to questionnaires administered by the Information Systems/Data Processing staff during the system definition phase.
38	I developed the information requirements analysis (i.e., the analysis of user needs) for this system.
39	I evaluated an information requirements analysis developed by Information Systems/Data Processing.
40	I approved an information requirements analysis developed by the Information Systems/Data Processing staff.
41	I developed a cost/benefit analysis for this system.
42	I evaluated a cost/benefit analysis developed by the Information Systems/Data Processing staff.
43	I approved a cost/benefit analysis developed by the Information Systems/Data Processing staff.

Participation Items for the Physical Design Phase

Item Number	Question
16	I had main responsibility for the development project during physical design.
19	Information Systems/Data Processing staff drew up a formalized agreement of the work to be done during physical design.
22	I was able to make changes to the formalized agreement of work to be done during physical design.
25	The Information Systems/Data Processing staff kept me informed concerning progress and/or problems during physical design.
28	I formally reviewed work done by Information Systems/Data Processing staff during physical design.
31	I formally approved work done by the Information Systems/Data Processing staff during physical design.
34	I signed off a formalized agreement of the work done by the Information Systems/Data Processing staff during physical design.
44	For this system, I defined/helped define input/output forms.

45	For this system, I defined/helped define screen layouts.
46	For this system, I defined/helped define report formats.
47	I developed system controls and/or security procedures for this system.
48	I evaluated system controls and/or security procedures developed by Information Systems/Data Processing.
49	I approved system controls and/or security procedures developed by Information Systems/Data Processing.
50	The Information Systems/Data Processing staff developed a prototype of the new system for me.
51	The Information Systems/Data Processing staff presented a detailed walk-through of the system procedures and processes for me.

Participation Items for the Implementation Phase

Item Number	Question
17	I had main responsibility for the development project during implementation.
20	Information Systems/Data Processing staff drew up a formalized agreement of the work to be done during implementation.
23	I was able to make changes to the formalized agreement of work to be done during implementation.
26	The Information Systems/Data Processing staff kept me informed concerning progress and/or problems during implementation.
29	I formally reviewed work done by Information Systems/Data Processing staff during implementation.
32	I formally approved work done by the Information Systems/Data Processing staff during implementation.
35	I signed off a formalized agreement of the work done by the Information Systems/Data Processing staff during implementation.
52	I developed test data specifications for this system.
53	I reviewed the results of system tests done by the Information Systems/Data Processing staff.
54	I approved the results of system tests done by the Information Systems/Data Processing staff.
55	The Information Systems/Data Processing staff held a "special event" to introduce the system to me.
56	I was trained in the use of this system.
57	I designed the user training program for this system.
58	I trained other users to use this system.
59	I created the user procedures manual for this system.

VITA

Kevin Fitzgerald, an "Army brat" was born in New York City in 1944 and lived around the United States, Japan for two years and France for three years. He graduated from Saint Thomas Aquinas High School in Fort Lauderdale, Florida. Upon graduation he joined the U. S. Army and served in the U. S. Army Honor Guard, 3 rd. Infantry Regiment, Ft. Myer (Arlington) Virginia for his entire period of service.

Upon separation as a Sergeant E-5 he entered the University of Florida and graduated in 1970 with a BSBA in Accounting. A CPA, he had a twenty year business career before beginning work on his Ph. D. at the University of Tennessee, Knoxville. His business career consisted of five years with Arthur Andersen & Co., eight years corporate accounting and finance and most recently seven years in corporate logistics management. His last position before returning to school was as Senior Vice President - Purchasing & Distribution for Scotty's, Inc. a half billion dollar building supply company headquartered in Winter Haven, Florida.

He and his wife of twenty-seven years, Elayne, a teacher at Lakeland Senior High School reside in Lakeland, Florida.