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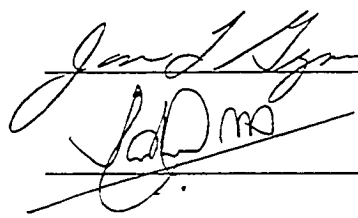
AN INVESTIGATION OF THE ORGANIZATIONAL IMPLEMENTATION OF

COMPUTER AIDED SOFTWARE ENGINEERING TOOLS:

A MULTIPLE CASE STUDY

The members of the committee approve the doctoral
dissertation of Bernhard A. Reeh

Jan L. Guynes
Supervising Professor



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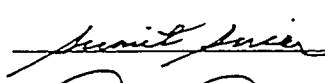

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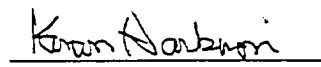

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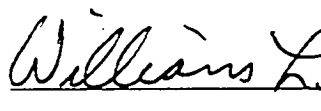

Dean of the Graduate School

AN INVESTIGATION OF THE ORGANIZATIONAL IMPLEMENTATION OF COMPUTER AIDED SOFTWARE ENGINEERING TOOLS: A MULTIPLE CASE STUDY

by

BERNHARD REEH

Presented to the Faculty of the Graduate School of

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of the Requirements

for the Degree of

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Most heartfelt thanks must also go to my parents and friends. Their loving support and encouragement have been a source of strength and stability throughout my education, during the writing of this dissertation, and throughout my life.

December 12, 1994

ABSTRACT

AN INVESTIGATION OF THE ORGANIZATIONAL IMPLEMENTATION OF COMPUTER AIDED SOFTWARE ENGINEERING TOOLS: A MULTIPLE CASE STUDY

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Bernhard A. Reeh, Ph.D.

The University of Texas of Texas at Arlington, 1995

Supervising Professor: Jan L. Guynes

Frequently, Computer Aided Software Engineering (CASE) tools are purchased, but they are used much less than originally expected or not used at all. This lack of an effective use of CASE tools is a fundamental problem of wasted resources, considering the high costs for acquiring and implementing CASE tools. The purpose of this study was to investigate management of the acquisition and implementation process of these tools on the organizational level. Understanding how organizational actions relate to a CASE tool's implementation success not only can contribute to knowledge of how these tools should be introduced, but also can lead to the development of effective strategies for planning and managing the acquisition and implementation of other organizational innovations.

This dissertation investigated perceptions of CASE tool related characteristics and implementation management strategies and their relationship with the tool's implementation success. This is one of the first studies that examines these relationships at both organizational and end user levels.

Because of the exploratory nature of this study and its information requirements, a multiple case study approach was selected. At the organizational level, data were primarily collected through interviews. Questionnaires and follow-up phone interviews were employed at the user level. For each organization, the results were analyzed separately for the organizational and individual levels, then compared and integrated. The results of this study were derived from cross-organizational analysis of the results.

Organizations that reported the CASE tool's implementation success differed in various ways from organizations that were less successful. At the more successful organizations, management's initial expectations with regard to the usability of the tool and its benefits were more realistic. Additionally, management had more realistic expectations with regard to the required learning curve and provided sufficient time and opportunity for developers to learn its use. Finally, more successful organizations more effectively managed the transition process and its political dynamics.

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CHAPTER 1

INTRODUCTION

1.1 Organizational Relevance of Innovative Information Technologies

Organizations are increasingly seeking competitive advantage from their innovative use of a variety of information technologies (IT). These benefits may originate from the effective targeting of IT for strategic purposes, from the efficient management of these technologies, or from a combination of these approaches.

Optimal usage of a new technology and the effective management of its organizational diffusion should be primary objectives of present MIS organizations [Agarwal, Higgins, and Tanniru, 1991]. In spite of the strategic relevance of keeping pace with technological progress, the capability of most organizations to absorb and apply information technology lags far behind the available opportunities [Raho, Belohlav, and Fiedler, 1987; Niederman, Brancheau, and Wetherbe, 1991]. Therefore, it is not surprising that facilitating organizational learning of a new technology and understanding its impact have been identified as key concerns by MIS managers, requiring additional research [Brancheau and Wetherby, 1987; Grover and Sabherwal, 1989; Watson and Brancheau, 1991; Niederman, Brancheau, and Wetherbe, 1991; Clark, 1992].

Despite these concerns, little research has been conducted to improve our understanding of the relationships between IT management strategies and the successful use of IT in organizations [Zmud, Boynton, and Jacobs, 1987; Moore and Benbasat, 1991]. There is also no empirical research which addresses how to facilitate organizational learning required for the adoption of IT innovations and their use [Brancheau and Wetherbe, 1990; Kwon, 1990]. Progress has often been very slow because technology-oriented people have not been sufficiently

concerned with the critical implementation success factors. This lack of understanding of the adoption and implementation process is especially apparent for Computer Aided Software Engineering (CASE) tools.

1.2 CASE Technology and its Organizational Impacts

The term CASE is an acronym for Computer-Aided Software Engineering [Yourdon, 1986]. Definitions for CASE include:

* "software for software" [Henderson and Sinfonis, 1989, p.5];

* "programs to automate the software development process" [Stamps, 1987, p.55];

* "a philosophy used as a template to guide the planning and implementation of an environment" [Case, 1985, p.55];

* "software to support any of the steps of planning, analysis, design, construction, and maintenance of information systems; tools which input or use information stored in an IS design database or 'repository' " [Everest and Alanis, 1993, p.228];

* "tools and methods to support an engineering approach to software development at all stages of the process" [Forte and Norman, 1992, p.28].

For the purpose of this paper, we have followed the definition of Forte and Norman. They referred to "software engineering" as a well-defined, coordinated and repeatable activity with widely accepted representations, design rules, and standards of quality. This definition emphasizes the need for a strict methodology directing the development process.

CASE promises to assist an organization not only by reducing development and maintenance costs, but also by developing better information systems more quickly, and managing and controlling the development life cycle more effectively [Lee, Chen and Norman, 1991]. Therefore, it provides the potential for information system (IS) functions to help their organizations' core business to deal more competently and promptly with internal and external opportunities and problems.

CASE involves changes to how MIS approaches systems development. It provides capabilities such as easy modification of computer drawn diagrams, automated control of design aspects, and information integration and reuse through a central repository. This technology makes it possible to introduce semi-formal and formal methods to the development process more efficiently by eliminating much of their clerical overhead. It has extended team efforts through coordination technology, project-wide consistency checking, and shared design data. In many cases, CASE has "unlinearized" software development in such a way that the process can be more interactive and iterative, more adjustable to individual project requirements [Boake, 1991]. For most organizations, CASE tools are innovations, since they are considered to be new by the people or the organizations that are targets of their adoption [Rogers, 1983].

1.3 Innovation Theory

Although considerable research is still required, classical diffusion of innovation theory has contributed some well developed concepts and a large body of empirical results relevant to the study of technology evaluation, adoption, and implementation [Fichman, 1992]. This theory provides a framework for estimating the likely rate of diffusion of a technology. In addition, it identifies several innovation related factors that facilitate or slow down technology adoption.

The theory incorporates both adoption and diffusion processes. The diffusion process focuses on the dissemination of new ideas from the sources of the innovation to its adopters. This view, also regarded as the supply side, has been examined by researchers in marketing [Robertson and Gatignon, 1986; Mahajan, Muller and Bass, 1990] and economics [Jensen, 1982; Chatterjee and Eliashberg, 1990]. The adoption, or innovation response, is a decision process which concentrates on the evaluation and adoption of an innovation by each of its potential final adopters. This view looks at the demand side and is more prevalent in the research on IT

dissemination. A major difference between both processes is that adoption is considered more an individual matter, while diffusion occurs among organizations or persons [Rogers, 1983].

Certain types of innovations go through an intermediate step. Before they are adopted by the final end-users, they have to be adopted by one or more intermediate levels. For example, one or more decision makers may first need to adopt an expensive or labor intensive innovation. Afterwards, this innovation needs to be diffused within the organization and adopted by its intended final end users. This internal diffusion process can be accelerated or slowed down by the management of the implementation process. Appropriate implementation strategies can support the process, while inappropriate ones can constrain it. CASE tools provide such an example.

CASE tools usually require substantial resources and effort for their effective implementation. Because of this enormous investment and the potential organizational impact of this technology, they are usually acquired at the organizational level. However, they are, in fact, used at the individual level to achieve the intended benefits.

This two-stage organizational implementation process is characterized by a separation of organizational and individual adoption decisions [Leonard-Barton, 1988; Lucas et al., 1990]. As outlined in Figure 1.1 a variety of internal and external factors can effect the diffusion of an innovation. Before an innovation is adopted by either an organization or an individual, it is diffused in the market. The developer or vendor of the innovation distributes it to the adopting organizations. The success of market penetration is determined by various factors, which are of primary interest to marketing research [Gatignon and Roberson, 1989; Mahajan, Muller, and Bass, 1990]. This diffusion process leads to the organizational adoption decision. This is the introductory "go or no go" decision, which is conducted by individuals evaluating an innovation for use by their organization. After this decision, the innovation has to be diffused throughout the organization with the intent to have it used by all targeted users of the innovation. The individual

adoption decision, or innovation response, represents the attitudinal and behavioral reaction within the organization by the targeted users. These responses determine the degree to which the innovation is utilized and if its potential benefits can be achieved.

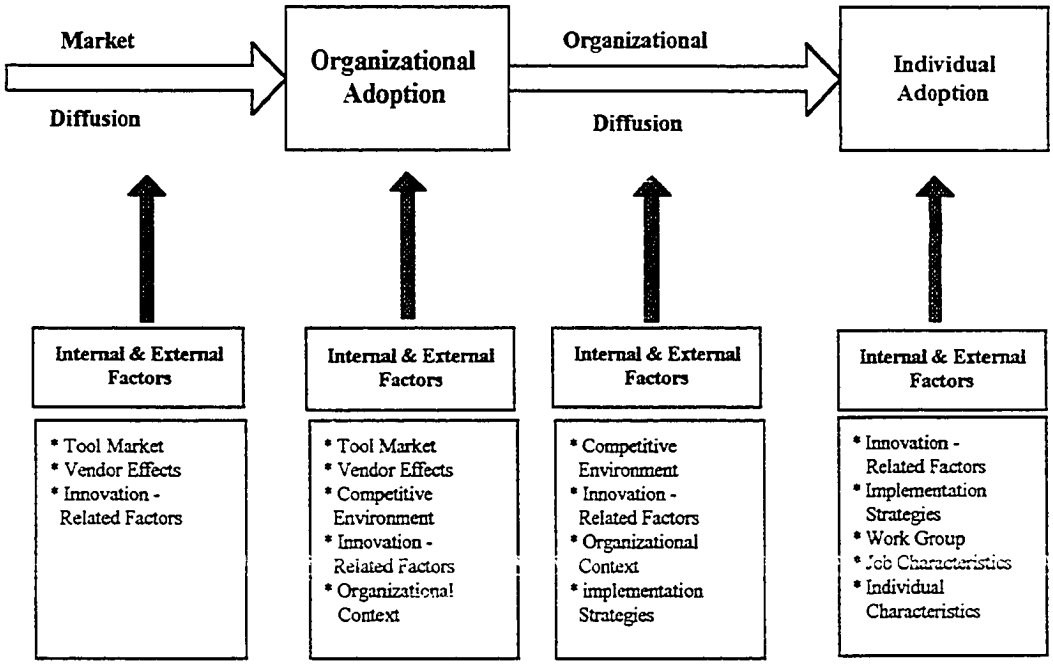

Figure 1.1: The Conceptual Diffusion-Adoption Model

The innovation response may be made within the context of different degrees of independence. If use of the innovation is wholly optional, the potential user is free to choose a response decision somewhere between total adoption and total rejection. Rogers [1983] calls this process a contingent innovation decision. If the decision is contingent, it faces the challenge that it needs to win approval through the political processes of conflict and bargaining [Zaltman, Duncan, and Holbek, 1973]. At the other extreme, if the usage is ordered and the potential user wishes to stay with the organization, use of the innovation cannot be rejected. Management may

intervene with forms of control and influence, ranging from clear directives to subtle indications of support [Leonard-Barton and Deschamps, 1988]. However, individuals have the freedom and power to slow down, block, underutilize, or undermine the adoption of the innovation [Keen, 1977; Kimberly, 1981; Leonard-Barton and Kraus, 1985; Leonard-Barton, 1987, 1988]. These innovation responses determine the degree to which the innovation is utilized and if its potential benefits can be achieved. The effects of unsuccessful innovations, caused by this type of direct or indirect rejection, have harmed many organizations. As it is outlined in the next section, this also applies to CASE tools.

1.4 Statement of Problem

Frequently, CASE tools are purchased, but only a portion of their functionality is used, or they are not used at all. CASE tools are often referred to as "shelfware", toys, or pure documentation aids [Vaughan, 1994; Rubin, 1991; Drotos and Burgetz, 1990]. It is estimated that two years after acquisition, about 70% of the tools are no longer used [Rubin, 1991]. There are other estimates that the portion is actually 85% [Keyes, 1992]. For those still in use, it is estimated that only 5% [Keyes, 1992] to 10% [Rubin, 1990] of the intended audience are using them in an effective manner.

In 1992, Forrester Research Inc. questioned senior MIS managers at fifty Fortune 1,000 companies about their experiences with CASE tools [Yuen and Spurgeon, 1992]. The results of the study indicated that the level of perceived user satisfaction with CASE was mixed; i.e., only twenty-five percent of the respondents felt that they achieved the expected benefits.

This lack of an effective use of CASE tools is a fundamental problem of wasted resources, considering that CASE tools cost, per user, between $10,000 [Forte, 1990] and $50,000 [Perry, 1992]. With projected growth rates for the broadly-defined worldwide CASE

market of 20% to 30% per year, growing from $2 billion in 1990 to $5 billion in 1993 [Forte, 1991], this indicates an ever increasing importance of the problem.

Despite ongoing review and critique, IT implementation research appears to have resulted in incomplete and inconclusive results [Franz and Robey, 1987; Kwong and Zmud, 1987; Markus and Robey, 1988; Davis, Bagozzi, and Warshaw, 1989]. Therefore, knowledge transfer and utilization of the results and experiences pertaining to the institutionalization of innovations have been very limited in the context of IT implementation [Iivary, 1986]. More specifically, very little research has been published about the implementation of CASE tools [Orlikowski, 1993; Wynekoop, 1992], in spite of the problems with their implementation.

This study addresses the mentioned implementation problems with CASE tools and the lack of a consistent and conclusive theoretical basis for their implementation. The problem is approached by examining why, after an initial adoption decision, many organizations have such difficulties in effectively implementing CASE technology.

1.5 Key Research Questions

Three fundamental aspects of the adoption of CASE tools and their implementation process were studied. As outlined in Figure 1.2, the three primary areas of research of this study included the effect of innovation-related factors on the organizational adoption decision, the organizational diffusion process, and the individual adoption decision. In addition, the effects of various implementation management strategies on the organizational diffusion process and the individual adoption decision were examined. The following research questions were addressed.

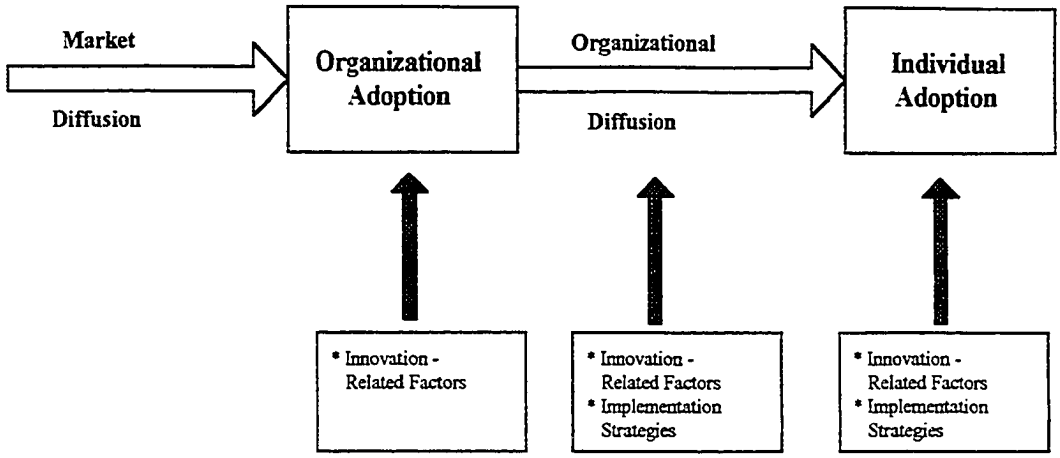

Figure 1.2: The Research Model

1.5.1 Organizational Adoption

* What factors determine an organization's decision to acquire a specific CASE tool?

* What adoption-related factors are related to the CASE tool's implementation success?

1.5.2 Organizational Diffusion

* What is the relationship between selected innovation related-factors and the organizational diffusion of that CASE tool?

* What is the relationship between selected innovation related factors and the effectiveness of the use of the CASE tool?

* What strategies do organizations use to manage the implementation process of acquired CASE tools?

* What is the relationship between active change management and the organizational diffusion of that CASE tool?

* What is the relationship between active change management and the effectiveness of the use of the CASE tool?

* What is the relationship between active transition management and the organizational diffusion of that CASE tool?

* What is the relationship between active transition management and the effectiveness of the use of the CASE tool?

* What is the relationship between active management of the political dynamics of the change process and the organizational diffusion of that CASE tool?

* What is the relationship between active management of the political dynamics of the change process and the effectiveness of the use of the CASE tool?

1.5.3 Individual Adoption

* What is the relationship between selected innovation related factors and the individual level of use of that CASE tool?

* What is the relationship between selected innovation related factors and the satisfaction of individual end-users with the CASE tool?

* What is the relationship between active change management and the individual level of use of that CASE tool?

* What is the relationship between active change management and the satisfaction of individual end-users with the CASE tool?

* What is the relationship between active transition management and the individual level of use of that CASE tool?

* What is the relationship between active transition management and the satisfaction of individual end-users with the CASE tool?

* What is the relationship between active management of the political dynamics of the change process and the individual level of use of that CASE tool?

* What is the relationship between active management of the political dynamics of the change process and the satisfaction of individual end-users with the CASE tool?

1.6 Importance of Research

This study benefits both the academic community and practitioners. It is one of the first studies to examine and compare, systematically, the effectiveness of various organizational implementation strategies. By considering both innovation and implementation management

related factors, a more in-depth understanding of the acquisition and implementation process was expected. Additionally, this research is one of very few studies which examines diffusion theory at both organizational and individual levels.

IS professionals within organizations could gain by obtaining help in more effectively and efficiently introducing CASE technology into their organization. This would result in fewer wasted resources with regard to capital, personnel, and interruption of work flow. CASE vendors could profit by receiving information that would allow them to improve their marketing strategy by being better able to address the critical success factors for a successful implementation of their products. By effectively applying CASE, IS departments should benefit by being better able to take advantage of the promises of this technology. Above all, the most important promise of this research is to make a contribution toward the goal of generating a theory-based framework that would assist an organization with planning and managing the issues relevant to the introduction of technical innovations.

1.7 Dissertation Guide

The remainder of the dissertation is organized into five additional chapters. Chapter Two reviews previous diffusion of innovation studies and their relationship with the research questions proposed by this study. The chapter begins with a discussion of the need to integrate different perspectives to study the diffusion of innovations. It follows with a review of empirical IT-related studies within classical diffusion theory that relate to the suggested research questions. Afterwards, studies supporting the proposed implementation strategies are assessed. This chapter ends with a discussion of research studies that examine the adoption of CASE tools. Chapter Three presents the proposed research methodology. It starts with an evaluation of the case study approach, followed by clarification of the appropriateness of this approach for the proposed research problem. In addition, sample selection and sample size determination are

discussed. It is followed by a review of the operationalization of the implementation factors and outcomes. The results for each investigated organization are presented in Chapter Four. In Chapter Five, a cross-organizational analysis of the results is conducted. Conclusions are proposed based on the comparison and integration of results from the individual organizations. Finally, Chapter Six discusses the significance and implications of the research results for practice and theory, along with a review of the contributions, strengths, limitations, and possible extensions of the research.

CHAPTER 2

LITERATURE REVIEW

To date, little research has been conducted to examine how CASE tools are adopted by organizations, diffused within these social structures, or assessed by their intended end users. This problem has been addressed by this study from two sides, utilizing a factor-based approach, as presented within classical diffusion theory, in conjunction with a process-based approach, operationalized as three implementation strategies.

2.1 The Factor Perspective within Classical Diffusion Theory

A diversity of individual, organizational, and technical variables have been explored as being potentially relevant to IS implementation effectiveness. Factor research seeks various factors that are associated with implementation success or failure.

Rogers [1983] provided a synthesis of over 3,000 previous studies of adoption and diffusion of innovations. The main elements in his approach to diffusion of innovation are: (1) the innovation, (2) which is communicated through certain channels, (3) over time, (4) among the members of a social system.

In the context of classical diffusion theory, an innovation can be described by at least five key characteristics. Depending on how they are perceived by the adopters of the innovation, they determine the actual rate and pattern of its diffusion and adoption:

* **Relative Advantage** - how much better an innovation is perceived to be, compared to the product or idea it displaces.

* **Compatibility** - how consistent an innovation is perceived to be with regard to existing values, past experiences, and the needs of the targeted adopters.

* **Triability** - how well the innovation can be learned, understood, and applied.

* **Observability** - how visible the results of an innovation are to others.

* **Complexity** - how difficult an innovation is perceived to be to learn and use.

It is assumed that an innovation in IT that fulfills these five criteria has greater potential for rapid and widespread adoption than one that lacks one or more of these properties [Rogers, 1983]. It is further assumed that a CASE tool needs these perceived characteristics to be successfully implemented. Previous IT diffusion studies have claimed the relevance of innovation characteristics in general [Leonard-Barton, 1987a; Lucas et al., 1990]. In addition, these specific innovation related characteristics have shown to be related to the implementation success of different types of IT innovations.

Relative Advantage: IS researchers have observed a relationship between usefulness of a specific innovation and its implementation success. For example, Adams [1992] cited a positive relationship between the advantage of voice and e-mail systems and implementation success; Moore and Benbasat [1991] identified it for the adoption of personal workstations. Wynekoop [1991] found relative advantage to be positively related to the acceptance and level of use of CASE tools. Based on the results of previous research, it is expected that there is a positive relationship between the perceived relative advantage of a CASE tool and its implementation success.

Compatibility: Previous IT diffusion studies claimed that an innovation should result in as little individual and organizational change as possible to be successfully implemented. Lucas et al. [1990] identified this requirement for decision support systems. In addition, an IT innovation should be compatible with the existing organizational and task related context [Leonard-Barton, 1988; Peters and Waterman, 1982]. This claim has been supported for medical innovations in hospitals [Meyer and Goes, 1988] and for personal workstations [Moore and Benbasat, 1991]. In practitioner journals, a variety of authors claimed that the support of an

already existing methodology through a CASE tool should considerably increase its compatibility and, therefore, the chances of the technology to be adopted [Smith and Oman, 1990; Martin, 1990; Rubin, 1990, 1991]. Based on these results and claims, it is expected that there is a positive relationship between the compatibility of a CASE tool with the work environment of its end users and its implementation success.

Triability of an Innovation: A variety of diffusion studies have noted a positive relationship between the triability of an IT innovation and the success of its adoption. This requirement has been identified for personal workstations [Moore and Benbasat, 1991], UPC scanning systems [Lund, 1982], and for a variety of other IT innovations [Leonard-Barton, 1988]. Based on their results, this study assumes that the possibility of potential adopters of CASE tools to evaluate these tools before hand, e.g. through pilot projects, is positively related to their implementation success.

Observability: Visibility of the results of an innovation have been associated with a successful implementation process. Observability of the results of personal workstations [Moore and Benbasat, 1991] and of medical innovations in hospitals [Meyer and Goes, 1988] have been found to be related to their implementation success. It is assumed that, if adopters can be recognized for their efforts, for example by creating a supportive environment, the chances of a successful adoption can be considerably increased [Gray, Brancheau and Kozar, 1992].

Complexity: Leonard-Barton [1988] and Meyer and Goes [1988] found low complexity or high ease of use of an innovation to be positively related to the implementation success of a variety of IT innovations. It has been shown that the perceived complexity of voice and e-mail [Adams et al., 1992], material requirement systems [Cooper and Zmud, 1990], and personal workstations [Moore and Benbasat, 1991] is negatively related to their implementation success. Wynekoop [1991] identified this relationship for CASE tools. Further, it has been claimed that, to reduce perceived complexity, there should be adequate and timely training not only in the use

of the tool, but also in the required software development and project management philosophy [Roberts, 1992].

2.2 Innovation Process Strategies

Process research deals more with the occurrence of events over time [Franz and Robey, 1987], with the relationships among the people involved in the implementation process, and with how they approach the implementation process [Lucas, Ginzberg, and Schultz, 1990]. It focuses on the relationship between the implementor of the new system and the potential user. Managing the organizational change that takes place during the development of the system is highlighted [Ginzberg, 1981]. Rather than centering around technical activities, the process research stream focuses on social change activities [Lewin, 1952]. As with any other change, there are also psychological and social dynamics in the implementation process of CASE tools that require attention [Chen, Nunamaker, and Weber, 1989; Orlikowski, 1989; Kemerer, 1988].

The congruence model of organizational behavior [Nadler and Tushman, 1981, 1992] focuses on the relationships among the people involved and how they should approach the implementation or change process. In contrast to the factor approach (e.g., Rogers [1983]), the model acknowledges the fact that individuals, tasks, strategies, and environments may differ among organizations. Therefore, different patterns of organization and management should be the best in different circumstances. Despite these contingencies, three fundamental challenges common to all implementation processes need to be overcome [Nadler, 1991]: resistance, control, and power.

2.2.1 Resistance and the Need to Motivate Change

An individual within an organization may be resistant to change for several reasons [Markus, 1983; Kotter and Schlesinger, 1979]. Resistance may be caused by a perceived loss of

stability, security, or autonomy. Individuals might be afraid of the unknown or of not being able to handle the new situation as well as the previous one. People also resist because of ideological reasons or simply because they see no improvement in the new situation. In any case, for a successful implementation, this resistance has to be managed by motivating changes in the behavior of these individuals. Prior literature has approached the need to motivate change in a variety of ways.

Lucas et al. [1990] found that a DSS achieves higher implementation success if its adopters face high problem urgency. This conclusion reflects Lewin's [1952] claim that people need to be "unfrozen" out of their inertia by surfacing dissatisfaction with the present situation, before they are willing to accept something new.

Participation in the change process promises to reduce resistance by informing individuals about the change process and its implications, and by building ownership of the change [Kotter and Schlesinger, 1979]. Lack of participation in decisions, lack of teamwork and collaboration, and miscommunication have been observed as being serious barriers to the introduction and implementation of IT innovations [Wynekoop, 1991; Azani and Khorramshahgol, 1993; Leonard-Barton, 1988]. Specifically, its importance has been identified for the adoption of spreadsheets [Brancheau and Wetherbe, 1990] and for hospital procedures [Coe and Barnhill, 1967].

Within the management literature, a variety of empirical studies emphasize the importance of the reward system for overcoming resistance and motivating change [Kerr, 1991; Quinn, 1992]. Equity theory claims that adopters act based on the rewards that they receive for their actions [Monge, Cozzens, and Contractor, 1992; Joshi, 1991]. For example, Kwon [1990] found the MIS climate in universities to be related to their adoption of IT innovations.

Training and access to help have been identified to be important for the adoption of structured analysis techniques [Leonard-Barton, 1987a]. Receiving the technical knowledge

required to use a complex innovation like CASE successfully is critical to implementors and potential adopters, as it not only enables, but also motivates change within end users. Social psychologists have employed learning models to describe this [Huber, 1991].

While previous studies have analyzed specific aspects of overcoming resistance and motivating change, this study took a more comprehensive approach. We expected a positive relationship between management of resistance and the implementation success of CASE tools.

2.2.2 Control and the Need to Manage the Transition

The change process frequently disrupts and overthrows existing formal systems of management control, as most formal organizational arrangements are developed for stable states, not for transition states. This can result in the organization's loss of the ability to coordinate its work effectively. Nadler [1981] proposed the need to control and manage this transition process. No previous empirical studies could be identified that addressed this challenge directly, but a variety of studies investigated separate aspects of managing the transition process.

If people are uncertain about their situation after the implementation of the innovation, it is common that resistance and confusion develop during the transition process [Becker and Harris, 1977]. Therefore, a clear and explicit description of the transition process, the desired future state, its implications for the individuals, and why the change is necessary needs to be developed and convincingly communicated. The effectiveness of the communication process has been identified to be related to the implementation success of various IT innovations [Ball et al., 1987; Brancheau and Wetherbe, 1990; Nilakanta and Scamell, 1990]. In the context of CASE tools, Wynekoop [1991] found that communication supports the transition process, but may be misleading by creating unrealistic expectations.

A consistent approach is required to manage the transition process effectively [Nadler, 1981]. For example, consistency in management commitment was identified as being relevant for

the implementation success of CASE tools [Wynekoop, 1991]. In addition, getting consistent support from many opinion leaders within an organization has been shown to be required for the implementation process of database management systems [Ball et al., 1987] and spreadsheet software [Brancheau and Wetherbe, 1990].

Interim structures are recommended to manage the transition process [Nadler, 1981]. A transition plan, explicit resources for the transition, transition management structures, and a transition manager can be important elements to manage the change process. The relevance of institutionalized champions of an innovation and of leadership during the change process for a successful management of the transition process have been suggested [Alexander, 1989; Leonard-Barton, 1987a, 1988].

It has been suggested that effective feedback mechanisms for transition managers are required to control the transition process [Nadler, 1981]. Effective feedback requires an effective communication process [Ball et al., 1987; Nilakanta and Scamell, 1990]. In this study, we examined how management of the transition process affected the implementation success of CASE tools.

2.2.3 Power and the Need to Shape the Political Dynamics of Change

An organization can be regarded as a political system, composed of individuals, groups, and coalitions striving for power within informal organizational arrangements [Tushman, 1977]. During change processes, this familiar struggle for power frequently becomes more intense, as the dismantling of the old and the emergence of new order creates ambiguity and promises the possibility of overturning or changing the balance of power among stakeholders.

For an innovation to be successful, support for change must reach a critical mass [Raghavan and Chand, 1989]. Opinion leaders can be successfully persuaded through the establishment of change agents [Alexander, 1989; Leonard-Barton, 1987a]. In many cases, these

people can considerably influence the attitudes and behaviors of other people [Ball et al., 1987; Brancheau and Wetherbe, 1990].

Actual and perceived management support have been shown to be relevant for the successful adoption of various IT innovations [Leonard-Barton, 1987a; Leonard-Barton and Deschamps, 1988; Lucas et al., 1990; Meyer and Goes, 1988; Zmud, 1984; Bush et al., 1987]. Management shows commitment by actively pursuing proper planning, organizing, staffing, leadership, and control. This is necessary for providing an appropriate social structure for a successful introduction of an IT innovation [Wilson, 1989; Yuen and Spurgeon, 1992; Bates, 1992].

Prior studies have indicated that the effectiveness of the communication process in shaping the dynamics of the change process is positively related to the implementation success of IT innovations [Ball et al., 1987; Brancheau and Wetherbe, 1990; Nilakanta and Scamell, 1990]. By supplying a vocabulary to delineate the change and symbols that have emotional impact, new power centers can be created or brought together under a common banner.

Uncertainty and turbulence can create dysfunctional effects within an organization. One way to compensate for these effects is by attempting to maintain stability in the form of structures, people, or physical locations [Nadler, 1981]. This study assessed the relevance of managing resistance, controlling the change process, and managing any power struggle during the transition process.

2.3 Integration of Implementation Factor and Implementation Process Perspectives

Different paradigms have been used to examine the diffusion and adoption of innovations [Kwon and Zmud, 1987]. It is quite common to separate IT diffusion research into implementation factor and implementation process approaches [Ginzberg, 1979, 1980]. However, both approaches need to be combined to get a more complete model of the

implementation process [Anderson, 1992; Fichman, 1992; Lucas et al., 1981, 1990; Kwon and Zmud, 1987].

Implementation factors (represented by innovation characteristics) and implementation processes (represented by the management of the implementation process) can actually be interdependent [Leonard-Barton, 1988; Leonard-Barton and Deschamps, 1988; Fichman, 1992]. For example, higher innovation complexity might result in the need for more user involvement and more user training. Therefore, this study has considered the possible impact of the selected innovation related characteristics on the potential success of the analyzed implementation strategies.

Following the example of Leonard-Barton [1988], individual innovation responses are influenced by two major forces. First, the characteristics of an innovation are as important for the end user as they are for the organization with regard to its adoption decision. Second, innovation responses are highly influenced by the manner in which the implementation process is managed. While the factor approach is represented by innovation-related classical diffusion variables, the process approach is considered through the examination of management implementation strategies.

2.4 Prior Implementation Research Related to CASE Tools

While practitioners have published many articles about the implementation of CASE tools, only two researchers, to date, have examined the implementation process of CASE tools and their impact on the organization.

Wynekoop [1991] tested if individuals' a priori perceptions of a CASE tool and organizational actions influence the success of its implementation. Seven organizations which used one specific CASE tool for about the same length of time were studied.

Her study was based on the assumption that individual actions determine organizational behavior, yet are constrained and influenced by the organization. CASE implementation was studied at both the individual (micro) and organizational level (macro). On the individual level, a causal model was developed that tested the impact of perceived CASE tool attributes, individual expectations, top-down communication, and perceived management commitment on individual implementation outcomes. Individual data were collected from potential end-users of the CASE tool through surveys. They were analyzed with a path analysis of the proposed model. On the organizational level, the impact of management commitment, amount of communication, and provided organizational resources on organizational implementation success were analyzed. The data were collected through interviews with people knowledgeable about the acquisition and implementation of that CASE tool. The qualitative findings were used to explain the results from the individual level.

Although most relationships in the path model could be supported, there were two unexpected outcomes. Perceived management commitment and communication amount were negatively related to the acceptance of the tool. Both of these initially counter-intuitive findings were explained with data from the organizational level. Management commitment in the form of mandating an innovation adoption can have a negative effect if end-users have incompatible interests. Additionally, management communication has a negative effect if it creates unrealistic expectations. In both cases, the combined analysis of the individual level with quantitative measures and the organizational level with qualitative measures clarified the results of the study. More significant relationships were identified, better explanations for the relationships were found, and unexpected relationships could be explained.

Wynekoop's study has influenced the design of this research project in various ways. The separated data collection on the individual and organizational levels and the later integrated analysis have proved to be valuable. In addition, in contrast to many other empirical adoption

studies, this one examines implementation success more thoroughly by using more than one construct to assess both individual and organizational implementation success. However, Wynekoop's study differs from the proposed study in several ways. While her dissertation was based on a survey approach testing a proposed model, this study was based on a multiple case study approach. Whereas the objective of her study was to confirm or disconfirm specific implementation success factors, this study was exploratory and explanatory. In addition, the current study defined the individual organization, not the end user, as the unit of analysis.

Orlikowski [1993] took a different approach to examine the adoption of CASE tools. She attempted a shift toward regarding the adoption and use of these tools as a form of organizational change process. It was argued that such a perspective would allow an organization to anticipate, explain, and evaluate different experiences and consequences subsequent to the introduction of CASE tools in organizations. The specified primary research question was: "What are the critical elements that shape the organizational changes associated with the adoption and use of CASE tools?" [p.310].

Using a grounded theory approach, the longitudinal experiences of two organizations were examined with regard to their adoption and use of CASE. This iterative approach combined inductive concepts derived from real-world observations with insights from existing formal diffusion of innovation theory. Its focus was on developing a context-based, process-oriented description and explanation of the investigated phenomenon.

The primary unit of analysis was the organization or the organizational department that experiences changes resulting from the introduction of a CASE tool. Triangulation across data collection methods (unstructured versus semi-structured interviewing, documentation review versus observation) and across data sources (multiple informants at different levels of the firm and from different functional affiliations) were used to increase construct and internal validity of the study. The results of her study included a conceptualization of the organizational change

process that is caused by the introduction of a CASE tool and a listing of various factors that were claimed to impact its implementation success.

The resulting process model was based upon the premise that human action and institutional context interact over time. The specified process begins with the decision to adopt a tool, followed by its adoption and use. It ends with the discussion of the consequences of adopting and using this tool. This process is characterized by a continuous interaction with its environmental, organizational, and IS context.

Orlikowski suggested that to account for the experiences and outcomes associated with the introduction of CASE tools, it is advisable to analyze the intentions and actions of key players, the social context within which the CASE tools are implemented, and the implementation process followed by the organization. It is advocated to understand the implementation of CASE tools as a process of organizational change over time and not only as the installation of a new technology.

There are several parallels between Orlikowski's study and the current study. Both studies investigated not only the implementation process of CASE tools but also its consequences. The research design of both studies was characterized by a multiple case study approach. In addition, both studies defined the organization as a unit of analysis.

Both Wynekoop's survey study [1991] and Orlikowski's multiple case study [1993] were influential for this research project with regard to their research paradigms. The first study demonstrated the value of separating the organizational and individual levels of adoption and took the first step in assessing implementation success in a more differentiated way. The second study looked at the implementation of an innovation as an organizational change process that needs to be managed and uses a case methodology that is justified by the complexity of this process and its context.

CHAPTER 3

RESEARCH METHODOLOGY AND VARIABLE OPERATIONALIZATION

3.1 The Case Study as a Research Approach

In an effort to extend and improve IT diffusion theory, it has been suggested that researchers should examine fewer organizations, in more detail, using replicated case study or ethnographic research methods. The case study research strategy is suitable for IT innovations that are characterized by an organizational level of adoption, a high knowledge burden for their users, and high user interdependence (e.g., CASE technology). IT innovations with these characteristics are regarded as too diverse and too intricate in their nature and impact to be successfully studied with cross-sectional methods [Fichman, 1992]. However, the results of individual case studies have been criticized for their lack of generalizability [Eisenhardt, 1989]. Therefore, the multiple case study approach was selected.

Use of the case study approach to examine the diffusion of CASE tools was selected for several additional reasons. This research strategy can result in theory that is novel, testable, and empirically valid [Eisenhardt, 1989], making it especially appropriate in new or underdeveloped topic areas such as diffusion of innovation theory. Case studies are appropriate for situations when a "how" or "why" question is being asked about a contemporary set of events, over which the investigator has little control [Yin, 1989; Leonard-Barton, 1990]. Case research has also been proposed for sticky and practice-based problems, where the experience of the participants is relevant and the context of activities is crucial [Bonoma, 1983]. The adoption process of CASE tools is characterized by this type of situation.

A large portion of the relatively small number of published case studies is characterized by methodological weaknesses [Benbasat, Goldstein, and Mead, 1987]. In recent years, a few researchers have addressed this problem by proposing general guidelines for conducting case research [i.e., Eisenhardt, 1989 and Yin, 1989]. However, none of these guidelines can be applied blindly, following any simple cookbook approach. Some of these guidelines are:

* define the research question before you start to collect data
* if possible develop a priori constructs
* avoid a priori theory and hypotheses
* specify your population
* use theoretical, not random sampling
* use multiple data collection methods
* combine qualitative and quantitative data
* use multiple investigators
* overlap data collection and analysis, including field notes
* use flexible and opportunistic data collection methods
* begin with within-case analysis
* use divergent techniques for cross-case pattern search
* iteratively tabulate evidence for each construct
* use replication, not sampling, logic across cases
* search for the why behind the relationships
* compare results with conflicting and with similar literature
* stop data collection when theoretical saturation is reached.

Throughout this study, both questionnaires and interviews were utilized to collect data about the context of CASE implementation. Questionnaires provided an efficient way of collecting data from many subjects within an organization, resulting in a more representative picture of the context of CASE implementation. Interviews were used to explore details, by providing a more comprehensive picture of the reality and information to interpret the results of the survey. Combining these data collection methods provided a richer understanding of the context of CASE implementation.

To keep an open mind for the context, this study abstained from prior commitment to hypotheses before gathering data. While this strategy yields less explanation of variability in

statistical terms, it provides a more fertile understanding of how and why processes and outcomes happen [Markus and Robey, 1988; Yin, 1993].

3.2 Sample Size and Sample Selection

There are no rules for sample size in qualitative research that this study could follow [Patton, 1990]. Eisenhardt [1989] proposed that between four and ten cases usually works well. She claimed that with less than four cases, it might be difficult to generate theory, yet with more than ten cases, it quickly becomes difficult to cope with complexity and volume of the data. Previous multiple case studies differed considerably in the number of cases that were examined (Table 3.1). While Orlikowski [1993] investigated only two organizations, Wynekoop [1991] examined seven organizations and Leonard-Barton [1990] assessed ten organizations. Therefore, data were collected from six organizations.

The organizations selected for this study have experienced various levels of implementation success. To control for variability caused by different CASE tool features, only the implementation of integrated CASE tools was examined. Following the definition of Norman and Forte [1992], this study broadly outlined CASE tools as "tools and methods to support an engineering approach to software development at all stages of the process" [p.28]. They were defined as integrated CASE tools, if, with the help of a repository, they seamlessly integrate all phases of the system development life cycle. Specifically, only the adoption and implementation of IEF by Texas Instruments was investigated. This CASE tool was selected because of its popularity in the market. This restriction attempted to control for any variability in implementation success caused by the existence of fundamentally different tool features and different problems with the tool itself. Its purpose was to obtain more specific and significant results. However, through this decision, it became more difficult to generalize the results of this study. For example, because of its methodology dependence, the implementation of IEF might

provide more of a culture shock for the adopting organization and, therefore, it might result in the need for additional or different implementation strategies.

Table 3.1: Recent Examples of Multiple Case Studies

Study	Description of Cases	Research Problem	Data Sources
Orlikowski (1993)	2 organizations	Adoption of CASE tools	Interviews Archives Observation
Banker & Kauffman (1991)	20 projects (in 1 organization)	Productivity implications of CASE tools	Interviews Archives Observation
Leonard-Barton (1987)	1 organization	Implementation of Structured Software Methodologies	Interviews Observation
Leonard-Barton (1990)	10 cases of technology tansfer (in 10 organizations)	Adoption of technical innovations	Interviews Archives Observation
Muir (1991)	6 organizations	Technology Transfer & Organizational Learning	Interviews Archives
Wynekoop (1991)	7 organizations	Adoption of CASE tools	Interviews Surveys Archives
Leonard-Barton (1988)	10 innovations (in 10 organizations)	Internal Technology Transfer	Interviews Experiment Observation
Zagorsky (1990)	1 organization	Implementation of CASE	Interviews Observation
Pettigrew (1988)	8 organizations	Strategic Change & Competitiveness	Interviews Archives

Initially, only organizations within the Dallas/Fort Worth area were approached with a written request to participate in this study. It was expected that this geographical restriction would have no significant effect on the generalizability of the results, since there was no reason to believe that firms in the Dallas/Fort Worth metroplex were different from others that use CASE tools. The names and addresses of organizations using IEF were collected from the attendence list of a national IEF users conference, from personal references, and through the local IEF users group. However, after considerable research, only six organizations which met the criteria could be identified. Since only four of these organizations agreed to participate, it was regarded as necessary to include organizations beyond this geographical area. Through references of a local consultant, four more organizations were approached by phone. These organizations are located in Kansas, Arizona, Minnesota, and Connecticut. Two of them agreed to participate. Lack of available time was stated as the primary reason for not participating in this study. Altogether the CASE tool adoption and implementation process was investigated at six organizations.

All of the examined organizations had used the CASE tool for at least one year and had used it to produce at least one large production system. This helped to control for the effects of the expected initial learning curve. To encourage participation and open communication, all participants and organizations were assured confidentiality throughout the study. It was emphasized that names, individual responses, and corporate information would not be disclosed. In addition, complimentary reports of the results were promissed to all participants upon request. As soon as there was commitment from an organization, a date for data collection was requested.

3.3 Research Design

3.3.1 Research Approach

Multiple organizational levels usually interact during the process of technical innovation [Tornatzki and Fleischer, 1990]. Decisions may be made at multiple levels in parallel, since

many technological innovations in organizations simultaneously affect individuals, groups, and organizations. Therefore, different levels of analysis had to be combined to fully understand the implementation process of IT and to address the problem of inconclusive research findings [Markus and Robey, 1988; Leonard-Barton, 1988, 1990; Fichman, 1992; Wynekoop, 1992].

This study examined both the individual and organizational levels of adoption. Coleman [1986] and Orlikowski and Robey [1991] proposed such a mixed level strategy of starting from the macrosocial level, moving down to the micro-level of individual behavior, and returning back to the organizational level. For example, Wynekoop [1992] examined the implementation process of a specific CASE tool in different organizations. She observed that the introduction of this new tool into a work setting (macro-level) changed the expectations of the individual end-users about the tool (micro-level). These changes altered the acceptance and level of use of the tool (micro-level), which in turn changed the end-user's work environment and the results of the latter (macro-level). Because of this interdependence, different levels need to be observed within the same time period. Although CASE technology can be expected to be acquired at the organizational level, the effectiveness of its use depends on the individual level. Therefore, this study has collected and analyzed data at both the individual and the organizational levels. This resulted in triangulation of data sources.

3.3.2 Triangulation of Data Sources and Data Collections Methods

Data were collected at the organizational level through semi-structured interviews. If permitted by the interviewed managers, their responses were taped to ensure a complete recording of their responses. For each organization, at least one IS manager involved in the acquisition and implementation process of the CASE tool was interviewed. This qualitative data collection provided a more in-depth understanding of the phenomena. The interview focused on the research questions to provide comparable information among the investigated organizations. In

addition, the interviewees were encouraged to discuss any aspect of the CASE tool and its implementation process.

At the individual level, data were collected through written surveys. Questionnaires were distributed to all system developers that were regarded by management as users of the acquired CASE tool. There was the potential risk that the manager would select only those users with a more positive opinion about the CASE tool and its implementation process. However, this potential bias had to be accepted to be able to identify CASE tool users. Unstructured interviews were conducted with one or two end user volunteers, which indicated their willingness to be interviewed on the returned questionnaires. This provided a more in-depth understanding of their responses. The representativeness of the interviewed users was evaluated by comparing their demographic data with that of the other surveyed users. Table 3.2 decribes the data sources for each of the six organizations.

Table 3.2: Data Source at each Organization

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F
Org. Level:						
* Title of Interviewed Manager	Manager for Distribution / NRP Development	Project Manager in the IS Dep.	CIO	Project Manager in the IS Dep.	Manager of Applications Development	Manger of Business and Change Management
Ind. Level:						
* No. of Responses	45	10	8	7	5	4
* No. of Surveys Distrbuted	110	20	50	15	6	40
* Response Rate	41%	50%	16%	47%	83%	10%
* No. of Interviewed Developers	2	1	1	2	1	1

Triangulation of data collection methods was utilized by combining quantitative and qualitative approaches. Quantitative data collection methods were based on close-ended survey questions, while qualitative approaches were in the form of open-ended survey questions and semi-structured interviews. This approach provided a richer basis for interpreting and validating results [Trend, 1979; McGrath, 1983; Kaplan and Duchon, 1988].

3.3.3 Refinement of Data Collection Instruments and Data Collection Procedure

This study started with pilot interviews at two organizations to refine the proposed manager interviews and questionnaire for the individual level (Figure 3.1). These two organizations were chosen from the Dallas / Fort Worth metroplex area. Based on what the interviewed managers deemed important for the adoption process in their organization, this process resulted in the incorporation of additional factors into the following interviews and the survey instrument. For example, additional questions were added for a separate evalutation of the CASE tool and its underlying methodology. The pilot studies also indicated the need for a more thorough assessment of the relationship between the CASE tool's underlying methodology and its implementation success.

The refined questionnaire was pilot tested with these two organizations to identify ambiguities, evaluate construct validity, length and question design. Factors related to unexpected responses to open-ended questions were discussed in greater detail during later interviews of managers. The pilot study resulted in adjustments to the content and format of the questionnaire and terminology used in the survey.

After the pilot interviews and pilot surveys were analyzed and adjustments to these instruments had been completed, attempts were made to collect data from both organizational and individual levels within the same time period by requesting each CASE user to complete the survey while the IS manager was interviewed. For those respondents who could not complete the

survey at that time, return envelopes were provided. The final analysis of results integrated both levels by using organizational data to explain data from the individual level, and results from the individual level to interpret organizational results.

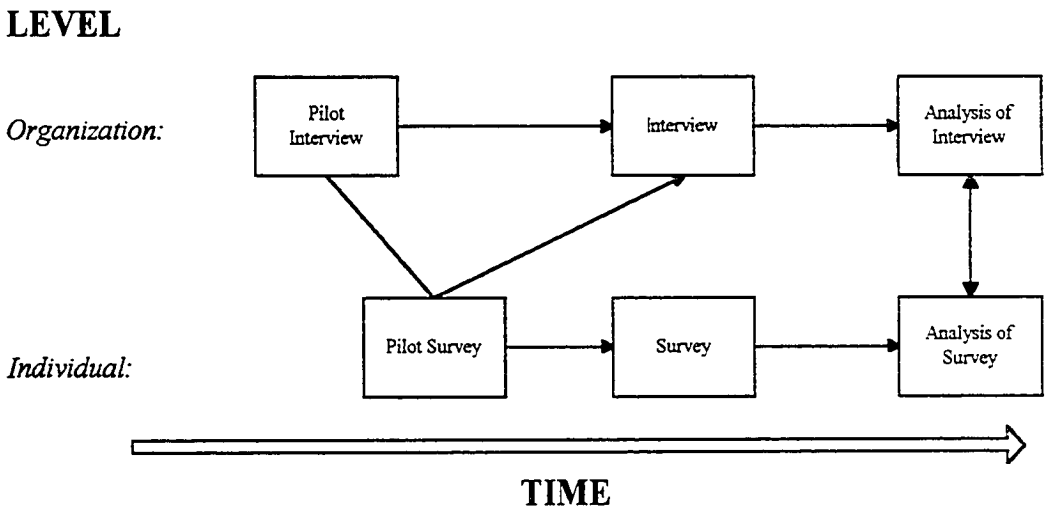

Figure 3.1: Model of the Methodological Approach

3.3.4 Operationalization of Implementation Strategies and Innovation-Related Factors

Both IS managers and CASE users were asked to evaluate several CASE tool-related factors and implementation strategies. For case studies, a priori specification of constructs has been recommended [Van de Ven and Poole, 1990; Eisenhardt, 1989, 1991]. The objective is to measure the constructs more accurately and to have guidance in collecting data, not to get overwhelmed by their volume.

Change management, transition management, and management of political dynamics represented the implementation strategies to be investigated. In Table 3.3, the constructs underlying the selected operational measures for each implementation strategy are listed to indicate what data were collected. Most of these activities were proposed by prior researchers.

Following Nadler and Tushman's [1977; 1980; 1992] example, the operational measures were combined into three constructs.

Table 3.3: Measures for Implementation Strategies

CONSTRUCTS	OPERATIONAL MEASURES
* change management:	- dissatisfaction with existing development environment - user participation - existence of formal rewards - existence of informal rewards - provision of time and opportunity to learn tool
* transition management:	- communication of clear image of future development environment - complete and consistent management of implementation process - special organizational arrangements for implementation process - feedback to management about implementation process - feedback to management about implementation process
* mgt of political dynamics:	- support of all key power groups - active guidance by established leaders - promotion of tool through management - emphasis on continuity and stability throughout implementation process

Most of the proposed innovation-related factors (i.e., relative advantage, compatibility, triability, result demonstrability, and ease of use) have been assessed by previous diffusion of innovation studies for a variety of IT innovations. For example, Leonard-Barton [1987a] assessed the impact of perceived innovation characteristics on the adoption of structured analysis techniques; Wynekoop [1992] tested the effect of relative advantage and perceived ease of use on the adoption of CASE tools. The operational measures used in this study were derived from an instrument developed by Moore and Benbasat [1991] to measure the perceptions of adopting an

IT innovation within an organizational context. These scales were developed based on experiences with the adoption of personal work stations, but they were designed to be " ... generally applicable to a wide variety of innovations, especially other types of information technologies" [Moore and Benbasat, 1991, p.194]. The constructs for the derived measures for data collection are outlined in Table 3.4.

Table 3.4: Measures for Innovation Related Factors

CONSTRUCTS	OPERATIONAL MEASURE
* relative advantage:	- speed of finishing task - quality of work - ease of doing one's job - effectiveness on the job - control over work
* compatibility:	- compatibility with system development work - compatibility with how one likes to work
* result demonstrability:	- ability to tell others about consequences of use - results of tool use apparent to its user
* ease of use:	- difficulty of learning use of tool - difficulty of learning use of methodology - difficulty of interacting with tool - difficulty of interacting with methodology - overall easy of use

3.3.5 Operationalization of Implementation Outcomes

A more comprehensive approach to the study of adoption of technological innovations requires that a broader range of outcomes be investigated [DeLeon and McLean, 1992; Nelson, 1990; Vanlommel and DeBrander, 1975]. As a result of this study, more than one interdependent measure was employed both at the organizational and at the individual level.

Organizational implementation success was measured, as it was perceived by the interviewed representatives of IS management, based on the diffusion and impact of the adopted CASE tool within the organization. Diffusion implies that organizational members are encouraged to commit to the usage of the innovation. The desired outcome of this process is that the innovation is used by all appropriate personnel within the organization. Organizational diffusion has been measured in different ways. Wynekoop [1991] defined it as the ratio of potential to actual users. She defined potential users as all system developers that, according to the plans of management, are supposed to use a specific CASE tool. Herbert [1991] added two more measures: ratio of systems that would benefit if they would be developed with a CASE tool to the systems that have actually been developed with a CASE tool and ratio of people trained in the use of a CASE tool to people still to be trained.

A CASE tool has a positive impact on the organization if its use results in improved organizational performance [Sullivan, 1985]. This study defined this positive impact as support of operational and strategic goals of organizational work. Based on surveys by Herbert [1991] and Binder, Guzinski, and Phillips [1989], the most frequently mentioned operational goals of software development managers were improvements in the quality of developed systems, in the quality of system documentation, and in productivity of the people involved in system development. Support of strategic organizational goals has been a measure of the perceived importance of the tool in attaining organizational goals. This dual view of organizational implementation success has provided a more complete picture than each one would have done by itself. See Table 3.5 for the constructs underlying the interview questions.

At the individual level, successful implementation of an innovation can be regarded as change plus improvement [Lucas et al., 1990]. Therefore, in this study, individual adoption of a CASE tool was measured in terms of both its level of use and its post-adoption impact. See Table 3.6 for the constructs underlying the survey questions.

Table 3.5: Measures for Organizational Implementation Success

CONSTRUCTS	OPERATIONAL MEASURE
* organizational diffusion	- ratio of potential to actual users of tool - ratio of potential to actual systems developed with tool
* organizational impact	- perceived importance of tool in attaining organizational goals - perceived change in quality of output - perceived change in quality of system documentation - perceived change in productivity

Table 3.6: Measures for Individual Implementation Success

CONSTRUCTS	OPERATIONAL MEASURE
* individual level of use	- portion of tool functionality used - portion of work done with tool - frequency of use of tool
* user satisfaction	- perceived utility from tool - relevancy of provided functionality - effect on job - flexibility of system - understanding of system - convenience of access - integration of system - completeness of output - format of output - currency of output - reliability of output - intention to keep using the tool - congruence with personal objectives

Use is the actual experience of utilizing the CASE tool, indicating that a change has occurred. In several conceptual MIS articles, researchers [e.g., Lucas, 1973; Ives, Hamilton, and

Davis, 1980; Hamilton and Chervany, 1991] have proposed the use of IT as a surrogate measure of its implementation success. In empirical MIS research, the level of use is one of the most frequently reported measures of the success of an information system [DeLone and McLean, 1992; Zmud, 1979]. Level of use was measured along three dimensions: portion of required tool functionality utilized, proportion of work that could be done compared with what is actually done with its help, and frequency of tool use (as adopted from Wynekoop [1991] and Herbert [1991]).

Post-adoption impact was assessed based upon the satisfaction of CASE tool users. This included the user's overall evaluation of the system, its use, and its impact on performance. Orlikowski [1988, 1989] found that system developers may be dissatisfied with a CASE tool, although they use it in their daily work. The measures of this study for user satisfaction with the CASE tool and its results (i.e., perceived utility from tool, relevancy of provided functionality, effect on job, flexibility of system, understanding of system, convenience of access, integration of system, completeness of output, format of output, currency of output, reliability of output, intention to keep using the tool, and congruence with personal objectives) have been derived from Baily and Pearson [1983].

3.4 Analysis of Data

Analysis of case study data is one of the least developed and most challenging parts of doing case studies [Yin, 1989]. This research methodology is considerably less developed than the statistics-based survey approach. It is packed with ambiguities and there are general strategies instead of specific methodological rules [Patton, 1990; Yin, 1989; Miles and Huberman, 1984]. The following two sections outline the approach that was chosen to analyze

the data collected at the organizational and individual levels. The last section presents the selected approach to ensure and test the validity and reliability of the findings.

3.4.1 Data Analysis for Organizational Level

Since the management interview included open-ended questions, it could be expected that the interviewed managers would use different terms to address similar adoption factors and implementation strategies. To make the results comparable across organizations, related concepts were combined into groups of factors and strategies. Frequency distributions were selected to specify how often specific groups of factors and strategies were mentioned across the interviewed organizations.

For the research questions relating innovation related factors and implementation strategies to the organizational implementation success of a CASE tool (Figure 3.2), the collected data were examined for each organization. Initially, managers' evaluation of innovation related factors and implementation strategies were qualitatively compared with those data collected at the user level. Observed discrepancies in the evaluation of the specified constructs resulted in a more in-depth analysis of the available data and in a more differentiated evaluation of those constructs. For example, if the manager claimed a high level of innovation related communication, but users indicated a lack of this type of communication, ineffectiveness of the communication process could be assumed. Afterward, the propositions were analyzed by qualitatively relating the observations for innovation related factors and implementation strategies with the observed organizational implementation success for each individual organization.

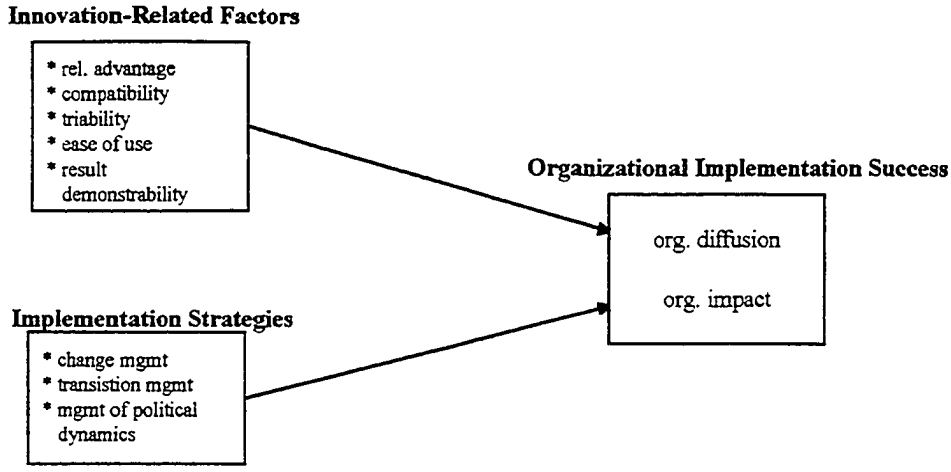

Figure 3.2: Implementation Model at the Organizational Level

3.4.2 Data Analysis for Individual Level

This section addresses the research questions that relate users' opinions about tool related factors and implementation strategies to the degree that they use their CASE tool and are satisfied with its use (Figure 3.3). Understanding the relationships and classification of new observations were both of interest to this study.

Survey results were initially examined within each individual organization. Initially, the responses for each construct were analyzed separately. The responses for each survey question were presented in form of frequency distributions. As part of the cross-organizational analysis, the observations for CASE tool related factors and implementation strategies were related to the reported implementation success. If unexpected relationships were identified at the individual level, the organizational level was further examined to explain the unexpected outcomes.

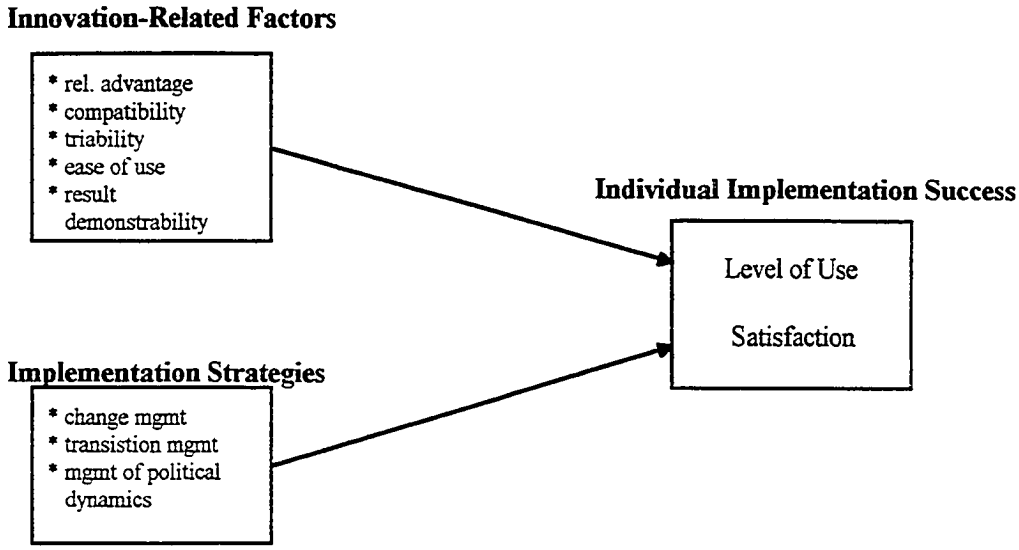

Figure 3.3: Implementation Model at the Individual Level

3.4.3 Reliability and Validity

Before any findings could be interpreted, their validity and reliability needed to be evaluated. Initially, the results were examined for face validity. This implied that results had to concur with the common sense of the investigator. Three additional criteria were proposed to ensure and assess the quality of the proposed conclusions [Kidder, 1981, pp. 7-8]:

* *Construct validity*: establishing correct operational measures for the constructs being studied;
* *External validity*: establishing the domain to which a study's findings can be generalized; and
* *Reliability*: demonstrating that the operations of a study - such as the data collection procedures - can be repeated, with the same results.

This study assessed construct validity on the basis of content validity and convergent validity [Brewer and Hunter, 1989]. All three forms of construct validity were supported by adopting most of the measures in the questionnaire from previously validated diffusion surveys [Moore and Benbasat, 1991; Bailey and Pearson, 1983; Orlikowski, 1993; Wynekoop, 1991; Herbert, 1991; Rai and Howard, 1993]. Additionally, questions were revised or new questions

were constructed, to satisfy the particular needs of this research. By explicitly addressing all three aspects of construct validity, this study improved on previous case studies that were frequently characterized by low concern for this form of validity [Yin, 1989; Benbasat, Goldstein, and Mead, 1987].

Content validity of a construct requires that the data collected with the specified measures provide a representative picture of its different dimensions. Therefore, each construct of this study was assessed based on more than one measure. However, content validity cannot be tested. It is, rather, a judgmental decision and can only be estimated. Cronbach [1971] suggested that experts in the field, familiar with the content of the constructs, evaluate versions of the instrument repeatedly, until some form of consensus is reached. Members of the academic community that are familiar with diffusion of innovation theory judged the content validity of the constructs used in this study. Finally, this study followed Patton's [1990] recommendation to leave the final evaluation of content validity to the reader. This was supported by describing the measures for each construct in Tables 3.3 to 3.6.

The purpose of convergent validity is to establish confidence that agreement among different measurements is caused by their measures' common focus on the construct, not by a shared bias in the research procedures [Patton, 1990; Eisenhardt, 1989]. Convergent validity was estimated by qualitatively comparing the results for each measure from questionnaires with the ones from interviews. As in most cases, the results concurred. There was a high level of confidence in the absence of a shared bias in the data collection method.

The external validity of this study was supported by collecting data from multiple units of analysis. The selection of a variety of contexts has enriched insights and enhanced generalizability of any findings beyond the actually examined cases [Van de Ven and Poole, 1990].

Reliability indicates the precision of measurement scores and how accurately such scores will be reproduced by repeated measurements. In this study, reliability was advocated by making the steps of the research process as operational as possible and by documenting the procedures followed [Yin, 1989]. Reliability of the measures at the individual level was estimated, using Cronbach's alpha [Churchill, 1979]. This measure provides a conservative estimate for a measure's reliability. The estimated reliability depended on the average inter-item correlation and the number of items measuring a construct. Specifically, as the average correlation among items increases and as the number of items increases, the value of alpha increases. A higher alpha indicates higher reliability of the instrument.

In the questionnaire, there were a number of constructs that were measured by using composites of one or more closed-ended response items. These composite measures were analyzed for reliability by using Cronbach's alpha method. The results of these analysis are summarized in Table 3.7.

Results from the analyses indicated that acceptable reliabilities were achieved for all the scales. All constructs had alpha values higher than .7, the value suggested for an exploratory study.

Table 3.7: Reliability of Proposed Constructs

Scale	# of Items	Cronbach's Alpha
Management of Change	5	.71
Management of Transition Process	5	.84
Management of Political Dynamics	4	.82
Relative Advantage	5	.82
Compatibility	2	.80
Result Demonstrability	3	.83
Ease of Use	5	.81
Level of Use	8	.84
Satisfaction	14	.93

CHAPTER 4

ANALYSIS OF RESULTS

4.1 Introduction

Six organizations were investigated. Four organizations were from the Dallas/Fort Worth area, one from Minnesota, and one from Kansas. Each of them had used IEF for at least two years and had developed at least one large application using IEF. At all organizations IS management made the decision to buy the CASE tool. For each organization, IS management was interviewed and questionnaires were distributed to its CASE tool users. The users stated their opinion regarding the CASE tool, management of its implementation process, and its implementation success. In addition to these issues, management was questioned about management of the adoption process.

For each organization, the managerial perspective of the CASE tool's adoption and implementation process are introduced first. This is followed by a discussion of the system developers' perspective on the implementation process. Finally, responses are compared to highlight conformity and disagreement. This comparison provides a more thorough understanding of the tool's implementation process and its success.

4.2 Discussion of Individual Organizations

4.2.1 Organization A

Management Perspective

Organization A is a large national retail company with department stores in all fifty states and Puerto Rico. The dominant portion of its business consists of providing merchandise

and services to consumers through department stores that include catalog departments. It markets predominantly family apparel, shoes, jewelry, accessories and home furnishings.

Organization A's IS department structure was hierarchical, with many organizational levels. It consisted of three major areas: data processing and operations; support; and development. The data processing and operations area managed the data centers and various mainframe software. The support area provided problem resolution for the retail stores. It managed their hardware and communications equipment. The development area was split up by user departments. It consisted of development for retail stores, catalog business, and other businesses (e.g., financial applications). The IS department employed more than 500 people.

A second-level manager was interviewed. He was a manager for "Distribution/NRP Development" in information systems and a member of the committee which implemented the CASE tool. Another manager of the same committee completed a management questionnaire. Data were collected regarding the adoption and implementation process of the tool and its implementation success.

The Acquisition Process

The selection, acquisition, and implementation process was coordinated by a special Advanced Information Technology (AIT) group. During the selection process, this group was supported by an external consulting company. The AIT group came up with two primary requirements with regard to the selection of a CASE tool. First, the tool had to provide a central repository to support the development of an enterprise-wide information architecture. Second, the tool had to provide a structure for standardization to improve the quality of the code and to ease future maintenance.

The final decision was between IEF and another integrated CASE tool. To obtain more information on each tool, a sample project was conducted with each of them. Ease of use and

training were not issues in the selection process because they were assumed to be about equal across both CASE tools. Through the tighter integration of the development phases, IEF provided more structure and consistency throughout the software development process. This promised higher quality of the generated code and higher system developer productivity in the long run. Besides these advantages, IEF had the reputation of having a good track record and Organization A already had a good relationship with TI. Therefore, IEF was purchased in 1990.

Management of the Implementation Process

This organization used several strategies to reduce system developers' and project managers' resistance toward IEF. Two pilot projects were conducted, and their success was used for leverage in convincing others about the benefits of using this tool. During lunch seminars, IEF and Information Engineering (IE) were sold to potential IEF users. In addition, the organization allowed considerable time and opportunity to learn the new development environment because it had heard of IEF's long learning-curve from TI and other organizations. Besides trying to provide sufficient time and training, it attempted to avoid pressure by selecting initial projects that were neither time-critical nor strategic. According to management, user involvement during the adoption and implementation process was not regarded as important and was not aspired to.

The transition process was supported and coordinated by a special project group. This group provided support in setting up IEF and establishing standards for its use. For example, it provided naming standards, policies for the use of information, training, and support for the creation of a basic infrastructure. In addition, the organization used the expertise of internal and external consultants to support and guide its projects. This support was regarded as essential for the innovation's implementation.

Level of Implementation

The use of IEF has lagged behind original expectations. Instead of providing an enterprise-wide system development environment, it has been used only on a very small portion of all suitable projects. All of them were of limited scope. This limited use of IEF did not include integration of the generated systems with other applications. Because fewer projects were using this tool than originally expected by management, there were only a handful of developers using IEF, although many were trained in its use.

Problems with Implementation Strategies

From an organizational perspective, several shortcomings in management of the transition process limited the implementation success of IEF. Weaknesses were noted in all three implementation strategies: change management, transition management, and political dynamics.

a) Management of Resistance to Change

Initially, management did not understand the impact and challenge that the adoption of IEF would have on its system developers. They regarded IEF as just another tool in the organization's toolbox for developing systems. It was assumed that project managers and software developers would be used to change, always seeking a better way of doing their job. Therefore, management assumed that the tool would be quickly assimilated.

In spite of management's knowledge of IEF's long learning curve, they did not provide sufficient time and opportunity for many project managers to introduce this new technology into their projects. Several project managers felt that they could not introduce it, as their application development backlog did not allow them to go through its long learning curve. Based on these assumptions, there was little effort to convince tool users of its benefits.

b) Management of the Transition Process

Management felt that transition management was not sufficiently complete and consistent. The development of the organization's IT architecture was more directed by its developing business needs and by the availability of new technologies than by an overall unifying IT vision or strategy. Therefore, this new tool could not overcome and integrate a highly hierarchical organization, characterized by little cooperation among departments and by highly separate projects. Overall, the introduction of this new tool did not introduce structure into a previously unstructured environment.

Having heard about the challenges of introducing IEF, the organization used the expertise of external consultants for its projects. However, even the consultants' expertise was occasionally insufficient, and they could not provide the required support.

c) Management of Political Dynamics

The use of IEF for developing a corporate information architecture ran into power struggles. IEF as an enterprise-wide system development environment requires organizational standards, policies, and top-down planning. Therefore, many people in middle management had to give up power. However, some of them were not willing and others were not able, because of the pressure of the existing application backlog to support and implement these changes. The resulting power struggle among different interest groups slowed down the adoption of this tool.

Impact of CASE Tool

Organization A was primarily satisfied with the capabilities of IEF and its use, as it related to the few applications that were developed with its help. The quality of the generated code was high and the applications satisfied user requirements. The IE methodology enabled the organization to get a clearer picture of user needs. In addition, it made it easier to adjust existing

applications to changes in business requirements. IEF was regarded as superior over the traditional unstructured approach for many business problems because it enforced consistency and allowed easy modifiability of the generated code. Overall, using the tool resulted in an improved maintainability of the generated applications. With exception of the code generated for its mainframe database, the efficiency of the generated code was satisfactory.

However, there were also some disappointments. Few productivity gains in system development could be observed. Management suspected that the organization had never fully mastered the learning curve, which was considered to be longer than expected. Lacking support for multiple hardware platforms was also severely limiting the usefulness of IEF, as it restricted its organization-wide usability. This was also a limiting factor for the development and operation of a global repository for maintaining a corporate information model.

The tool was regarded as weakest in its front-end elements (i.e., the information systems planning and business area analysis components) and strongest in its back-end capabilities. However, even at the back-end, it was regarded as more useful for certain types of applications than for others. It was regarded as most appropriate for medium-sized applications. For smaller applications, the tool required too much overhead and for larger applications, it did not provide sufficient flexibility. It was regarded as primarily useful for the development of transaction processing and decision support systems which involved a considerable amount of number crunching. Management stated that it lacked capabilities for the development of fully functional graphical user interface (GUI) centered applications.

Overall, management of Organization A reported problems with managing change, the transition process, and its political dynamics. They stated that these shortcomings slowed down the organizational diffusion of the CASE tool. Whenever they used the tool, they were satisfied with its impact on the system development process. However, this organization could not use the tool as frequently as originally expected because it did not provide the expected functionality and

flexibility. While management was satisfied with the impact of the tool, they were very dissatisfied with its level of use.

User Perspective

The CASE tool user survey was distributed to 105 IEF users. Forty-five surveys were returned. The survey instrument measured three issues: user opinions concerning the manner in which different implementation strategies were implemented by management, the perceived importance that these strategies had for implementing the tool, and the manner in which the innovation was evaluated. Survey respondents were asked to mark, from the list provided, the top three or four least and most important implementation strategies. Implementation success was measured, based on the level of use of the tool, its impact on the job performance of these developers, and on their satisfaction with the tool.

Management of the Implementation Process

The implementation process of an innovation can be inhibited for various reasons. The intended end-users might resist its adoption because of its inherent characteristics or because of the manner in which the implementation process is managed. Management of this process needs to consider potential end-user resistance. In addition, the transition process needs careful coordination and direction to avoid chaos and confusion which would affect the implementation success of the innovation. Finally, the political dynamics during this process need to be carefully managed to avoid political tensions which might result in resistance toward the innovation.

a) Management of the Resistance to Change

An innovation cannot be successfully implemented if its potential end users resist its implementation. Therefore, it is important that the implementation process is managed in such a way that no additional resistance is generated and any existing resistance is overcome.

Survey questions related to change management are shown in Table 4.1. As shown, the majority of the respondents at Organization A were not satisfied with the change management process. However, they were more satisfied with what they deemed the most important strategies.

Being provided sufficient time and opportunity to learn the use of the CASE tool was judged as extremely important by most respondents (65%). However, only 49% of the respondents stated that the allocated time and opportunity were either GOOD or VERY GOOD. It is surprising that over 85% stated that they received sufficient training in the tool and its underlying methodology (Table 4.2). Information obtained from follow-up interviews and respondent write-ins revealed that at least one respondent regarded the hiring of consultants as especially helpful. One respondent felt that he received his training too early.

User involvement during the acquisition and implementation phases of an innovation is another strategy frequently used to achieve end user buy-in and to overcome resistance. However, less than 50% of the respondents regarded this strategy as effectively implemented. Several developers had no involvement in the acquisition decision. Fifteen survey respondents rated user participation as one of the most important strategies for managing change, while eleven other respondents rated it least important, indicative of no agreement in the importance of this issue. From a managerial perspective, CASE tools are an organizational innovation, and, as such, acquisition and implementation decisions are generally made at the organizational level. However, from a developer's perspective, it is not surprising that many respondents regarded user participation as important for implementation success of the CASE tool.

Table 4.1: Change Management at Organization A

* sufficient time and opportunity to learn its use

	frequency	percent		frequency
excellent	0	0	least important	0
very good	7	15.6	most important	29
good	15	33.3		
neutral	7	15.6		
fair	12	26.7		
poor	4	8.9		
very poor	0	0		

* user participation in the acquisition and implementation process

	frequency	percent		frequency
excellent	1	2.4	least important	11
very good	9	21.4	most important	15
good	8	19		
neutral	9	21.4		
fair	8	19		
poor	6	14		
very poor	1	2.4		
N/A	3			

* explaining the need for changing the prior system development process

	frequency	percent		frequency
excellent	0	0	least important	9
very good	6	13.6	most important	11
good	16	36.4		
neutral	6	13.6		
fair	8	18.2		
poor	8	18.2		
very poor	0	0		
N/A	1			

* formal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	31
very good	0	0	most important	1
good	3	8.3		
neutral	8	13.6		
fair	8	22.2		
poor	11	30.6		
very poor	6	16.7		
N/A	9			

* informal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	31
very good	0	0	most important	0
good	5	12.8		
neutral	9	23.1		
fair	12	30.8		
poor	8	20.5		
very poor	5	12.8		
N/A	6			

End-user resistance is virtually inevitable if they do not understand the reasons for changing their familiar status quo. Overall, more developers were satisfied then dissatisfied with the explanation of the need for change.

Table 4.2: Training and Support at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	11(25.0)	13(29.5)	14(31.8)	1(2.3)	3(6.8)	2(4.5)	0(0)
* I received sufficient training in utilizing this CASE tool	5(11.1)	20(44.4)	15(33.3)	2(4.4)	2(4.4)	1(2.3)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	4(8.9)	14(31.1)	11(24.4)	4(8.9)	8(17.8)	2(4.4)	2(4.4)

(Note: Numbers in parentheses refer to percentage)

Formal and informal rewards are frequently used strategies to motivate people to take specific actions. However, the results indicate that this strategy was not only not employed at Organization A, but that the majority of respondents also regarded it as one of the least important strategies for the implementation success of the CASE tool. Several respondents considered rewards to be inapplicable for the implementation process of a CASE tool. An interviewed developer stated that most of them did not expect any additional rewards because knowledge of this technology would look good on their resume. This indicates that system developers were motivated to learn and use this innovation and did not expect additional incentives

Of the developers' two most important change management strategies (i.e., time and opportunity to learn the use of the tool and user participation), neither strategy was deemed successful by a majority of respondents. These observations are indicative of a high potential for resistance to change.

b) Transition Management

The adoption of an organizational innovation such as a CASE tool impacts many people and usually requires considerable changes in the systems development environment. The managerial strategies shown in Table 4.3 have been recommended to coordinate and direct the transition process.

Of the five transition management strategies evaluated, the respondents rated the existence of a clear image of the envisioned system development environment as one of the most important factors. However, less than 25% felt that management was effective in demonstrating such a vision. This lack of a clear image may have resulted in resistance and confusion during the transition process.

Completeness and consistency in managing the implementation process was another factor which was mentioned as one of most important strategies for a successful transition process. However, the majority of the respondents were not satisfied with the manner in which this process was managed. It is interesting to note that the respondents that were the most dissatisfied with these issues also regarded them as very important for the implementation process.

System developers mentioned several shortcomings in the transition process. In write-ins to open-ended questions, there were complaints about not enough people being dedicated to the overall support of the product. In addition, one respondent stated that some of the provided support personnel, as well as some of the TI consultants, lacked the required expertise (e.g. IEF's interface with DB2). Another criticism was the lack of available client-server hardware.

Lack of feedback from management and lack of a perceived vision are consistent with the observed shortcomings and inconsistencies in the management of the transition. This could potentially result in confusion and resistance among system developers.

Table 4.3: Management of the Transition Process at Organization A

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	5
very good	3	6.7	most important	23
good	7	15.6		
neutral	13	28.9		
fair	9	20.0		
poor	7	15.6		
very poor	6	13.3		

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	3
very good	1	2.3	most important	19
good	14	31.8		
neutral	6	13.6		
fair	11	25.0		
poor	10	22.7		
very poor	2	4.5		
N/A	1			

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	0	0	least important	10
very good	6	13.6	most important	3
good	13	29.5		
neutral	11	25.0		
fair	10	22.7		
poor	4	9.1		
very poor	0	0		
N/A	1			

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	0	0	least important	14
very good	2	4.4	most important	5
good	9	20.0		
neutral	11	24.4		
fair	10	22.2		
poor	10	22.2		
very poor	3	6.7		

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	2	4.5	least important	16
very good	6	13.6	most important	4
good	11	25.0		
neutral	10	22.7		
fair	10	22.7		
poor	4	9.1		
very poor	1	2.3		
N/A	1			

Special temporary project groups are frequently used to support and guide the transition process. Their work can reduce confusion and resistance on the side of users. There was little agreement on the effectiveness of these groups at Organization A.

One developer reported that a special group was created for the implementation and management of IEF. However, it was rather passive and reactive in its approach. This resulted in a lack of support for standardization and central control, which was reflected by the small number of organizational changes caused by the introduction of IEF. This group did too little to support the development of an enterprise data model by providing hardly any help with the integration of applications and the development of an ISP. The resulting ISP, which was developed within one year, had little organizational impact with regard to providing a basis for planning and integrating future applications. From that perspective, the development of the ISP failed.

Developers experienced several inconsistencies in management of the transition process. Based on the write-in of one respondent, many managers were not able to agree on common standards for systems development. In the opinion of another respondent, inconsistent methodologies were used in conjunction with IEF because some IS managers wanted to continue the use of traditional development methods or tried to shortcut IE. Two developers cited the lack of a clear vision as being responsible for lack of consistency in the implementation process.

c) Management of Political Dynamics

Every organization can be regarded as a political system consisting of individuals and groups struggling for power within formal and informal organizational arrangements. Organizational innovations, such as CASE tools, which have the potential to change the interaction among individuals and groups can affect this political system. The dismantling of the existing system development environment could produce ambiguities and uncertainties which

could result in overturning the existing balance of power among the stakeholders. This struggle for power could negatively affect the implementation success of the innovation. Management needs to oversee the political dynamics during such a change process to avoid having the stakeholders deadlock each other. As can be seen in Table 4.4, there were several weaknesses in managing the political dynamics at Organization A. These political tensions could have affected the implementation success of the CASE tool more than resistance by system developers or chaos during the transition process.

The system developers judged support by key organizational power groups as one of the most important factors for managing the political dynamics of the adoption process. Since there were more respondents criticizing than praising the support by power groups, it can be assumed that not all of these groups effectively supported the implementation process. Respondent write-ins reflected criticism regarding support from the data center and managers of end-user departments. Other respondents complained of apathy of many end-users.

While there was top management commitment and support for this new system development environment, it was not effective in overcoming this power struggle. An interviewed developer blamed different factors for this lack of success. Primarily, top management was suffering from a lack of credibility. Among many system developers, it had the reputation of trying out any new "silver bullet" without making any long-term commitments. In addition, top management did not provide sufficient active guidance for developing an integrated organizational approach toward systems development and for overcoming the established "kingdoms" within the organizational hierarchy.

Active guidance by established leaders was another factor which was regarded as one of the most important strategies in managing the political dynamics of the transition process. By actively pursuing proper planning, organizing, staffing, leadership, and control, management can effectively direct the transition process. This would reduce the possibility of political struggle

among power groups. The responses of the developers indicate, at best, a mixed evaluation of the effectiveness of the leadership. Without their guidance, it is not surprising that most developers did not perceive managerial emphasis on continuity and stability during the transition process.

Table 4.4: Management of the Political Dynamics at Organization A

* support of all key power groups within the organization

	frequency	percent		frequency
excellent	0	0	least important	2
very good	5	11.1	most important	30
good	9	20.0		
neutral	12	26.7		
fair	10	22.2		
poor	7	15.6		
very poor	2	4.4		

* active guidance by established leaders

	frequency	percent		frequency
excellent	0	0	least important	5
very good	5	11.6	most important	13
good	10	23.3		
neutral	11	25.6		
fair	9	20.9		
poor	7	16.3		
very poor	1	2.3		
N/A	2			

* management's explicit emphasis on continuity and stability

	frequency	percent		frequency
excellent	0	0	least important	5
very good	2	4.7	most important	9
good	9	20.9		
neutral	7	16.3		
fair	15	34.9		
poor	6	14		
very poor	4	9.3		
N/A	2			

* promotion of the CASE tool by management

	frequency	percent		frequency
excellent	0	0	least important	11
very good	4	9.1	most important	11
good	11	25.0		
neutral	10	22.7		
fair	14	31.8		
poor	4	9.1		
very poor	1	2.3		
N/A	1			

Management's promotion of the CASE tool was regarded as rather ineffective by the majority of respondents. Many developers considered IEF as just another "sliver bullet". This

was because Organization A had tried many unsuccessful innovations in information systems. People resisted because they experienced these types of innovations before and believed they were never successful. Therefore, they would continue doing their work like always anyway.

Again, less than 50% of respondents were satisfied with what they deemed two of the most important political dynamics issues. Without adequate guidance by established leaders and without management's emphasis on continuity and stability in the implementation process, political tensions could have been created that negatively affected the implementation process of the innovation.

Evaluation of the CASE Tool

Diffusion of innovation research has proposed several innovation related characteristics (e.g., relative advantage, compatibility, ease of use). Past empirical research for various types of innovations has shown that these factors can influence the implementation success of an innovation.

a) Relative Advantage of CASE Tool and Demonstrability of its Results

There was high agreement among the respondents regarding the relative advantages of using the CASE tool, compared with their previous development environment (Table 4.5). Respondents cited improvement in their quality of work, job productivity, and job effectiveness. In addition, many felt that the tool made their job easier. In respondent write-ins, full integration of the CASE tool, consistency within its input and output, and improvements in project management were praised.

The value of using the CASE tool and its underlying methodology was apparent to an overwhelming majority of the respondent developers. Understanding these benefits, they did not perceive any difficulties with demonstrating them to other people.

Table 4.5: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Using this CASE tool improves the quality of my work	5(11.4)	15(34.1)	11(25.0)	7(15.9)	4(9.1)	1(2.3)	1(2.3)
* Using this CASE tool enables me to accomplish tasks more quickly	3 (6.8)	13(29.9)	14(31.8)	9(20.5)	2(4.5)	1(2.3)	2(4.5)
* Using this CASE tool enhances my effectiveness on the job	1(2.3)	13(30.2)	11(25.2)	11(25.6)	4(9.3)	2(4.7)	1(2.3)
* Using this CASE tool makes it more difficult for me to do my job	1(2.3)	3(7.0)	3(2.3)	13(30.2)	10(23.3)	7(16.3)	6(14.0)
* Using this CASE tool gives me less control over my work	2(4.7)	1(2.3)	6(14.0)	6(14.0)	13(30.2)	9(20.9)	6(14.0)
* The value of using this CASE tool is apparent to me	11(25.6)	15(34.1)	10(23.3)	5(11.6)	1(2.3)	1(2.3)	0(0)
* The value of using the methodology is apparent to me	10(22.7)	15(34.8)	11(25.0)	4(9.1)	3(6.8)	0(0)	1(2.3)
* I would have difficulties telling others about the benefits of using this CASE tool	0(0)	3(6.8)	7(15.9)	1(2.3)	10(22.7)	13(29.5)	10(22.7)

(Note: Numbers in parentheses refer to percentage)

b) Organizational and Individual Compatibility

Two-thirds of the respondents experienced significant changes in the system development process after introduction of the CASE tool (Table 4.6). The most significant changes were in the software methodology and their tasks. While there were significant changes in the system development process, changes in the underlying organizational structure and style were judged to be less significant.

Most developers stated that implementation of the CASE tool resulted in fundamental changes in their individual work environment. However, most of them felt comfortable with the implications of using this innovation. Only 14% stated that the CASE tool did not fit well with the way they liked to work. This indicates high motivation of most system developers to adopt this innovation and to adapt to their different needs.

Table 4.6: Organizational and Individual Compatibility of the CASE Tool at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	2(4.4)	6(13.5)	7(15.6)	11(24.4)	13(28.9)	6(13.3)
* Using this CASE tool is not compatible with all aspects of my system development work	9(20.9)	8(18.6)	9(20.9)	5(11.6)	3(7.0)	6(14.0)	3(7.0)
* Implementation of this CASE tool resulted in changes in our tasks	10(22.7)	15(34.1)	10(22.7)	5(11.4)	1(2.3)	2(4.5)	1(2.3)
* Implementation of this CASE tool did not result in changes in org. structure or style	6(13.6)	8(18.2)	7(15.9)	5(11.4)	9(20.5)	5(11.4)	4(9.1)
* I think that using this CASE tool fits well with the way I like to work	6(14.0)	9(20.9)	9(20.9)	13(30.2)	3(7.0)	3(7.0)	0(0)
* Implementation of this CASE tool did not require changes in our hardware architecture	5(11.6)	7(16.3)	5(11.6)	9(20.9)	8(18.6)	4(9.3)	5(11.6)
* Implementation of this tool required changes in the software development methodology	16(37.2)	18(41.9)	5(11.6)	2(4.7)	2(4.7)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

Most respondents had little difficulty learning the tool and its underlying methodology (Table 4.7). While only a few developers expressed problems with the methodology, even fewer judged their interaction with the CASE tool as difficult.

Implementation Experiences

a) Level of Use

As shown in Table 4.8, most of the respondents used the tool frequently. In addition, the majority used it for more than 40% of their work. Considering that almost 60% of the respondents had used the tool for more than one year, this shows that these system developers were very experienced in the use of the tool.

Table 4.7: The CASE Tool's Ease of Use at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	4(9.3)	2(4.7)	8(18.6)	4(9.3)	10(23.3)	9(20.9)	6(14.0)
* Learning to use the underlying methodology has been difficult for me	2(4.5)	3(6.8)	10(22.7)	4(9.1)	9(20.5)	9(20.5)	7(15.9)
* My interaction with this CASE tool is clear and understandable	5(11.6)	11(25.6)	10(23.3)	10(23.3)	6(14.0)	0(0)	1(2.3)
* The methodology underlying the CASE tool is clear and understandable	5(11.4)	10(22.7)	13(29.5)	4(9.1)	8(18.2)	4(9.1)	0(0)
* Overall, I believe that this CASE tool is easy to use	4(9.3)	8(18.6)	14(32.6)	5(11.6)	9(20.9)	2(4.7)	1(2.3)

(Note: Numbers in parentheses refer to percentage)

Table 4.8: Level of Use of the CASE Tool at Organization A

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
11(25.6)	11(25.6)	4(9.3)	8(18.6)	6(14.0)	3(7.0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
10(23.3)	1(2.3)	9(20.9)	11(25.6)	12(27.9)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
9(20.9)	8(18.6)	7(16.3)	10(23.3)	9(20.9)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	5(11.4)	13(29.5)	14(31.8)	12(27.3)

(Note: Numbers in parentheses refer to percentage)

b) Impact of the Use of the CASE Tool

The CASE tool had a positive impact on the system development process (Table 4.9). Most developers cited a better understanding of business requirements, as well as better quality

work. Many of them felt that the use of the tool improved their productivity, and that the tool reduced the effort to maintain new systems. However, over 70% of the respondents did not experience any savings in the overall cost for system development.

Table 4.9: Impact of the Use of the CASE Tool at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	10(23.3)	14(32.6)	7(16.3)	6(14.0)	5(11.6)	0(0)	1(2.3)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	3(7.1)	12(28.6)	10(23.8)	11(26.2)	4(9.5)	0(0)	2(4.8)
* The tool reduces the effort to maintain new systems	4(9.3)	12(27.9)	8(18.6)	11(25.6)	2(4.7)	2(4.7)	4(9.3)
* My productivity has increased because of this CASE tool	3(7.1)	10(23.8)	7(16.7)	11(26.2)	6(14.3)	3(7.1)	2(4.8)
* Overall costs for system development are lower	3(7.0)	3(7.0)	6(14.0)	14(32.6)	9(20.9)	5(11.6)	3(7.0)
* My customers are more satisfied with my performance	3(7.1)	3(7.1)	5(11.9)	24(57.1)	4(9.5)	1(2.4)	2(4.8)
* My manager is more satisfied with my performance	1(2.4)	7(16.7)	4(9.5)	23(54.8)	6(14.3)	0(0)	1(2.4)
* The tool facilitates planning and controlling	3(7.1)	7(16.7)	15(35.7)	8(19.0)	8(19.0)	0(0)	1(2.3)

(Note: Numbers in parentheses refer to percentage)

One respondent mentioned the extensive time required for analysis when using the CASE tool. In his opinion, this has resulted in the impression of outside power groups that projects do not progress. This lack of perceived cost savings and extensive analysis time could explain why few developers experienced higher customer or management satisfaction with their performance. Overall, the data indicate that the new development tool had a positive effect on the system development process, but that these improvements did not result in positive feedback for most system developers.

c) Satisfaction with the Tool and its Use

As seen in Table 4.10, most of the responding developers were satisfied with the overall use of the tool. The benefits that they experienced from the use of the tool outweighed its costs. Most of those using the CASE tool did so because they liked it, 76% wanted to continue using it and 72% wanted to even increase its use. The very high inclination of the respondents to use this tool might be a result of their perceived benefits from its use (e.g. ease of use, system quality, system maintainability) and their lesser emphasis on some of its less favorable aspects (e.g., cost of system development).

In general, the respondents were slightly less satisfied with the specific results of the tool. While many claimed that their work was more up to date and that the capabilities of this tool are easy to use, only 36% experienced any increased performance on their job since the introduction of the tool. This result is surprising, because the majority of the developers experienced improvements in their productivity and quality of work. One possible explanation might be that the context of the development process obstructed the realization of immediate improvements in system development. Inhibiting factors in the system development context (e.g., organizational structure or organizational politics) could have suppressed improvements in the overall job performance of individual developers.

Many developers were less satisfied with some of the specific capabilities of the tool. Less than half of them regarded it as flexible enough to be changed or adjusted in response to new conditions, demands, or circumstances, and less than a third of the respondents felt that the tool provided all the functions that they needed for their job. In write-ins and during an interview, several developers mentioned limitations in its capability to generate efficient code and limited applicability to specific types of applications. The CASE tool was regarded as more appropriate for developing simple on-line software, since it did not generate efficient enough code for batch or

complex on-line software. One respondent stated that the inefficiency of the generated COBOL code sometimes required them to manually write the source code.

Table 4.10: Satisfaction with CASE Tool at Organization A

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	6(14.0)	9(20.9)	12(27.9)	5(11.6)	7(16.3)	3(7.0)	1(2.3)
* I use this CASE tool because I like it	8(18.6)	7(16.3)	8(18.6)	16(37.2)	1(2.3)	2(4.7)	1(2.3)
* I would like to continue using this CASE tool	12(28.6)	9(21.4)	11(26.2)	5(11.9)	3(7.1)	0(0)	2(4.8)
* I would like to increase the use of this CASE tool	12(27.9)	10(23.3)	9(20.9)	5(11.6)	3(7.0)	2(4.7)	2(4.7)
* I use this CASE tool because there is no way to complete my job without it	5(11.4)	5(11.4)	2(4.5)	8(18.2)	3(6.8)	5(11.4)	16(36.4)
* Because of this CASE tool, the results of my work are more up to date	2(4.8)	10(23.8)	13(31.0)	11(26.2)	3(7.1)	2(4.8)	1(2.4)
* For me, it is very easy to utilize the capabilities of this CASE tool	7(16.7)	7(16.7)	10(23.8)	5(11.9)	3(7.1)	9(21.4)	1(2.4)
* The system provides me with all the functionality that I need	2(4.7)	4(9.3)	14(32.6)	8(18.6)	11(25.6)	3(7.0)	1(2.3)
* Since the introduction of the tool, my job performance has increased	3(7.1)	4(9.5)	8(19.0)	18(42.9)	7(16.7)	0(0)	2(4.8)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	1(2.4)	7(16.7)	9(21.4)	13(31.0)	6(14.3)	5(11.9)	1(2.4)
* I completely understand use of the tool	5(11.9)	8(19.0)	9(21.4)	3(7.1)	6(14.3)	9(21.4)	2(4.8)
* The tool sufficiently integrates different parts of the software development process	3(7.1)	10(23.8)	18(42.9)	5(11.9)	3(7.1)	3(7.1)	0(0)
* This CASE tool provides all the functions I need for my job	1(2.4)	4(9.5)	8(19.0)	5(11.9)	16(38.1)	6(14.3)	2(4.8)
* I am satisfied with the tool interface and the display of the output content	0(0)	9(21.4)	11(26.2)	9(21.4)	10(23.8)	1(2.4)	2(4.8)
* The output of this CASE tool is consistent and dependable	2(4.8)	10(23.8)	17(40.5)	10(23.8)	2(4.8)	0(0)	1(2.4)
* This CASE tool helps me to achieve my personal objectives	8(19.0)	7(16.7)	5(11.9)	12(28.6)	2(4.8)	5(11.9)	3(7.1)

(Note: Numbers in parentheses refer to percentage)

Summary of Survey Results

The collected data indicate that the CASE tool was successfully used by the responding system developers. They used the tool extensively, experienced a positive impact on their work, and were satisfied with its use. This is surprising, considering the problems observed during implementation, and the shortcomings in managing the transition process.

Comparison of Management's and System Developers' Responses at Organization A

Both management's and the system developers' evaluation of the management implementation process indicated shortcomings. Both groups agreed on weaknesses in the strategies used to manage resistance to change. However, it is surprising that less than 50% of the responding developers indicated dissatisfaction with user participation, although management did not listen to their tool preferences.

Neither of these two groups was satisfied with the management of the transition process. They agreed on the lack of a clear vision and on the lack of a consistent and complete management of the implementation process. They were also not satisfied with the effectiveness of the provided support groups.

Both groups reported problems with the political dynamics of the implementation process. Management and developers cited insufficient support from selected organizational power groups. They also recognized shortcomings in their leaders' guidance of the implementation process.

Developers were more convinced about the positive impact of the innovation on the system development process than management. Neither group was completely satisfied with the tool and its use. They also agreed on weaknesses in the tool's functionality and flexibility. At the time of data collection, it would be used only for specific types of applications.

4.2.2 Organization B

Management Perspective

Organization B is a large multi-national petroleum company with operations in everything from exploration to marketing. It conducts exploration and production activities in twenty-six countries.

Its IS department structure was hierarchical, with approximately six organizational levels. Within this structure, the decision making authority of the IS groups was more centralized than that of other branches. Organization B's IS department was composed of application development, technical development support, and an implementation team. Some of the development teams were co-located with their business users, but they reported to their IS manager. Overall, approximately 200 people worked in the IS department of the investigated branch and approximately 25% of them were in systems development.

For this study, a project manager was interviewed. Because of his personal involvement in the information systems department, he was interviewed regarding the adoption and implementation process of the CASE tool.

The Acquisition Process

Organization B's evaluation process for a "complete" CASE tool started in 1988. Management initiated this process primarily because CASE tools were very popular at that time. They appeared to emerge as the wave of the future that would increase productivity of systems development.

The selection process lacked a structured and formal approach. A few interviews were conducted with other organizations which had previously adopted CASE tools. Although various tools were superficially examined, there were no extensive examinations or comparisons of the

different CASE tools through pilot tests. Management's final decision for IEF was based primarily on their impression that IEF had "a lot of potential" within their organization and that it was the apparent market leader at that time.

Several benefits were expected from the acquisition of IEF, based upon its full coverage and tight integration of all phases of the system development life cycle. The CASE tool was supposed to help in identifying business rules and improving developers' productivity. In addition, IEF was expected to improve the quality of the generated code by providing more consistency across development phases and improving system maintainability by providing better documentation. Because of its robustness, the tool was supposed to be adopted as a new standard across divisions to provide an integrated data model that enforced a minimum of data redundancy.

Management of the Implementation Process

Management felt that system developers initially wanted IEF because it appeared to be good for their resume and the wave of the future. Therefore, the organization did not perceive any resistance or any need to motivate them to learn and use this new tool. It was regarded as sufficient to send a small group of people to TI's "boot camps" where they finished training projects from start to finish within two to three week training periods. In addition, outside consultants trained internal consultants in the tool and its underlying methodology.

Initially, the organization investigated multiple subject areas simultaneously, which resulted in the use of IEF for four to five major projects. However, without much experience and planning, these projects got hung in the analysis phase. There were problems with coordination, overlap, and interdependencies among these applications. Because of these problems, the development of a central Information Systems Plan (ISP) was regarded as necessary, and a project group was formed for its development. Some of the applications were temporarily placed

on hold until the ISP was completed. Development of other applications was continued, and they were supposed to be mapped backwards in this global information architecture. The ISP resulted in standards and policies which enforced the standardization of system development and integration of the resulting applications.

Level of Implementation

Two to three years ago, management became increasingly concerned with the lack of productivity and lack of results with IEF. Therefore, funds for its use were starting to dry out and its support has continually decreased until management eventually decided to stop using it for the development of new applications. Today, IEF is only used by six to eight people for completing an enterprise data model which has been under development for several years. In addition, it is used for maintaining and enhancing a few existing applications. They include one customer system, one billing system, one general ledger system, and several reference tables (e.g. for geographical boundaries and locations for reporting sales). All of the completed projects involved the reengineering of existing applications. These reflect less then 20% of all appropriate local applications which could have been successfully finished with IEF. Overall, the CASE tool has been utilized much less than originally expected by management.

Problems with Implementation Strategies

From an organizational perspective, problems with the implementation process limited its implementation success. Most problems were observed in management of the transition process.

a) Management of the Resistance to Change

When system developers started to experience the unexpectedly long learning curve, they became frustrated and resistant. Resistance became even stronger when developers were asked to redo some of their work that did not satisfy the requirements of IE. The organization did not

anticipate these problems, since no serious pilot studies were conducted. When management became aware of this resistance, little was done to manage it.

b) Management of the Transition Process

There were considerable problems with the way the tool and the methodology were implemented within the organization. Development of the ISP ended in an "analysis paralysis". Problems with the implementation of IE, with external consultants, and with the management of end-users were regarded as responsible for this delay.

The project groups started with the generic James Martin methodology and got hung up in the design of the enterprise data model because of its inability to apply an appropriate theory to the specific needs of its organization. The progress of this group was slowed down by searching for a perfect model. Some of the observed mistakes were that areas outside of the organization were modeled and that the resulting model was too detailed (e.g. modeling of phone numbers). By tightening IE beyond what is supported by IEF and by highly normalizing data structures, a global logical model was finally developed, but could not be implemented in this form. Additional time was required to appropriate the rules to get a model usable for system development.

Over time, several external consultants were included in the development process. However, since they had different interpretations of IE, they continuously initiated changes in the model. For an extensive period of time, the project group did not have one true methodological approach, and it took time to decide on the one approach that would result in a model which could be finally implemented. This indecisiveness prolonged the organizational learning curve.

Finally, weaknesses in end-user requirements slowed down the modeling process. Frequently, different departments could not agree on definitions and naming conventions for the data in the repository. Some users also had difficulties stabilizing their requirements.

The resulting ISP enforced organizational standards and policies which were too rigid in the way they were implemented and enforced. One central group within IS enforced these standards by signing off on each phase of each project. However, this approval system frequently slowed down development work and created resistance when more modeling and more generic designs were demanded. After experiencing pressure from business users, management recognized that there were too many policemen for modeling and implementation. As a result, project managers gained more decision making power and responsibility. There was also less emphasis on getting a perfect model before it was implemented. This decision resulted in higher productivity and more successful projects.

c) Management of Political Dynamics

The political dynamics during the implementation process were characterized by the failure to recognize that top management support does not necessarily result in end-user buy-in. While management support was ensured from the beginning, there was insufficient user involvement. It was not realized that, even with a CASE tool like IEF, users need to drive and influence the system development process. IS management believed that resistance of business people affected the implementation success of IEF. In the opinion of IS management, users caused problems by continuously modifying their requirements and by delegating business users with insufficient business knowledge to the development teams. This resistance within end-user departments could not be overcome.

Impact of CASE Tool Characteristics

Management's initial satisfaction with IEF reversed over time. At the beginning, it was very enthusiastic about the potential impact of this tool on its organization. However, it cooled down when it perceived that system developers in their organization could not overcome the

learning curve and that they could not increase their productivity. Management was very disillusioned, as much fewer systems could be replaced than expected and the expected integrated information architecture did not materialize.

Overall, management of Organization B reported serious shortcomings in the way they managed change, the transition process, and its political dynamics. They stated that these shortcomings prevented the organizational diffusion of the CASE tool. While there were no significant complaints about the tool itself, management was very dissatisfied that it was used much less than originally expected.

User Perspective

Ten out of about twenty developers returned the questionnaire at Organization B. The instrument collected information about the CASE tool, the implementation management process, and its implementation success.

Management of the Implementation Process

a) Management of the Resistance to Change

The responding developers regarded user participation during the acquisition and implementation process as one of the most important strategies to overcome user resistance (Table 4.11). However, only 50% of them felt that user involvement was effective.

Eighty percent of the developers stated that they had insufficient time and opportunity to learn the use of the CASE tool. One developer claimed that the organization tried to do too much without a pilot project. Therefore, it is surprising that 90% declared that they received sufficient training in the tool and its methodology (Table 4.12).

Three respondents rated explaining the need for change as one of the most important strategies for the tool's implementation success, while two other developers rated it least

important. There was clearly no agreement in the importance of this issue. However, almost 90% of all developers thought that their organization sufficiently explained the need for change.

Table 4.11: Change Management at Organization B

* user participation in the acquisition and implementation process				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	7
good	5	50		
neutral	2	20		
fair	0	0		
poor	2	20		
very poor	1	10		

* sufficient time and opportunity to learn its use				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	10	most important	3
good	0	0		
neutral	1	10		
fair	7	70		
poor	1	10		
very poor	0	0		

* explaining the need for changing the prior system development process				
	frequency	percent		frequency
excellent	0	0	least important	2
very good	3	33.3	most important	3
good	5	55.6		
neutral	0	0		
fair	0	0		
poor	1	11.1		
very poor	0	0		
N/A	1			

* formal rewards for implementing and / or using this CASE tool				
	frequency	percent		frequency
excellent	0	0	least important	7
very good	0	0	most important	0
good	2	20		
neutral	1	10		
fair	1	10		
poor	4	40		
very poor	2	20		

* informal rewards for implementing and / or using this CASE tool				
	frequency	percent		frequency
excellent	0	0	least important	7
very good	1	10	most important	0
good	2	20		
neutral	1	10		
fair	5	50		
poor	1	10		
very poor	0	0		

Table 4.12: Training and Support at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	3(30)	4(40)	2(20)	0(0)	1(10)	0(0)	0(0)
* I received sufficient training in utilizing this CASE tool	2(20)	3(30)	4(40)	0(0)	1(10)	0(0)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	0(0)	3(30)	2(20)	2(20)	2(20)	1(10)	0(0)

(Note: Numbers in parentheses refer to percentage)

Less than 50% felt that there were enough formal and informal rewards. However, rewards were regarded as one of the least important strategies to overcome resistance. Overall, the responding developers mentioned some problems with the strategies used to manage resistance to change. These results indicate that there was some potential for resistance to change during the implementation process.

b) Transition Management

Having a clear image of the envisioned system development environment was considered as one of the most important strategies for managing the transition process (Table 4.13). Eighty percent of the developers criticized the lack of a clear vision. Based on the write-in of one respondent, the organization was looking for another "silver bullet" which it could use for everything.

Without a clear vision, it is not surprising that 70% of the respondents considered management of the transition process incomplete and inconsistent. One developer stated that the organization was in the habit of changing technology in the middle of development projects. Two other respondents mentioned that the reorganization of business during the implementation of the tool negatively affected its implementation success.

Table 4.13: Management of the Transition Process at Organization B

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	10	most important	7
good	0	0		
neutral	1	10		
fair	7	70		
poor	1	10		
very poor	0	0		

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	2
very good	0	0	most important	2
good	2	20		
neutral	1	10		
fair	4	40		
poor	3	30		
very poor	0	0		

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	0	0	least important	2
very good	1	10	most important	1
good	5	50		
neutral	3	30		
fair	1	10		
poor	0	0		
very poor	0	0		

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	0	0	least important	2
very good	0	0	most important	0
good	3	30		
neutral	4	40		
fair	3	30		
poor	0	0		
very poor	0	0		

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	0	0	least important	4
very good	0	0	most important	0
good	1	10		
neutral	3	30		
fair	4	40		
poor	1	10		
very poor	0	0		
N/A	1			

The majority of respondents considered the implementation support by the provided project groups as effective. The establishment of a TECH group to share knowledge was especially praised by one developer. Overall, there were shortcomings in management of the transition process. Therefore, the organization appeared to be relatively unsuccessful in avoiding confusion and chaos during the transition process.

Few developers were satisfied with the feedback from management. However, it was judged as one of the least important factors for managing the transition process.

c) Management of Political Dynamics

Less than 50% of respondents stated that all organizational power groups supported the implementation process and that management's promotion of the CASE tool was effective (Table 4.14). These issues were also considered as two of the most important strategies for successfully managing political dynamics of the implementation process.

Only 30% of the developers judged the guidance by their leaders as effective. Two developers stated that the very late delegation of decision making authority to project managers negatively affected the implementation success of the tool. Overall, management of the political dynamics of the transition process was characterized by various problems. These shortcomings indicate that there was significant potential for political tensions during the implementation process.

Evaluation of the CASE Tool

a) Relative Advantage of CASE Tool and Demonstrability of its Results

The respondents were convinced of the CASE tool's relative advantage over the previous development environment (Table 4.15). Using the tool improved their quality of work, productivity, job effectiveness, and made it easier to do their job. Since the value of using the

tool and its methodology was apparent to them, most of them did not experience any difficulties telling others about these benefits.

Table 4.14: Management of the Political Dynamics at Organization B

* support of all key power groups within the organization				
	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	7
good	4	40		
neutral	2	20		
fair	2	20		
poor	1	10		
very poor	1	10		
* promotion of the CASE tool by management				
	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	4
good	2	20		
neutral	3	30		
fair	3	30		
poor	2	20		
very poor	0	0		
* active guidance by established leaders				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	10	most important	2
good	2	20		
neutral	2	20		
fair	1	10		
poor	2	20		
very poor	1	10		
* management's explicit emphasis on continuity and stability				
	frequency	percent		frequency
excellent	0	0	least important	5
very good	0	0	most important	1
good	2	20		
neutral	1	10		
fair	0	0		
poor	6	60		
very poor	1	10		

b) Organizational and Individual Compatibility

Only 40% of the developers stated that their system development work was compatible with the requirements of the tool (Table 4.16). However, all of them felt that using this tool fit well with the way they like to work.

Most of the respondents did not regard the changes caused by the introduction of the CASE tool as minor. All of them stated that it resulted in changes in their tasks and most of them observed changes in organizational structure and style. The majority declared that its implementation required changes in their hardware architecture and software methodology.

Table 4.15: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Relative Advantage							
* Using this CASE tool improves the quality of my work	5(50)	3(30)	1(10)	1(10)	0(0)	0(0)	0(0)
* Using this CASE tool enables me to accomplish tasks more quickly	4(40)	2(20)	4(40)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool enhances my effectiveness on the job	0(0)	7(70)	3(30)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool makes it more difficult for me to do my job	0(0)	0(0)	1(10)	1(10)	4(40)	4(40)	0(0)
* Using this CASE tool gives me less control over my work	1(10)	0(0)	3(30)	2(20)	2(20)	1(10)	1(10)
Result Demonstrability							
* The value of using this CASE tool is apparent to me	6(60)	2(20)	2(20)	0(0)	0(0)	0(0)	0(0)
* The value of using the methodology is apparent to me	3(30)	2(20)	5(50)	0(0)	0(0)	0(0)	0(0)
* I would have difficulties telling others about the benefits of using this CASE tool	0(0)	0(0)	1(10)	0(0)	1(10)	4(40)	4(40)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

Most of the developers regarded the CASE tool as easy to use (Table 4.17). More than 50% experienced no difficulties learning to operate the tool and its methodology. Most of them felt that the interaction with the tool and its methodology was clear and understandable.

Implementation Experiences

a) Level of Use

Most of the responding developers were experienced users of the tool (Table 4.18). They used it frequently and completed a large portion of their work with its help. In addition, most of them had used it for more than one year.

Table 4.16: Organizational and Individual Compatibility of the CASE Tool at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Individual Compatibility							
* I think that using this CASE tool fits well with the way I like to work	2(20)	4(40)	4(40)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool is not compatible with all aspects of my system development work	0(0)	1(10)	4(40)	1(10)	3(30)	1(10)	0(0)
Organizational Compatibility							
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	0(0)	1(10)	2(20)	5(50)	2(20)	0(0)
* Implementation of this CASE tool resulted in changes in our tasks	3(30)	5(50)	2(20)	0(0)	0(0)	0(0)	0(0)
* Implementation of this CASE tool did not result in changes in org. structure or style	1(10)	1(10)	1(10)	1(10)	4(40)	0(0)	2(20)
* Implementation of this CASE tool did not require changes in our hardware architecture	0(0)	0(0)	1(10)	3(30)	1(10)	0(0)	5(50)
* Implementation of this tool required changes in the software development methodology	4(40)	1(10)	4(40)	1(10)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

b) Impact of the Use of the CASE Tool

The respondents were very convinced of the positive impact of the CASE tool on their system development work (Table 4.19). Most of them cited improvements in their determination of business requirements, quality of work, productivity, and maintainability of the generated systems. The majority of developers felt that their customers and managers were more satisfied

with their performance. However, only 40% of them stated that using this tool lowered the overall costs for system development.

Table 4.17: The CASE Tool's Ease of Use at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	0(0)	2(20)	2(20)	0(0)	4(40)	1(10)	1(10)
* Learning to use the underlying methodology has been difficult for me	0(0)	1(10)	2(20)	0(0)	4(40)	2(20)	1(10)
* My interaction with this CASE tool is clear and understandable	1(11.1)	1(11.1)	6(66.7)	0(0)	1(11.1)	0(0)	0(0)
* The methodology underlying the CASE tool is clear and understandable	2(20)	1(10)	5(50)	1(10)	1(10)	0(0)	0(0)
* Overall, I believe that this CASE tool is easy to use	0(0)	7(70)	2(20)	0(0)	1(10)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.18: Level of Use of the CASE Tool at Organization B

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
7(70)	0(0)	2(20)	1(10)	0(0)	0(0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
1(11.1)	0(0)	0(0)	3(33.3)	5(55.5)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
1(10)	1(10)	0(0)	5(50)	3(30)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	0(0)	1(10)	5(50)	4(40)

(Note: Numbers in parentheses refer to percentage)

Table 4.19: Impact of the Use of the CASE Tool at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	0(0)	5(50)	3(30)	0(0)	0(0)	1(10)	1(10)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	5(50)	2(20)	2(20)	0(0)	1(10)	0(0)	0(0)
* The tool reduces the effort to maintain new systems	5(50)	2(20)	1(10)	2(20)	0(0)	0(0)	0(0)
* My productivity has increased because of this CASE tool	1(10)	5(50)	3(30)	1(10)	0(0)	0(0)	0(0)
* Overall costs for system development are lower	1(10)	0(0)	3(30)	4(40)	0(0)	1(10)	1(10)
* My customers are more satisfied with my performance	1(10)	4(40)	1(10)	4(40)	0(0)	0(0)	0(0)
* My manager is more satisfied with my performance	0(0)	5(50)	0(0)	4(40)	1(10)	0(0)	0(0)
* The tool facilitates planning and controlling	0(0)	5(50)	0(0)	2(20)	2(20)	1(10)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Satisfaction with the Tool and its Use

Overall, the respondents were very satisfied with the tool and its use (Table 4.20). All of them wanted to increase using the CASE tool. Although the majority stated that they could not complete their job without it, all of them used it because they liked it. They felt that the benefits derived from using this tool outweighed its cost. They stated that it was easy to use, provided the required functionality and flexibility, and positively affected their job performance.

Summary of Survey Results at Organization B

Developers' evaluation of the management implementation process was mixed. While citing only a few problems with the management of resistance to change, they felt that there were serious shortcomings in management of the transition process and in management of its political

dynamics. Despite these problems, they successfully used the CASE tool for their systems development work.

Table 4.20: Satisfaction with CASE Tool at Organization B

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	2(20)	5(50)	1(10)	2(20)	0(0)	0(0)	0(0)
* I use this CASE tool because I like it	3(30)	5(50)	1(10)	1(10)	0(0)	0(0)	0(0)
* I would like to continue using this CASE tool	6(60)	1(10)	2(20)	1(10)	0(0)	0(0)	0(0)
* I would like to increase the use of this CASE tool	5(50)	3(30)	1(10)	0(0)	1(10)	0(0)	0(0)
* I use this CASE tool because there is no way to complete my job without it	3(30)	1(10)	3(30)	0(0)	1(10)	0(0)	2(20)
* Because of this CASE tool, the results of my work are more up to date	2(20)	3(30)	0(0)	5(0)	0(0)	0(0)	0(0)
* For me, it is very easy to utilize the capabilities of this CASE tool	0(0)	5(50)	3(30)	2(20)	0(0)	0(0)	0(0)
* The system provides me with all the functionality that I need	0(0)	5(50)	3(30)	1(10)	1(10)	0(0)	0(0)
* Since the introduction of the tool, my job performance has increased	2(20)	2(20)	1(10)	4(40)	1(10)	0(0)	0(0)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	0(0)	3(30)	3(30)	2(20)	2(20)	0(0)	0(0)
* I completely understand use of the tool	0(0)	4(40)	2(20)	1(10)	3(30)	0(0)	0(0)
* The tool sufficiently integrates different parts of the software development process	1(10)	4(40)	4(40)	1(10)	0(0)	0(0)	0(0)
* This CASE tool provides all the functions I need for my job	1(10)	2(20)	4(40)	0(0)	2(20)	1(10)	0(0)
* I am satisfied with the tool interface and the display of the output content	0(0)	5(50)	2(20)	1(10)	2(20)	0(0)	0(0)
* The output of this CASE tool is consistent and dependable	2(20)	4(40)	3(30)	1(10)	0(0)	0(0)	0(0)
* This CASE tool helps me to achieve my personal objectives	0(0)	3(30)	4(40)	2(20)	0(0)	1(10)	0(0)

(Note: Numbers in parentheses refer to percentage)

Comparison of Management's and System Developers' Responses at Organization B

Management and developers agreed in their evaluation of most aspects managing the implementation process. Both parties cited only a few problems with managing resistance to change. They mentioned problems with the unexpectedly long time required to learn the use of the tool. Due to the unexpected long learning curve, systems developers experienced initial problems with the use of the tool. This resulted in lower satisfaction. However, with more experience, their satisfaction increased, because they felt that through this tool they could develop new applications faster and with higher quality.

Both groups observed various problems in managing the transition process. They agreed that the organization did not have a clear image of the system development environment which was aimed for throughout the transition process. Both groups emphasized the lack of consistency and completeness in managing the transition process.

Management and developers experienced weaknesses in managing the political dynamics of the implementation process. Both groups concurred that not all organizational power groups were supporting the implementation process. However, they did not agree on management's commitment. While management did not mention any weaknesses in their support of the implementation process, developers criticized the effectiveness of management's promotion of the CASE tool.

There was no agreement on the tool's impact on the system development process. While management was disillusioned about its effects, developers appreciated its positive impact and were satisfied with its use. Therefore, it is not surprising that management reported a much lower use of the innovation than originally expected, while the responding developers reported on its successful use.

Management reported that primarily because of the unexpected long learning curve, system developers experienced initial problems with the use of the tool. This resulted in lower satisfaction on the sides of management and system developers. However, with more experience, their satisfaction increased, because they felt that through this tool they could develop new applications faster and with higher quality. However, by the time developers were finally sufficiently experienced in the use of the tool and of its underlying methodology, ready to cash in on the expected benefits, top management had already written off this tool. There were no plans by management to use this tool for future system development projects.

4.2.3 Organization C

Managerial Perspective

Organization C is a large medical foundation which includes several famous hospitals. They have treated patients from around the world since the late 19th century. Its research center has been a pioneer in medical research.

Organizations C's IS department was officially hierarchical in structure, with five distinct organization layers. However, it operated informally as a matrix structure. IS people cooperated with business managers, but they were reported to IS managers. The department consisted of four divisions: clinical application development, administrative application development, IT architecture and technology support, and technical services. The department employed more than 300 people. Approximately fifty employees had access to the CASE tool and twenty were active users.

The Chief Information Officer of one of the foundation's major hospitals was interviewed to investigate the CASE tool adoption. The adoption and implementation process of the tool and evaluation of implementation success were discussed.

The Acquisition Process

Organization C was using Assembly language for application development when the search process for a new development tool started. Management was looking for a software development tool that would provide them the most accurate code, reflect users' requirements most accurately and provide the highest productivity. Reusable code was needed to support these objectives. Envisioning a growing environment, the new development environment had to support an evolutionary migration of old applications to this environment.

Everything from COBOL to 4GL's to CASE tools was considered and evaluated. The primary constraint was that the tool had to work with IBM's DB2 in a predominately CICS mainframe environment. After a long discussion, management decided to leapfrog technical development and to go with CASE tools.

IEF by Texas Instruments and another integrated CASE tool were both considered. Both vendors provided in-house demonstrations of their tools. The evaluation process was supported by outside consultants. Primarily because of its better track record, IEF was selected. In addition, IEF was preferred because its rigid approach promised to bring more structure and coordination into the existing highly decentralized and consensus-based organization. The tool was acquired in 1990.

Management of the Implementation Process

The organization did not start with an information systems plan (ISP), as recommended by Texas Instruments. This task was regarded as too overwhelming; too much time would have passed before the completion of the first production system. Instead, management decided to start with some quick pilot projects to learn the requirements of the new development environment. Primarily smaller non-mission critical systems were selected. Their initial success was used to demonstrate the benefits of the innovation. Against outside recommendations, the

organization also started with one mission critical system. Because the implementation of this project was very difficult, management would not recommend doing it again. However, it was successfully completed. A pseudo ISP was developed afterwards, but little effort was spent on it.

Initially, management dedicated a significant amount of attention to implementing the tool, recognizing the need for a large critical mass of people from different disciplines. This was regarded as a major reason for the lack of resistance toward the adoption of this tool.

Several people supported the infrastructure of the implementation process (e.g., in database administration, encyclopedia support, joint application development sessions). In addition, a development support center, consisting of approximately four people, supported developers with the tool and its management.

Level of Implementation

The organization developed a few large applications in the DB2/CICS mainframe environment with this CASE tool. Since its adoption, approximately 20% of all applications, or 60% of all generated lines of code were developed in this new environment. This includes three larger systems and a fourth one which is in the process of being completed. The high utilization was as originally expected by management. However, with the move to a client-server system and downsizing, the tool is used less frequently, because in its present release, it is regarded as more appropriate for the development of mainframe based applications.

Problems with Implementation Strategies

Management observed only a few problems with implementation of the CASE tool. It required a lot of energy to move from assembler to DB2 and CASE tools. Because management

initially underestimated this huge challenge, there were insufficient resources (e.g., hardware) for the first pilot projects.

The organization employed a large development staff, using many different development tools and methodologies in parallel. Because each development platform had its own fans, there was some competitiveness. Management was not sure if this might have resulted in political tensions which could have affected implementation success of the CASE tool.

Moving from Assembler to an integrated CASE tool implies a very steep learning-curve and almost a total mind set change. The organization spent a lot of time and resources to train each programmer, but it seemed that they never overcame the initial learning curve. This problem was even more challenging because the experienced developers were required to maintain the existing applications, and new people had to be trained for each new project. Therefore, there was a learning curve for each new project.

Management felt that they had to pay a tremendous price for adopting the tool. Tremendous amounts of money were spent not only on the tool set, but also for training and the required hardware architecture. Therefore, management's expectations were very high.

Impact of CASE Tool Characteristics

Despite the initial problems, most management expectations with regard to the CASE tool have been met. Problem logs recorded during implementation of the tool did not indicate any major problems. The quality of the generated applications is high and they are very maintainable. Productivity improvements were almost as expected. The only disappointment was that the organization was not able to reuse code.

Management assumed that a lot of future applications were to be developed with this tool. However, system development objectives have changed from mainframe-centered to client-server applications. Management thought that it might be easier to use dedicated client-server

development tools such as Powerbuilder to develop these types of applications on UNIX workstations. In addition, the organization was not convinced that IEF had the technical capabilities to satisfy the new development needs. Therefore, it was assumed that different development tools would be used in the future. The organization sees a need for new CASE tools for client-server application development which are lighter, more agile, and cheaper than IEF. Management hopes that a lot of the acquired knowledge (e.g., modeling skills) can be reused with these new tools. However, at the time of data collection, management had no specific plans for moving to another CASE tool.

Overall, management of Organization C reported only minor problems with managing change, the transition process, and its political dynamics. They stated that these shortcomings did not slow down the organizational diffusion of the CASE tool. Whenever they used the tool, they were satisfied with its impact on the system development process.

User Perspective

Eight out of about fifty CASE tool users at Organization C responded to the survey. They provided information about their attitudes toward the tool, the implementation management process, and its implementation success.

Management of the Implementation Process

a) Management of the Resistance to Change

Most of the respondents felt that they received sufficient time and opportunity to learn the use of the tool (Table 4.21), and all of them regarded their training in the tool and its methodology as sufficient (Table 4.22). One respondent especially praised the arrangements for accommodation of the learning curve. This was rated as one of the most important strategies for successfully managing resistance to change.

Table 4.21: Change Management at Organization C

* sufficient time and opportunity to learn its use

	frequency	percent		frequency
excellent	0	0	least important	0
very good	2	25.0	most important	5
good	3	37.5		
neutral	1	12.5		
fair	1	12.5		
poor	1	12.5		
very poor	0	0		

* explaining the need for changing the prior system development process

	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	2
good	2	25.0		
neutral	2	25.0		
fair	3	37.5		
poor	1	12.5		
very poor	0	0		

* user participation in the acquisition and implementation process

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	2
good	0	0		
neutral	1	12.5		
fair	0	0		
poor	5	62.5		
very poor	2	25.0		

* formal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	4
very good	0	0	most important	2
good	0	0		
neutral	0	0		
fair	1	16.7		
poor	3	50.0		
very poor	2	33.3		
N/A	2			

* informal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	4
very good	0	0	most important	0
good	0	0		
neutral	2	28.6		
fair	2	28.6		
poor	2	28.6		
very poor	1	14.3		
N/A	1			

All respondents agreed that formal and informal rewards for adopting the tool were ineffective. Additionally, these incentives were regarded as one of the least important strategies for the success of the implementation process.

Overall, developers' evaluation of the strategies used to manage the resistance to change was primarily negative (Table 4.21). The negative evaluation of explaining the need for change and providing user participation indicates a significant potential for resistance among the system developers toward adopting the innovation.

b) Transition Management

The majority of respondents regarded a clear image of the envisioned system development environment as one of the most important strategies in managing the transition process (Table 4.23). However, they reported that the organization was ineffective in providing this clear image.

Table 4.22: Training and Support at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	2(25.0)	5(62.5)	1(12.5)	0(0)	0(0)	0(0)	0(0)
* I received sufficient training in utilizing this CASE tool	3(37.5)	3(37.5)	2(25.0)	0(0)	0(0)	0(0)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	2(25.0)	1(12.5)	4(50.0)	0(0)	1(12.5)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.23: Management of the Transition Process at Organization C

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	5
good	2	25.0		
neutral	0	0		
fair	1	12.5		
poor	3	37.5		
very poor	2	25.0		

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	3
good	1	12.5		
neutral	1	12.5		
fair	2	25		
poor	3	37.5		
very poor	1	12.5		

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	1
good	1	16.7		
neutral	1	16.7		
fair	2	33.3		
poor	1	16.7		
very poor	1	16.7		
N/A	2			

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	0	0	least important	4
very good	0	0	most important	0
good	0	0		
neutral	2	28.6		
fair	3	42.9		
poor	1	14.3		
very poor	1	14.3		
N/A	1			

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	0
good	3	42.9		
neutral	0	0		
fair	2	28.6		
poor	2	28.6		
very poor	0	0		
N/A	1			

One developer commented that the organization was using different development environments and they probably would not continue using IEF. Therefore, it is not surprising

that the majority of respondents were also dissatisfied with other aspects of managing the implementation process.

Feedback from management was regarded as one of the least important transition management strategies. Provision of special project groups was not ranked by any respondents as being either one of the most or least important implementation strategies.

Most developers felt that transition management was incomplete and inconsistent and that the organization was ineffective in its attempt to provide special project groups to support this process. These problems might be related to the observation that feedback about the progress of the implementation process both for and from management was regarded as ineffective. This indicates insufficient communication among developers and management with regard to implementation of the CASE tool. These results indicate a significant potential for chaos and confusion during the implementation process which could have affected the tool's implementation success.

c) Management of Political Dynamics

Most of the developers stated that the organization was ineffective in getting the support from all organizational power groups and that guidance from leaders during the implementation process was ineffective (Table 4.24).

Three survey respondents rated CASE tool promotion as one of the most important political dynamics strategies, while three other respondents rated it least important. There was clearly no agreement in the importance of this issue.

Table 4.24: Management of the Political Dynamics at Organization C

* support of all key power groups within the organization

	frequency	percent		frequency
excellent	0	0	least important	2
very good	1	14.3	most important	5
good	0	0		
neutral	0	0		
fair	2	28.6		
poor	2	28.6		
very poor	2	28.6		
N/A	1			

* active guidance by established leaders

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	3
good	2	25.0		
neutral	0	0		
fair	0	0		
poor	4	50.0		
very poor	2	25.0		

* promotion of the CASE tool by management

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	3
good	0	0		
neutral	1	14.3		
fair	2	28.6		
poor	2	28.6		
very poor	2	28.6		
N/A	1			

* management's explicit emphasis on continuity and stability

	frequency	percent		frequency
excellent	0	0	least important	5
very good	0	0	most important	0
good	0	0		
neutral	1	12.5		
fair	4	50.0		
poor	1	12.5		
very poor	2	25.0		

Overall, the responding developers indicated serious problems with managing the political dynamics of the implementation process. All these shortcomings provided a potential for political tensions, which could have affected the implementation process of the innovation.

Evaluation of the CASE Tool

a) Relative Advantage of CASE Tool and Demonstrability of its Results

Most developers were positive about the relative advantage of the CASE tool, compared with their previous development environment (Table 4.25). The majority claimed improvements in the quality of their work, in productivity, and job effectiveness. Most of them also felt more control over their work and reported that the tool made it easier to do their work. Overall, the value of using the CASE tool and its methodology was apparent to most developers, and they did not experience difficulties telling others about these benefits.

Table 4.25: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Relative Advantage							
* Using this CASE tool improves the quality of my work	2(25.0)	2(25.0)	1(12.5)	2(25.0)	1(12.5)	0(0)	0(0)
* Using this CASE tool enables me to accomplish tasks more quickly	0(0)	5(62.5)	1(12.5)	0(0)	0(0)	2(25.0)	0(0)
* Using this CASE tool enhances my effectiveness on the job	0(0)	5(62.5)	1(12.5)	0(0)	2(25.0)	0(0)	0(0)
* Using this CASE tool makes it more difficult for me to do my job	0(0)	0(0)	3(37.5)	1(12.5)	0(0)	3(37.5)	1(12.5)
* Using this CASE tool gives me less control over my work	0(0)	1(12.5)	0(0)	1(12.5)	1(12.5)	3(37.5)	2(25.0)
Result Demonstrability							
* The value of using this CASE tool is apparent to me	2(25.0)	3(37.5)	1(12.5)	1(12.5)	0(0)	1(12.5)	0(0)
* The value of using the methodology is apparent to me	1(12.5)	6(75.0)	1(12.5)	0(0)	0(0)	0(0)	0(0)
* I would have difficulties telling others about the benefits of using this CASE tool	0(0)	2(25.0)	0(0)	1(12.5)	2(25.0)	1(12.5)	2(25.0)

(Note: Numbers in parentheses refer to percentage)

b) Organizational and Individual Compatibility

Almost all developers stated that using this tool fits well with the way they like to work (Table 4.26). However, results regarding the compatibility of the CASE tool with their individual system development work were mixed. Since most of the respondents had been using it for over one year (Table 4.28), it is unlikely that they were still adjusting to the needs of the tool. No respondents judged the changes caused by the introduction of the tool as minor. Most of them claimed that its implementation required significant changes in their hardware architecture, software methodology, and tasks.

Table 4.26: Organizational and Individual Compatibility of the CASE Tool at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Individual Compatibility							
* Using this CASE tool is not compatible with all aspects of my system development work	0(0)	1(12.5)	2(25.0)	1(12.5)	2(25.0)	2(25.0)	0(0)
* I think that using this CASE tool fits well with the way I like to work	2(25.0)	4(50.0)	1(12.5)	0(0)	1(12.5)	0(0)	0(0)
Organizational Compatibility							
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	0(0)	0(0)	0(0)	4(50.0)	2(25.0)	2(25.0)
* Implementation of this CASE tool resulted in changes in our tasks	1(12.5)	4(50.0)	2(25.0)	0(0)	0(0)	1(12.5)	0(0)
* Implementation of this CASE tool did not result in changes in org. structure or style	1(12.5)	1(12.5)	2(25.0)	1(12.5)	1(12.5)	2(50.0)	0(0)
* Implementation of this CASE tool did not require changes in our hardware architecture	1(12.5)	0(0)	0(0)	1(12.5)	1(12.5)	3(37.5)	2(25.0)
* Implementation of this tool required changes in the software development methodology	2(25.0)	4(50.0)	0(0)	1(12.5)	1(12.5)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

Most developers judged the CASE tool and its methodology as easy to learn and to operate (Table 4.27). Overall, they were convinced about its ease of use.

Implementation Experiences

a) Level of Use

Most of the respondents could be considered power users of the CASE tool (Table 4.28). They used it frequently and did a lot of their work with this tool. Most of them used it for over a year. One developer stated that three or four applications were developed with this tool and that another development project would be completed within the next few months. However, there were no plans for its future use.

b) Impact of the Use of the CASE Tool

The responding developers observed a positive impact of the CASE tool on their system development work (Table 4.29). Most of them experienced improvements in their specification of business requirements, quality of work, and productivity. However, there was no agreement about its impact on the maintainability of the generated systems and on the overall costs for system development. The majority did not detect significant changes in the satisfaction of their customers and managers with their performance.

c) Satisfaction with the Tool and its Use

Table 4.30 shows that the responding developers were not completely satisfied with the use of the CASE tool. Most them felt that the tool was easy to use and regarded its output as consistent and dependable. The majority wanted to continue using it and half of them wanted

even to increase its use. However, there was also criticism with regard to lack of functionality and lack of flexibility adjusting to changing demands. Therefore, it is not surprising that the tool's cost-benefit ratio differed among the respondents.

Table 4.27: The CASE Tool's Ease of Use at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	0(0)	0(0)	3(37.5)	0(0)	1(12.5)	3(37.5)	1(12.5)
* Learning to use the underlying methodology has been difficult for me	0(0)	1(12.5)	1(12.5)	1(12.5)	1(12.5)	3(37.5)	1(12.5)
* My interaction with this CASE tool is clear and understandable	0(0)	5(62.5)	0(0)	2(25.0)	1(12.5)	0(0)	0(0)
* The methodology underlying the CASE tool is clear and understandable	0(0)	3(37.5)	4(50.0)	0(0)	1(12.5)	0(0)	0(0)
* Overall, I believe that this CASE tool is easy to use	0(0)	4(50.0)	2(25.0)	1(12.5)	0(0)	1(12.5)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.28: Level of Use of the CASE Tool at Organization C

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
5(62.5)	3(37.5)	0(0)	0(0)	0(0)	0(0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
0(0)	2(25.0)	1(12.5)	1(12.5)	4(50.0)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
0(0)	2(25.0)	1(12.5)	2(25.0)	3(37.5)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	0(0)	2(25.0)	4(50.0)	2(25.0)

(Note: Numbers in parentheses refer to percentage)

Table 4.29: Impact of the Use of the CASE Tool at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	0(0)	5(62.5)	2(25.0)	1(12.5)	0(0)	0(0)	0(0)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	1(12.5)	3(37.5)	1(12.5)	2(25.0)	0(0)	0(0)	0(0)
* The tool reduces the effort to maintain new systems	0(0)	3(37.5)	1(12.5)	3(37.5)	1(12.5)	0(0)	0(0)
* My productivity has increased because of this CASE tool	1(12.5)	2(25.0)	2(25.0)	2(25.0)	0(0)	1(12.5)	0(0)
* Overall costs for system development are lower	0(0)	1(12.5)	1(12.5)	2(25.0)	3(37.5)	1(12.5)	0(0)
* My customers are more satisfied with my performance	0(0)	0(0)	3(37.5)	5(62.5)	0(0)	0(0)	0(0)
* My manager is more satisfied with my performance	0(0)	0(0)	2(25.0)	5(62.5)	1(12.5)	0(0)	0(0)
* The tool facilitates planning and controlling	0(0)	1(12.5)	4(50.0)	3(37.5)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Summary of Survey Results at Organization C

The developers at Organization C observed significant problems with the implementation of the CASE tool. They identified major shortcomings in managing resistance to change, in transition management, and in managing the political dynamics. These shortcomings provided a potential for resistance, chaos, confusion, and political tensions during the implementation process, which would have negatively affected the implementation success of the CASE tool. However, the responding developers reported that they were successfully using the tool.

Table 4.30: Satisfaction with CASE Tool at Organization C

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	1(12.5)	0(0)	3(27.5)	3(37.5)	1(12.5)	0(0)	0(0)
* I use this CASE tool because I like it	3(37.5)	0(0)	1(12.5)	1(12.5)	0(0)	1(12.5)	2(25.0)
* I would like to continue using this CASE tool	4(50.0)	2(25.0)	1(12.5)	0(0)	1(12.5)	0(0)	0(0)
* I would like to increase the use of this CASE tool	3(37.5)	1(12.5)	0(0)	3(37.5)	1(12.5)	0(0)	0(0)
* I use this CASE tool because there is no way to complete my job without it	3(37.5)	0(0)	0(0)	0(0)	0(0)	3(37.5)	2(25.0)
* Because of this CASE tool, the results of my work are more up to date	0(0)	2(25.0)	2(25.0)	2(25.0)	2(25.0)	0(0)	0(0)
* For me, it is very easy to utilize the capabilities of this CASE tool	0(0)	3(37.5)	4(50.0)	0(0)	1(12.5)	0(0)	0(0)
* The system provides me with all the functionality that I need	0(0)	0(0)	3(37.5)	1(12.5)	3(37.5)	1(12.5)	0(0)
* Since the introduction of the tool, my job performance has increased	0(0)	2(25.0)	1(12.5)	3(37.5)	2(25.0)	0(0)	0(0)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	0(0)	0(0)	2(25.0)	2(25.0)	4(50.0)	0(0)	0(0)
* I completely understand use of the tool	0(0)	3(37.5)	0(0)	1(12.5)	3(37.0)	1(12.5)	0(0)
* The tool sufficiently integrates different parts of the software development process	0(0)	5(62.5)	2(25.0)	0(0)	0(0)	1(12.5)	0(0)
* This CASE tool provides all the functions I need for my job	0(0)	0(0)	1(12.5)	1(12.5)	5(62.5)	1(12.5)	0(0)
* I am satisfied with the tool interface and the display of the output content	0(0)	2(25.0)	2(25.0)	1(12.5)	3(37.5)	0(0)	0(0)
* The output of this CASE tool is consistent and dependable	0(0)	6(75.0)	1(12.5)	0(0)	1(12.5)	0(0)	0(0)
* This CASE tool helps me to achieve my personal objectives	2(25.0)	0(0)	1(12.5)	3(37.0)	1(12.5)	0(0)	1(12.5)

(Note: Numbers in parenthesis refer to percentage)

Comparison of Management's and System Developers' Responses at Organization C

Management had a much higher opinion about the implementation process than the responding system developers. Management explained the significantly lower satisfaction of system developers with their underlying aversity to management's actions. An interviewed developer stated that management's evaluation was more positive because either they did not want

to criticize their own actions or they were organizationally too remote to understand their problems.

The two parties disagreed in their evaluation of the strategies used to manage resistance to change. Developers identified the organization's explanation of the need for change and user participation as the primary problems. However, management emphasized the unexpected long learning curve.

Developers criticized transition management. They felt that there was no clear image of the envisioned system development environment and that the transition process was ineffectively managed. However, these problems were not confirmed by management.

Management's suspicion of political tensions during the transition process was supported by the developers' criticism of the political dynamics. The developers felt that missing support from all organizational power groups and their leaders' ineffective guidance was negatively affecting the CASE tool's implementation success.

Management's satisfaction with the tool's level of use and with its effects on the system development process was not shared by most developers. They mentioned lack of functionality and flexibility as primary reasons for not being very satisfied with its use. In addition, management pushed through a mission critical system under significant difficulties. It is likely that this negatively affected developers' satisfaction with the use of the tool. While management reported on its successful use by the organization, they were uncertain about its future use for application development projects because of its limited functionality.

4.2.4 Organization D

Managerial Perspective

Organization D is a major telecommunication provider. It is active in all three telecommunication markets - local service, long distance, and cellular. It also competes in global

network outsourcing, the rapidly growing data communications market for multinational corporations.

Organization D's IS department was composed of long distance and local communication divisions. Each division was based on a matrix organization. IS people reported to both to business and IS managers. This enabled frequent informal communication between IS people and their business users. Overall, the organizaiton employied approximately 6.000 people with the IS department. At the local communication side, which was investigated for this study, there were approximately 2,000 employees in IS and 1,500 in systems development.

A project manager was interviewed for this study. This person was working in the information systems department of the division for local telecommunication services. The interview provided information about management of the adoption and implementation process of the CASE tool and its implementation success.

The Acquisition Process

In 1982, Organization D examined IEF for the first time. However, after the merger with another company, two different integrated CASE tools were competing with each other for adoption and top management decided to go with the other tool.

The tool was evaluated the second time in 1992. The tool was supposed to complement the existing toolbox because it provided model-driven development with 100% code generation. Because of these unique features, no other tool was considered for adoption. The organization hoped that the tool would help to improve productivity in system development. This was an organizational requirement at that time. After one successful pilot project, top management decided to purchase the tool in 1993.

Management of the Implementation Process

The implementation process started with several pilot projects. In parallel, the tool's infrastructure was established. After six months, the first project was successfully completed. Expertise from this project was shared among other projects and was formally collected by a support group. These specialists were later used as "coaches" to train system developers in the use of the tool and its methodology. Initially, the development of these change agents slowed down the implementation process, but with increasing expertise they were able to perform knowledge transfer and to accelerate the implementation process. They provided training and support at all levels and reduced the need for external consultants. Management regarded their activities as essential for managing resistance to change. In addition, they attempted to avoid political tensions and resistance by providing open education at all organizational levels and by keeping the implementation process "public" to avoid the perception of "hidden agendas".

While the adoption decision was centralized, the implementation process was decentralized. Management felt that sufficient resources and specialists were made available. Since there were no plans to use IEF as an organizational standard, but to use it on a project-to-project basis, the final adoption decision was left to each individual project group. Throughout the implementation process, upper management decided upon a "wait-and-see" approach by simultaneously experimenting with object-oriented systems development methodologies and tools.

When the tool was acquired, there were already several Information System Plans (ISP) in place. They were used to coordinate the use of the CASE tool. There was a high level ISP for the organization and several separate ones for individual divisions. They were documented with various tools.

Level of Implementation

Many developers received training in the use of the tool. However, less than twenty percent of them were using it for system development. At the time of data collection, only four applications were completed with this tool. These were less than originally expected by management. However, management felt that it had a positive impact on the operational and strategic objectives of the organization because it helped to build the required applications.

Problems with Implementation Process

There was some resistance among system developers to adopt the new tool. Management identified various reasons for resistance. In their opinion, some developers were reluctant to get additional training and to deliver something they had not delivered before (e.g., explicit system models). Initially, resistance slowed down the implementation process. However, resistance decreased when developers and managers learned more about the tool and its underlying methodology.

There were political tensions which resulted in resistance by a few project groups and other organizational power groups. Many developers and managers felt allegiance to other tools. By giving them up, they were afraid to lose control of their work. Management felt that these political tensions seriously affected the implementation success of the CASE tool. The interviewed manager believed that the cause for most implementation problems could be found in "politics".

Finally, management appeared less than committed to the adoption of the tool because, in parallel, it was conducting a pilot study with object-oriented system development methodologies. The objective of that study was to evaluate object-oriented system development methodologies as a replacement for information engineering. Without a long-term perspective, it is not surprising that management confessed shortcomings in its leadership and in that of other internal leaders.

Impact of CASE Tool

Overall, management expressed satisfaction with the quality of the generated code, system documentation, ease of maintenance of the generated systems, and developer productivity. They felt that the tool had a more positive impact on code quality than on developer productivity. In addition, it has been regarded as easy to use and as compatible with the existing system development infrastructure. Therefore, it was assumed that this tool would be used for the development of more applications.

User Perspective

At Organization D, seven out of fifteen CASE tool users returned the instrument. They reported their experiences with the tool, the implementation management process, and its implementation success.

Management of the Implementation Process

a) Management of the Resistance to Change

Explaining the need for change was regarded as one of the most important strategies for avoiding resistance to change (Table 4.31). More than 70% of the developers agreed that the organization effectively implemented this strategy.

Everybody agreed on the availability of sufficient time and opportunity to learn the use of the CASE tool. Therefore, it is not surprising that the majority stated that they received sufficient training in the tool and its methodology (Table 4.32). In addition, more than 50% of the respondents were satisfied with user participation during the tool's acquisition and implementation process.

Table 4.31: Change Management at Organization D

* explaining the need for changing the prior system development process				
	frequency	percent		frequency
excellent	1	14.4	least important	1
very good	2	28.6	most important	3
good	2	28.6		
neutral	1	14.3		
fair	1	14.3		
poor	0	0		
very poor	0	0		
* sufficient time and opportunity to learn its use				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	2	28.6	most important	1
good	5	71.4		
neutral	0	0		
fair	0	0		
poor	0	0		
very poor	0	0		
* user participation in the acquisition and implementation process				
	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	0
good	4	57.1		
neutral	2	28.6		
fair	1	14.3		
poor	0	0		
very poor	0	0		
* formal rewards for implementing and / or using this CASE tool				
	frequency	percent		frequency
excellent	0	0	least important	4
very good	0	0	most important	2
good	0	0		
neutral	3	42.9		
fair	2	28.6		
poor	1	14.3		
very poor	1	14.3		
* informal rewards for implementing and / or using this CASE tool				
	frequency	percent		frequency
excellent	0	0	least important	5
very good	0	0	most important	0
good	2	28.6		
neutral	1	14.3		
fair	3	42.9		
poor	1	14.3		
very poor	0	0		

While most developers felt that insufficient rewards for using the CASE tool were provided, they stated that this strategy as one of the least important strategies for overcoming

resistance to change. Overall, the respondents did not indicate any serious problems with the strategies used to manage resistance to change.

Table 4.32: Training and Support at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	4(57.1)	1(14.3)	0(0)	0(0)	2(28.6)	0(0)	0(0)
* I received sufficient training in utilizing this CASE tool	5(71.4)	1(14.3)	1(14.3)	0(0)	0(0)	0(0)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	4(57.1	1(14.3)	2(28.6)	0(0)	0(0)	0(0)	0(0)

(Note: Numbers in parenthesis refer to percentage)

b) Transition Management

Only one developer thought that the organization was not complete and consistent in managing the transition process (Table 4.33). This is not surprising, because most of them thought that their organization was effectively providing a clear image of the envisioned system development environment. However, one developer judged the parallel experimentation with other CASE tools and development techniques as problematic for its implementation success. Another respondent addressed the lack of long-term planning.

Most respondents were satisfied with the way special project groups supported the implementation process. One respondent explicitly praised the expertise of the internal consultants. Another liked the hiring of experienced people from the outside for knowledge transfer. Overall, the respondents considered the transition process as well managed. These

results indicate that there was little confusion or chaos which could have slowed down the implementation process.

Table 4.33: Management of the Transition Process at Organization D

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	0
very good	3	42.9	most important	2
good	0	0		
neutral	3	42.9		
fair	0	0		
poor	1	14.3		
very poor	0	0		

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	1
very good	1	14.3	most important	2
good	3	42.9		
neutral	2	28.6		
fair	1	14.3		
poor	0	0		
very poor	0	0		

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	0	0	least important	2
very good	3	42.9	most important	1
good	3	42.9		
neutral	1	14.3		
fair	0	0		
poor	0	0		
very poor	0	0		

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	1	14.3	least important	2
very good	0	0	most important	1
good	1	14.3		
neutral	2	28.6		
fair	2	28.6		
poor	1	14.3		
very poor	0	0		

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	1	14.3	least important	3
very good	0	0	most important	1
good	2	28.6		
neutral	3	42.9		
fair	1	14.3		
poor	0	0		
very poor	0	0		

c) Management of Political Dynamics

The support by different power groups within the organization was considered as one of the most important strategies in managing the political dynamics (Table 4.34). However, less than 50% of the developers felt that is was effectively provided. One respondent mentioned a lack of obvious support from some factions of management, and another criticized the limited willingness of several groups to utilize the tool for application development.

Table 4.34: Management of the Political Dynamics at Organization D

* support of all key power groups within the organization				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	5
good	3	42.9		
neutral	1	14.3		
fair	2	28.6		
poor	1	14.3		
very poor	0	0		

* management's explicit emphasis on continuity and stability				
	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	5
good	2	28.6		
neutral	3	42.9		
fair	2	28.6		
poor	0	0		
very poor	0	0		

* active guidance by established leaders				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	14.3	most important	3
good	3	42.9		
neutral	2	28.3		
fair	1	14.3		
poor	0	0		
very poor	0	0		

* promotion of the CASE tool by management				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	14.3	most important	2
good	2	28.6		
neutral	3	42.9		
fair	1	14.3		
poor	0	0		
very poor	0	0		

Management's explicit emphasis on continuity and stability during the transition process was also considered as one of the most important strategies. However, less than 30% of the respondents stated that this strategy was effectively implemented.

Less than 15% of the developers were dissatisfied with the guidance by their leaders and the management's promotion of the CASE tool. One developer positively mentioned the small pilot projects that were used to promote the tool.

System developers felt not only that the strategies for managing the political dynamics were important for the tool's implementation success, but also that the effectiveness of their implementation was mixed. This indicates the possibility of political tensions during the implementation process which could have negatively affected the tool's implementation success.

Evaluation of the CASE Tool

a) Relative Advantage of CASE Tool and Demonstrability of its Results

At Organization D, the developers were convinced of the relative advantages of the new CASE tool over their previous development environment (Table 4.35). All of them experienced improvements in their productivity and quality of work. Most of the respondents thought that the adoption of the tool did not result in loss of control over their work. Overall, the value of using the tool and its methodology was apparent to most of them, and they did not experience difficulties telling others about these benefits.

b) Organizational and Individual Compatibility

Most developers thought that using this tool fit well with the way they liked to work. However, less than 50% of them considered it as compatible with all aspects of their system development work.

Only one developer regarded the changes caused by its introduction as minor. All of them claimed the need for changes in their software development methodology, but more than 50% stated that it did not require changes in their hardware architecture. Most of them stated that the introduction of the tool resulted in changes in their tasks and in their organizational structure and style.

Table 4.35: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Relative Advantage							
* Using this CASE tool improves the quality of my work	3(42.9)	2(28.6)	2(28.6)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool enables me to accomplish tasks more quickly	2(28.6)	2(28.6)	3(42.9)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool enhances my effectiveness on the job	2(28.6)	2(28.6)	2(28.6)	1(14.3)	0(0)	0(0)	0(0)
* Using this CASE tool makes it more difficult for me to do my job	1(14.3)	0(0)	0(0)	2(28.6)	0(0)	3(42.9)	1(14.3)
* Using this CASE tool gives me less control over my work	0(0)	0(0)	1(14.3)	1(14.3)	0(0)	4(57.1)	1(14.3)
Result Demonstrability							
* The value of using this CASE tool is apparent to me	4(57.1)	0(0)	1(14.3)	2(28.6)	0(0)	0(0)	0(0)
* The value of using the methodology is apparent to me	3(42.9)	1(14.3)	0(0)	3(42.9)	0(0)	0(0)	0(0)
* I would have difficulties telling others about the benefits of using this CASE tool	0(0)	0(0)	0(0)	1(14.3)	2(28.6)	1(14.3)	3(42.9)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

Table 4.37 shows that the CASE tool and its methodology were regarded as easy to learn. In addition, most developers considered the innovation as clear and understandable. Overall, most developers described the CASE tool as easy to use.

Implementation Experiences

a) Level of Use

Most developers at Organization D used the tool frequently and for more than 80% of their work. Since most of the respondents worked with it for over a year, they were considered experienced users of the CASE tool.

Table 4.36: Organizational and Individual Compatibility of the CASE Tool at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Individual Compatibility							
* Using this CASE tool is not compatible with all aspects of my system development work	0(0)	0(0)	4(57.1)	0(0)	1(14.3)	2(28.6)	0(0)
* I think that using this CASE tool fits well with the way I like to work	2(28.6)	2(28.6)	1(14.3)	2(28.6)	0(0)	0(0)	0(0)
Organizational Compatibility							
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	0(0)	1(14.3)	2(28.6)	1(14.3)	2(28.6)	1(14.3)
* Implementation of this CASE tool resulted in changes in our tasks	0(0)	2(28.6)	4(57.1)	1(14.3)	0(0)	0(0)	0(0)
* Implementation of this CASE tool did not result in changes in org. structure or style	0(0)	0(0)	2(28.6)	1(14.3)	4(57.1)	0(0)	0(0)
* Implementation of this CASE tool did not require changes in our hardware architecture	1(14.3)	2(28.6)	1(14.3)	1(14.3)	2(28.6)	0(0)	0(0)
* Implementation of this tool required changes in the software development methodology	1(14.3)	2(28.6)	4(57.1)	0(0)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

b) Impact of the Use of the CASE Tool

The tool's impact on the system development work was considered as positive (Table 4.39). The developers reported improvements in the specification of business requirements, the quality of work, and productivity. None of them claimed higher costs for system development.

Finally, nobody believed that their customers and managers were less satisfied with their performance.

Table 4.37: The CASE Tool's Ease of Use at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	0(0)	0(0)	0(0)	0(0)	0(0)	3(42.9)	4(57.1)
* Learning to use the underlying methodology has been difficult for me	0(0)	0(0)	1(14.3)	0(0)	0(14.3)	3(42.9)	2(28.6)
* My interaction with this CASE tool is clear and understandable	2(28.6)	2(28.6)	1(14.3)	1(14.3)	1(14.3)	0(0)	0(0)
* The methodology underlying the CASE tool is clear and understandable	0(0)	3(42.9)	1(14.3)	0(0)	1(14.3)	2(28.6)	0(0)
* Overall, I believe that this CASE tool is easy to use	2(28.6)	2(28.6)	1(14.3)	2(28.6)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.38: Level of Use of the CASE Tool at Organization D

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
4(57.1)	2(28.6)	1(14.3)	0(0)	0(0)	0(0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
1(14.3)	0(0)	0(0)	1(14.3)	5(71.4)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
1(14.3)	0(0)	2(28.3)	0(0)	4(57.1)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	1(14.3)	2(28.6)	1(14.3)	3(42.9)

(Note: Numbers in parentheses refer to percentage)

c) Satisfaction with the Tool and its Use

Most of the developers were satisfied with the CASE tool and its use (Table 4.40). They wanted not only to continue, but to increase its use. Most of them used it because they liked it. All of them felt that the benefits from using this tool far outweighed its costs. However, many respondents appeared to be less satisfied with the functionality of the tool and its flexibility.

Table 4.39: Impact of the Use of the CASE Tool at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	2(28.6)	1(14.3)	3(42.9)	1(14.3)	0(0)	0(0)	0(0)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	2(28.6)	1(14.3)	1(14.3)	2(28.6)	1(14.3)	0(0)	0(0)
* The tool reduces the effort to maintain new systems	2(28.6)	1(14.3)	0(0)	4(57.1)	0(0)	0(0)	0(0)
* My productivity has increased because of this CASE tool	1(16.7)	1(16.7)	1(16.7)	3(50.0)	0(0)	0(0)	0(0)
* Overall costs for system development are lower	1(14.3)	1(14.3)	2(28.6)	3(42.9)	0(0)	0(0)	0(0)
* My customers are more satisfied with my performance	1(14.3)	2(28.6)	0(0)	4(57.1)	0(0)	0(0)	0(0)
* My manager is more satisfied with my performance	1(14.3)	2(28.6)	1(14.3)	3(42.9)	0(0)	0(0)	0(0)
* The tool facilitates planning and controlling	2(28.6)	1(14.3)	3(42.9)	0(0)	1(14.3)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Summary of Survey Results

Most of the responding developers described the implementation management process as effective. They did not report any significant shortcomings in managing resistance to change or in transition management. They only indicated some problems with the political dynamics. Overall, they perceived a relative advantage in the use of this CASE tool and regarded it as easy

to use. Therefore, its high level of use, positive impact on their system development process, and satisfaction with its use were not surprising.

Table 4.40: Satisfaction with CASE Tool at Organization D

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	3(42.9)	1(14.3)	2(28.6)	0(0)	1(14.3)	0(0)	0(0)
* I use this CASE tool because I like it	3(42.9)	2(28.6)	1(14.3)	0(0)	1(14.3)	0(0)	0(0)
* I would like to continue using this CASE tool	4(57.1)	0(0)	2(28.6)	1(14.3)	0(0)	0(0)	0(0)
* I would like to increase the use of this CASE tool	4(57.1)	1(14.3)	2(28.6)	0(0)	0(0)	0(0)	0(0)
* I use this CASE tool because there is no way to complete my job without it	1(14.3)	2(28.6)	0(0)	0(0)	1(14.3)	1(14.3)	2(28.6)
* Because of this CASE tool, the results of my work are more up to date	0(0)	3(42.9)	1(14.3)	2(28.6)	1(14.3)	0(0)	0(0)
* For me, it is very easy to utilize the capabilities of this CASE tool	2(28.6)	1(14.3)	3(42.9)	1(14.3)	0(0)	0(0)	0(0)
* The system provides me with all the functionality that I need	0(0)	2(28.6)	0(0)	1(14.3)	3(42.9)	1(14.3)	0(0)
* Since the introduction of the tool, my job performance has increased	1(14.3)	2(28.6)	1(14.3)	3(42.9)	0(0)	0(0)	0(0)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	1(14.3)	0(0)	2(28.6)	2(28.6)	2(28.6)	0(0)	0(0)
* I completely understand use of the tool	1(16.7)	2(33.3)	1(16.7)	0(0)	2(33.3)	0(0)	0(0)
* The tool sufficiently integrates different parts of the software development process	2(28.6)	2(28.6)	2(28.6)	1(14.3)	0(0)	0(0)	0(0)
* This CASE tool provides all the functions I need for my job	0(0)	1(14.3)	4(57.1)	0(0)	1(14.3)	1(14.3)	0(0)
* I am satisfied with the tool interface and the display of the output content	0(0)	3(42.9)	0(0)	1(14.3)	2(28.6)	1(14.3)	0(0)
* The output of this CASE tool is consistent and dependable	2(28.6)	2(28.6)	2(28.6)	1(14.3)	0(0)	0(0)	0(0)
* This CASE tool helps me to achieve my personal objectives	2(28.6)	2(28.6)	0(0)	3(42.9)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Comparison of Management's and System Developers' Responses at Organization D

There were only a few differences in management's and developers' assessment of the implementation management process. Neither group observed significant shortcomings in managing resistance to change. They felt that sufficient training and explanations for the need for change were provided to overcome resistance to change.

Management cited several issues that could have resulted in chaos and confusion during the implementation process. They felt that there were weaknesses in their long-term image of the envisioned system development environment and shortcomings in transition management. However, it is surprising that most developers were satisfied with transition management.

Both parties agreed on management's active approach in managing the political dynamics of the transition process. However, they realized that not all organizational power groups were supporting the adoption decision. Management and developers regarded management of the political dynamics as the most important factor for the CASE tool's implementation success.

There was minor criticism about the tool's lack of functionality and flexibility. Only a few applications were developed with this tool and there are no plans to standardize on this tool. However, both management and developers were satisfied with the tool's impact on the software development process and considered it as an implementation success. Therefore, it is not surprising that management assumed that the tool would be used for more development projects.

4.2.5 Organization E

Managerial Perspective

Organization E is a large international manufacturer of cellular mobile telephone switching systems. The company manufactures telephone instruments, telephone networks, cables, and electronic defense systems. From its European base, it is exporting both traditional and cellular technologies.

The IS department of its U.S. headquarters consisted of two groups. One kept the computers running by managing hardware and operating the mainframe computers. The other group developed business applications. This included electronic data interchange, data administration, and database administration. Seventeen developers were located in this group. Six of these seventeen were working with the CASE tool, while the others maintained existing systems without the tool. The manager of applications development was interviewed regarding the management of the adoption and implementation process of the CASE tool and its implementation success.

The Acquisition Process

In 1992, Organization E decided to acquire a CASE tool. At that time, there was no vision or strategy for solving the IS-related problems of the company. One of the primary challenges was to increase the effectiveness of IS planning by better aligning IS initiatives with business needs. In the past, there was no consolidated management direction. Before 1992, top management wanted things from IS without considering their resource limitations and without setting priorities. Therefore, there was an urgent need to find a way to maximize the return on investments in IS. Management wanted to solve this problem in a methodical way by buying into a systems development methodology. Therefore, the strategic decision was made to invest in IE. From that perspective, management did not feel the need for a CASE tool. However, at the tactical level, an increase in system developer productivity was regarded as necessary. This requirement resulted in the decision to acquire a CASE tool.

The tool-related choices soon narrowed down to two alternatives. Both alternatives were evaluated. Internally, developers were trained in both tools and within a time period of two weeks, a small prototype was developed with each of them. The results of these projects indicated that the other CASE tool was not as integrated as IEF. This implied more rework

during system development, insufficient support for automatic code generation, and problems with system maintenance on the design level. In addition, the vendor of the other tool was not considered to be as stable as TI.

The selection process resulted in the unanimous agreement to purchase IEF. At the tactical level, this tool was preferred because of its promised higher productivity. From a strategic perspective, it was preferred, because its underlying repository enabled tighter enforcement of IE principles.

Management of Implementation Process

Management of the transition process was described as focused, complete, and consistent. Initially, two IS managers pushed and organized introduction of the CASE tool in addition to their day-to-day work. As soon as the tool was acquired, they conducted one pilot project and organized four-day Joint Application Development (JAD) sessions of cross-functional teams to develop an Information Systems Plan (ISP). Within four months, a working ISP was developed, which helped to prioritize IS projects based on their relationship to business needs. Management of the implementation process was outlined by an organization-specific "roadmap". This formal document was derived from TI's "Roadmap for the Introduction of IEF". The derived document helped to plan and guide the implementation process by formalizing policies (e.g. standards for naming conventions and system interfaces) and setting goals with regard to implementation of the tool. A small group within the IS department maintained this document by documenting any new goals and decisions with regard to its system development environment. This document provided the structure and consistency in managing the change process.

Organization E avoided resistance of system developers by having appropriate long-term strategies in place. In their opinion, management created a progressive organization with a culture that looked forward to change. The human resource policy of this organization focused

on the willingness of system developers to embrace change. The organization prides itself in employing only highly skilled and experienced system developers who shorten learning curves and are motivated to learn new technologies. Resistance was also avoided by providing sufficient training to everybody.

The politics of the implementation process were characterized by little struggle and sufficient support from all key power groups. The two initial champions of the tool sold it to all power groups by giving presentations on multiple occasions. In addition, the success of the pilot study resulted in the support of top management and in the allocation of sufficient resources for the large-scale implementation and support of the tool. Political tensions among IS developers were avoided by the lean and efficient organizational structure of the small IS department. With only seventeen developers working in system development, work is accomplished within a team-oriented culture with little bureaucracy and open communication. Management thought that in contrast to IS departments in larger organizations, this department was more focused in its vision of its system development environment. Therefore, there were no competing factions (like between object-oriented system development and information engineering supporters) within the group of system developers.

Level of Implementation

Initially, the tool was used for the development of an ISP to prioritize system development needs. From the organizational perspective, this ISP was regarded as successful because it was on time, under budget, and met its objectives. It provided a baseline for setting priorities and selecting new system development projects. Most applications derived from this ISP were developed with this CASE tool.

The organizational impact on the adoption of the tool was regarded as very limited. At the tactical or system developer level, there was little productivity improvement because it was

deemed that automation and structure provided with IEF could not increase the efficiency of the already highly experienced developers. At the organizational level, there were slight productivity improvements, because the tool's methodology put more emphasis on doing the right things. At the strategic level, better prioritization of system development projects was achieved. However, it was assumed that the same success would have been possible with the methodology alone, without the support of a CASE tool. Overall, the organization was more satisfied with the impact of IE than that of IEF. This is reflected by its plans to use IEF to enforce future application and data standards, but build the front-ends of future applications with other development tools.

Problems with Implementation Strategies

a) Management of Transition Process

According to management, there were only minor problems throughout the implementation process. In general, management of the transition process was characterized by a lack of foresight. The organization started too late in setting up the required infrastructure (e.g. DB2 and repository) for moving the pilot project directly into operation. This not only slowed down implementation of the initial project by more than three months, but also negatively affected the interest of top management in IEF. The pilot project primarily survived because of the good track record of the developers.

b) Management of Political Dynamics

Within the political dynamics of the implementation process, there were weaknesses with regard to support by top management. The two initial champions had difficulties selling the need for the development of an ISP, since it was difficult to show a direct return on investment.

Overall, IE and IEF were more successful with middle and operational level managers, because they had a better understanding and more commitment than top level management. The lack of support by this power group is reflected by their lack of cooperation for prioritizing IS projects during the monthly meetings with representatives of the IS department and end users. This negatively affected the organizational usefulness of the ISP and the implementation success of IEF. In addition, the implementation process was initially slowed down, because lack of top management support resulted in insufficient funds for required external consulting.

Impact of CASE Tool

Before the adoption of IEF, the organization had no system development and no official software development methodologies. Each system was developed differently, depending upon the environments and specific customer needs. This resulted in problems with integrating applications and with moving people with different skill sets among projects. The adoption of IEF and IE required significant changes in the system development approach. However, no changes in organizational structure and tasks were required.

Organization E was satisfied with IEF's functionality. However, as a programming environment, it was not regarded as better or worse than any other system development environment. It helped to avoid clerical errors such as typing mistakes, but it did not prevent logical design errors. Management did not regret the acquisition of IEF, but the tool was also not regarded as a panacea for all types of development projects. It was only useful for the development of certain types of applications and, to be successfully used, it required thorough project management. Overall, management was satisfied with the tool's impact on the software development process and considered it as an implementation success.

User Perspective

The survey was distributed to all IEF users at this organization. Five out of six developers returned the instrument. The instrument assessed their opinion regarding the CASE tool, the implementation management process, and their satisfaction with its use.

Management of the Implementation Process

a) Management of the Resistance to Change

Sufficient time and opportunity to learn the use of the tool was rated one of the most important implementation strategies to overcome user resistance (Table 4.41). However, only 40% of the respondents felt that sufficient time and opportunity were actually provided, and only 60% stated that they received sufficient training in the tool and its methodology (Table 4.42).

Eighty percent of the respondents agreed that the need for change was effectively explained. The results relating to user participation in the acquisition and implementation process were mixed. Only 50% of the respondents felt this was achieved.

Formal and informal rewards were considered as two of the least important factors to overcome resistance. However, only 25% of the respondents regarded them as not effectively provided. Overall, the data suggest that the organization had problems with managing the resistance to change among its developers. The most crucial area was the failure to provide sufficient training.

b) Transition Management

A clear image of the envisioned system development environment and the completeness and consistency in management of the implementation process were judged as two of the most important strategies to manage the transition process (Table 4.43). While the majority of the respondents claimed that their organization was effectively providing a clear vision, less than half

of the respondents were satisfied with the manner in which the implementation process was managed.

Table 4.41: Change Management at Organization E

* sufficient time and opportunity to learn its use

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	5
good	2	40		
neutral	0	0		
fair	0	0		
poor	3	60		
very poor	0	0		

* explaining the need for changing the prior system development process

	frequency	percent		frequency
excellent	1	20	least important	0
very good	2	40	most important	2
good	1	20		
neutral	0	0		
fair	0	0		
poor	1	20		
very poor	0	0		

* user participation in the acquisition and implementation process

	frequency	percent		frequency
excellent	0	0	least important	3
very good	2	50	most important	2
good	0	0		
neutral	0	0		
fair	0	0		
poor	2	50		
very poor	0	0		
N/A	1			

* formal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	3
very good	1	25	most important	1
good	1	25		
neutral	1	25		
fair	0	0		
poor	1	25		
very poor	0	0		
N/A	1			

* informal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	0
good	3	75		
neutral	0	0		
fair	0	0		
poor	1	25		
very poor	0	0		
N/A	1			

Table 4.42: Training and Support at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	1(20)	1(20)	1(20)	1(20)	1(20)	0(0)	0(0)
* I received sufficient training in utilizing this CASE tool	0(0)	2(40)	2(40)	0(0)	1(20)	0(0)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	0(0)	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

None of the respondents appeared to be dissatisfied with the provided special project groups, but these groups were not regarded as very important for the implementation success of the CASE tool. Overall, the organization appeared to be relatively successful in avoiding confusion and chaos during the transition process.

c) Management of Political Dynamics

Table 4.44 shows that there were some problems with the political dynamics at Organization E. The majority of respondents stated that not all power groups within their organization supported the CASE implementation. However, most developers considered the guidance by their leaders and the promotion of the CASE tool by their management as effective. Overall, the data indicate political tensions which could have slowed down the implementation process.

Table 4.43: Management of the Transition Process at Organization E

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	0
very good	2	40	most important	2
good	1	20		
neutral	1	20		
fair	1	20		
poor	0	0		
very poor	0	0		

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	20	most important	2
good	1	20		
neutral	0	0		
fair	2	40		
poor	1	20		
very poor	0	0		

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	1	20	least important	1
very good	1	20	most important	0
good	1	20		
neutral	2	40		
fair	0	0		
poor	0	0		
very poor	0	0		

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	0	0	least important	1
very good	1	20	most important	0
good	1	20		
neutral	2	40		
fair	0	0		
poor	1	20		
very poor	0	0		

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	0	0	least important	2
very good	0	0	most important	1
good	1	25		
neutral	1	25		
fair	1	25		
poor	1	25		
very poor	0	0		
N/A	1			

Table 4.44: Management of the Political Dynamics at Organization E

* support of all key power groups within the organization

	frequency	percent		frequency
excellent	0	0	least important	1
very good	1	20	most important	2
good	0	0		
neutral	1	20		
fair	2	40		
poor	1	20		
very poor	0	0		

* promotion of the CASE tool by management

	frequency	percent		frequency
excellent	0	0	least important	2
very good	1	20	most important	2
good	2	40		
neutral	1	20		
fair	0	0		
poor	1	20		
very poor	0	0		

* management's explicit emphasis on continuity and stability

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	0
good	1	20		
neutral	2	40		
fair	2	40		
poor	0	0		
very poor	0	0		

* active guidance by established leaders

	frequency	percent		frequency
excellent	0	0	least important	0
very good	3	60	most important	0
good	0	0		
neutral	1	20		
fair	1	20		
poor	0	0		
very poor	0	0		

Evaluation of the CASE Tool

a) Relative Advantage of CASE Tool and Demonstrability of its Results

The majority of respondents judged the new development environment superior to the previous one (Table 4.45). Using the CASE tool improved their productivity, quality of work, and job effectiveness. Since the value of using the tool and its methodology were apparent to most developers, they did not experience difficulties telling others about the benefits of using this tool.

Table 4.45: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Relative Advantage							
* Using this CASE tool improves the quality of my work	1(20)	1(20)	1(20)	1(20)	0(0)	1(20)	0(0)
* Using this CASE tool enables me to accomplish tasks more quickly	2 (40)	0(0)	2(40)	0(0)	0(0)	1(20)	0(0)
* Using this CASE tool enhances my effectiveness on the job	0(0)	2(40)	2(40)	1(20)	0(0)	0(0)	0(0)
* Using this CASE tool makes it more difficult for me to do my job	0(0)	1(20)	0(0)	0(0)	1(20)	0(0)	3(60)
* Using this CASE tool gives me less control over my work	0(0)	2(40)	0(0)	1(20)	1(20)	0(0)	1(20)
Result Demonstrability							
* The value of using this CASE tool is apparent to me	2(40)	1(20)	1(20)	0(0)	1(20)	0(0)	0(0)
* The value of using the methodology is apparent to me	0(0)	2(40)	2(40)	1(20)	0(0)	0(0)	0(0)
* I would have difficulties telling others about the benefits of using this CASE tool	0(0)	1(20)	0(0)	0(0)	1(20)	1(20)	2(40)

(Note: Numbers in parentheses refer to percentage)

b) Organizational and Individual Compatibility

Most developers stated that their system development work was not compatible with the requirements of the tool (Table 4.46). Therefore, it is not surprising that 40% of them did not like the work style imposed by the new development environment.

None of the respondents thought that the changes caused by the introduction of the CASE tool were minor. All of them cited the requirement for major changes in their software development methodology, and most of them claimed the need for major changes in their hardware architecture. While the innovation usually resulted in changes in the tasks of most respondents, it apparently resulted in few changes in organizational structure and style.

Table 4.46: Organizational and Individual Compatibility of the CASE Tool at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Individual Compatibility							
* I think that using this CASE tool fits well with the way I like to work	0(0)	2(40)	1(20)	0(0)	1(20)	1(20)	0(0)
* Using this CASE tool is not compatible with all aspects of my system development work	0(0)	3(60)	1(20)	0(0)	0(0)	1(20)	0(0)
Organizational Compatibility							
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	0(0)	0(0)	0(0)	2(40)	3(60)	0(0)
* Implementation of this CASE tool resulted in changes in our tasks	0(0)	2(0)	1(20)	1(20)	0(0)	1(20)	0(0)
* Implementation of this CASE tool did not result in changes in org. structure or style	1(20)	0(0)	1(20)	0(0)	2(40)	0(0)	1(20)
* Implementation of this CASE tool did not require changes in our hardware architecture	1(20)	0(0)	0(0)	0(0)	3(60)	1(20)	0(0)
* Implementation of this tool required changes in the software development methodology	3(60)	2(40)	0(0)	0(0)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

The CASE tool was judged easy to use by most of the developers (Table 4.47). Few of them expressed difficulties learning its methodology, and even fewer mentioned problems with learning how to operate the tool. All respondents considered the tool and its methodology clear and understandable.

Implementation Experiences

a) Level of Use

Most of the respondents at Organization E were experienced users of the CASE tool (Table 4.48). They used it frequently and completed a large portion of their daily work with its help.

Table 4.47: The CASE Tool's Ease of Use at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	0(0)	0(0)	1(20)	0(0)	1(20)	2(40)	1(20)
* Learning to use the underlying methodology has been difficult for me	0(0)	1(20)	1(20)	1(20)	0(0)	1(20)	1(20)
* My interaction with this CASE tool is clear and understandable	1(20)	2(40)	2(40)	0(0)	0(0)	0(0)	0(0)
* The methodology underlying the CASE tool is clear and understandable	0(0)	3(60)	1(20)	1(20)	0(0)	0(0)	0(0)
* Overall, I believe that this CASE tool is easy to use	0(0)	2(40)	2(40)	0(0)	1(20)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.48: Level of Use of the CASE Tool at Organization E

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
3(60)	1(20)	1(20)	0(0)	1(20)	0(0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
1(20)	0(0)	0(0)	1(20)	3(60)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
1(20)	1(20)	0(0)	0(0)	3(60)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	0(0)	2(40)	1(20)	2(40)

(Note: Numbers in parentheses refer to percentage)

b) Impact of the Use of the CASE Tool

Overall, the respondents reported a positive impact of the CASE tool on their system development work (Table 4.49). The majority experienced increased productivity, easier determination of business requirements, and improved maintainability of the generated systems. However, less than 50% of the developers stated that their customers and managers were satisfied with their work. It is surprising that only a few respondents mentioned improvements in the quality of their work and even fewer observed lower overall costs for system development.

Table 4.49: Impact of the Use of the CASE Tool at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	0(0)	0(0)	3(60)	1(20)	0(0)	1(20)	0(0)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	1(20)	1(20)	0(0)	1(20)	0(0)	2(40)	0(0)
* The tool reduces the effort to maintain new systems	0(0)	2(40)	2(40)	0(0)	0(0)	1(20)	0(0)
* My productivity has increased because of this CASE tool	2(40)	0(0)	1(20)	1(20)	0(0)	1(20)	0(0)
* Overall costs for system development are lower	0(0)	1(20)	0(0)	2(40)	0(0)	1(20)	1(20)
* My customers are more satisfied with my performance	0(0)	0(0)	1(20)	2(40)	1(20)	0(0)	1(20)
* My manager is more satisfied with my performance	0(0)	1(20)	1(20)	2(40)	0(0)	1(20)	0(0)
* The tool facilitates planning and controlling	0(0)	1(20)	2(40)	1(20)	0(0)	1(20)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Satisfaction with the Tool and its Use

Overall, the developers of Organization E were satisfied with the use of the CASE tool (Table 4.50). Everybody not only wanted to continue, but to increase using the tool. Although

the majority stated that they also could complete their job without it, they claimed that they used it because they liked it. All respondents stated that it was easy to use the capabilities of the tool and that they completely understood the use of the tool. However, there was no agreement regarding flexibility of the tool to adjust to changing requirements, and nobody thought that the tool provided all the required functionality.

Table 4.50: Satisfaction with CASE Tool at Organization E

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	0(0)	2(40)	1(20)	1(20)	0(0)	1(20)	0(0)
* I would like to continue using this CASE tool	3(60)	0(0)	1(20)	1(20)	0(0)	0(0)	0(0)
* I would like to increase the use of this CASE tool	2(40)	0(0)	2(40)	1(20)	0(0)	0(0)	0(0)
* I use this CASE tool because there is no way to complete my job without it 0(0)	2(40)	0(0)	0(0)	1(20)	0(0)	2(40)	
* I use this CASE tool because I like it	2(40)	1(20)	1(20)	0(0)	0(0)	1(20)	0(0)
* For me, it is very easy to utilize the capabilities of this CASE tool	1(20)	0(0)	3(60)	1(20)	0(0)	0(0)	0(0)
* I completely understand use of the tool	1(20)	1(20)	2(40)	1(20)	0(0)	0(0)	0(0)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	0(0)	1(20)	1(20)	2(40)	1(20)	0(0)	0(0)
* The system provides me with all the functionality that I need	0(0)	0(0)	0(0)	0(0)	5(100)	0(0)	0(0)
* This CASE tool provides all the functions I need for my job	0(0)	0(0)	1(20)	1(20)	2(40)	1(20)	0(0)
* Since the introduction of the tool, my job performance has increased	0(0)	1(20)	1(20)	2(40)	1(20)	0(0)	0(0)
* The tool sufficiently integrates different parts of the software development process	3(60)	0(0)	1(20)	1(20)	0(0)	0(0)	0(0)
* Because of this CASE tool, the results of my work are more up to date	0(0)	2(40)	1(20)	1(20)	1(20)	0(0)	0(0)
* I am satisfied with the tool interface and the display of the output content	0(0)	1(20)	2(40)	0(0)	2(40)	0(0)	0(0)
* The output of this CASE tool is consistent and dependable	2(40)	0(0)	0(0)	1(20)	2(40)	0(0)	0(0)
* This CASE tool helps me to achieve my personal objectives	2(40)	1(20)	0(0)	2(40)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Summary of Survey Results

The responding system developers of Organization E indicated that the CASE tool was successfully used. They liked the tool and reported a positive impact on their job performance. These very positive results were surprising, considering the problems reported during the implementation process.

Comparison of Management's and System Developers' Responses at Organization E

Management and system developers differed in their evaluation of the implementation management process. According to management, the organization actively addressed resistance to change. Management stated that their human resource policy created a culture that looked forward to change, and developers cited rewards for implementing and using the CASE tool. However, both factions disagreed on the availability of sufficient time and opportunity for training.

Management thought that the transition process was effectively managed. They only confessed to a lack of foresight with regard to setting up the required infrastructure. The developers' assessment was not as positive. While most developers agreed on the existence of a long-term vision, they considered the transition management process as incomplete and inconsistent.

According to both management and system developers, there were only a few problems with the political dynamics. Both groups concurred with the lack of support from all power groups. They stated that top management's decreasing commitment negatively affected the

implementation success of the CASE tool. However, they agreed on the successful promotion of the innovation and on the effectiveness of their leaders' guidance.

Developers were even more satisfied with the positive impact of the development tool on the system development process than management. At the time of data collection, the CASE tool was used for maintaining existing applications that were developed with this tool and for most new applications. Both groups considered it as an implementation success. However, the level of its future use is uncertain because both parties agreed that the tool's limited functionality and flexibility restricts its applicability to changing system development requirements.

4.2.6 Organization F

Managerial Perspective

Organization F is the holding company for a large airline company and a group of regional airlines. Over 70% of its sales were in the US and Canada. It services more than 192 worldwide destinations.

The structure of Organization F's IS department was very hierarchical, consisting of at least five formal levels of management. Despite the rigidity of its departmental (and organizational) structure, management felt that there was insufficient top-down communication and control. Approximately 12,000 employees reported to the CIO, and approximately 2,000 of them were worked in systems development.

A former member of the CASE tool selection committee was interviewed. His title at the time of data collection was "Manager for Business and Change Management". He reported on the management of the adoption and implementation process of the CASE tool and on its implementation success.

Acquisition Process

The CASE tool acquisition process for Organization F started in 1989. A focus group of four to five people representing a variety of areas within information systems was formed to manage the selection process of a CASE tool. Three CASE tool vendors were selected to give in-house presentations to management and software developers. Afterward, the focus group administered questionnaires to system developers and managers to obtain their opinions regarding the CASE tools presented.

The results of the survey revealed different objectives and expectations between top management and system developers in regard to the CASE tools. Top management primarily wanted a CASE tool to bring structure into system development. Their contention was that investing in a highly structured CASE tool would result in improvements in the development process and sharing of resources across a variety of areas. Prior to this time, system development at Organization F was very unstructured, resulting in a variety of system development methodologies. Top management selected IEF because information engineering (IE) was its underlying methodology, providing a rigid structure to the system development life cycle.

The system developers, however, preferred a different CASE tool, one which did not enforce a specific development methodology. System development felt that many activities might be done faster by providing flexibility with regard to development approaches. Although management, for the most part, agreed, they wanted to enforce one methodology as a strategic decision. After much debate, management's objective of enforcing one methodology won out over system development's objective of retaining flexibility. This resulted in the acquisition of IEF.

Management of the Implementation Process

Organization F applied several strategies to manage the implementation of IEF. For example, it addressed potential resistance of system developers by communicating the advantages of using IEF and by training them in the use of IEF.

Training sessions were organized not only to teach system developers how to use IEF, but also to make them more inclined to use it. Many developers were sent to TI's "boot camps" to learn the benefits of IEF. For other developers, in-house training was provided. In addition, a few pilot projects were conducted. Their success was communicated to system developers to obtain their support for IEF.

The organization attempted to actively manage the transition process. A central support group was established to manage the implementation of IEF. To provide direction, it offered a vision of the desired systems development environment. This vision of a global IS development architecture included a framework for future system development projects. They also intended to bring together the people doing data modeling and system development. The objective was to develop standards and policies for the system development process to improve the quality of the developed systems and their integration. Moreover, lower system development costs were expected by enabling the sharing of resources and providing a more supportive and rigorous environment for project management.

Level of Implementation

Despite the previously described implementation strategies, the diffusion of IEF throughout the organization and its organizational impact have been very limited. Prior to 1994, only two small projects had been completed and are currently being maintained, using IEF. A major development effort for a car and hotel rental system failed. Another large system is currently under development.

Problems with Implementation Strategies

From the perspective of management, weaknesses in implementation management strategies were the major reasons for the lack of IEF's implementation success. While there were attempts to manage the change process, they were usually half-hearted and remained ineffective. Specifically noted were failures in managing the resistance of system developers in controlling the transition process, and in avoiding power struggles among organizational key power groups.

a) Change Management

There were several shortcomings in motivating the change process, which resulted in conflicts among organizational units and resistance by many systems developers. Specifically, programmers and data modelers were the most resistant. Following are several reasons for their resistance.

Management made major efforts to promote IEF, yet many developers were not convinced of its advantages. For example, although there were presentations by representatives of TI and system developers went to TI for additional training, TI was regarded as an engineering company rather than a software developer. As a result, there were doubts about its long-term commitment and plans with regard to IEF. In addition, pilot projects were initiated and successful results of a function point analysis were supposed to convince developers of the advantages of IEF. However, many developers discarded the implications of these results because of the limited scope of these projects. Therefore, according to management, IEF never gained credibility by its potential users.

Some developers considered IEF as a threat to their job. Although management tried to convince them that good system developers would still be needed, it was not communicated

effectively that, while there might be less work at the back-end of the system development life cycle, more developers would be essential during the earlier phases.

Finally, some systems developers resisted because they felt they did not receive enough time and opportunity to learn the use of IEF. While having to worry about immediate delivery of projects, they also had to become familiar with the intricacies of IEF. Because of the ineffectiveness of the communication process and insufficient opportunity to learn IEF, many people were frustrated and eventually left the organization.

b) Management of Transition Process

There were also shortcomings in the management of the transition process, which resulted in frustration of the participants and in a lack of direction in the acquisition and implementation process. Weaknesses could be observed with regard to the consistency of user involvement, the communication of a clear vision, and implementation support.

While the focus group represented the interests of developers during the acquisition process, their decision was eventually overturned by management. Developers were asked for their opinions, but afterward their preferences were not considered. This represents an inconsistency in management of the transition process and caused additional resistance among system developers.

There were also inconsistencies during the transition process in the way system developers understood their organization's vision for their system development environment. For example, there was ambiguity with regard to the goals of the data modeling group. While the original task of this group was to develop an independent data model, IEF requires a separate data model and the integration of data and process modeling. In addition, the data modeling group had previously used specialized tools which were perceived by these people to be more

effective for data modeling than the functionality of IEF. These people could not be convinced of the need to change to IEF.

Lack of consistency and completeness characterized management's approach toward implementation support. On the one hand, top management intended to establish IE supported by IEF as an enterprise standard to structure the system development process. On the other hand, it was also attempting to cut overhead and support. This resulted in a lack of tool and methodology support needed to establish the required infrastructure. No cross-organizational group with methodology experts was set up. Such a group could have established organizational standards and communicated their expertise across the organization. Therefore, the success of individual projects remained of primary importance, which implied that there was no organizational approach toward IEF and IE.

This lack of coordination and completeness also reflects the organization's approach toward training. While there were attempts to coordinate the attendance of TI-sponsored training seminars in order to obtain training discounts, this task was never centralized or focused . This approach reflects the project-based approach of the organization toward systems development and maintenance, which frequently resulted in lack of coordination and efficiency. At the end, most system developers had to organize their own training.

c) Management of Political Dynamics

The implementation process at Organization F was characterized by power struggles among different interest groups. There was the struggle between the developers supporting IEF versus those supporting the traditional approach of separating data and process modeling. At the same time, there was the conflict of interest among IEF supporters, which required more resources from the organization, and top management, which was attempting to cut overhead costs. In addition, a lack of top management commitment to the change process prolonged the

problem. It was very difficult to resolve any of these conflicts, since without top management support, there was no "final court of appeal", which could have resolved or otherwise stopped ongoing conflicts.

Impact of the CASE Tool

Management regarded IEF as a useful tool, if used in the organizational context. However, on a project-by-project basis, as it was used in this organization, it was regarded as less useful than other established tools. Management believes that IEF still lacks functionality for many types of tasks.

Compatibility problems with the work styles of individual system developers were observed. Based on observations of management, most developers in this organization prefer to code and do not recognize the underlying need for a structured approach. This attitude was reflected by the prevalent "go code" approach of this organization. This conflicts with the emphasis on system analysis and design by integrated CASE tools such as IEF. There were also other compatibility problems with regard to the underlying methodology. While in the past, data and process modeling were assigned to separate organizational units, IE requires its integration with regard to both the organizational structure and individual work style.

Ease of use was not regarded as an issue. IEF was only regarded as difficult in the sense that it was different. It is different with regard to the underlying methodology and its 'point and click' approach toward systems development. Management assumed that some might have regarded it as more difficult to use than others because of differences in personalities and skills.

The level of utilization of IEF has not satisfied the original expectations of management. However, management blamed weaknesses in project management, rather than limitations of the tool. For example, according to management, the car and hotel reservation system did not fail because of inherent weaknesses in IEF, but because of shortcomings in the project management

of this system development project. Management assumed that it could save money by reducing the number of system developers in favor of more and better development tools. In addition, the capabilities of IEF were overestimated and the need for training underestimated. Management explained its unrealistic expectations by stating that it went into this project with "closed eyes". Overall, management considered IEF as an implementation failure.

User Perspective

The survey was distributed to all IEF users at this location. Only four out of about forty developers returned the instrument. The respondents were asked for their opinion regarding the tool, the implementation management process, and implementation success.

Management of the Implementation Process

a) Management of the Resistance to Change

Sufficient time and opportunity to learn the innovation was considered as one of the most important strategies to manage resistance to change (Table 4.51). However, only 25% of the respondents felt that sufficient time and opportunity were actually provided. All respondents were convinced of having received sufficient training in utilizing this CASE tool and half of them were satisfied with the training in its methodology (Table 4.52).

User participation in the implementation process and explaining the need for change received mediocre evaluations. Less than 50% of the respondents felt that the provided user participation was effective and less than 50% felt that the need for change was sufficiently explained.

Formal and informal rewards were judged as less important strategies to overcome resistance. No respondent thought that rewards were effectively provided. Overall, the

respondents of Organization F were not satisfied with the way their organization managed resistance to change.

Table 4.51: Change Management at Organization F

* sufficient time and opportunity to learn its use

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	3
good	1	25		
neutral	2	50		
fair	1	25		
poor	0	0		
very poor	0	0		

* user participation in the acquisition and implementation process

	frequency	percent		frequency
excellent	0	0	least important	1
very good	1	25	most important	1
good	0	0		
neutral	1	25		
fair	1	25		
poor	1	25		
very poor	0	0		

* explaining the need for changing the prior system development process

	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	0
good	1	25		
neutral	2	50		
fair	1	25		
poor	0	0		
very poor	0	0		

* formal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	0
good	0	0		
neutral	0	0		
fair	0	0		
poor	2	50		
very poor	2	50		

* informal rewards for implementing and / or using this CASE tool

	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	0
good	0	0		
neutral	0	0		
fair	0	0		
poor	1	25		
very poor	3	75		
N/A	1			

Table 4.52: Training and Support at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* I received sufficient training in the CASE tool's methodology	1(25)	1(25)	0(0)	0(0)	2(50)	0(0)	0(0)
* I received sufficient training in utilizing this CASE tool	1(25)	3(75)	0(0)	0(0)	0(0)	0(0)	0(0)
* If I have problems with this CASE tool, there is sufficient support available	1(25)	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

b) Transition Management

A clear image of the envisioned system development environment was considered as one of the most important strategies to manage the transition process (Table 4.53). However, most of the respondents felt that their organization was not effectively providing a clear vision.

No respondent was satisfied with the manner in which the implementation process was managed and the feedback for management. Less than 50% of the respondents appeared to be satisfied with the provided special project groups. Overall, these shortcomings indicate that the organization was not successful in avoiding confusion and chaos during the transition process.

c) Management of Political Dynamics

All respondents regarded the support by all organizational power groups as a very important factor for successfully managing the political dynamics of the transition process (Table 4.54). They agreed that not all power groups supported the CASE implementation. However, active guidance by established leaders and management's promotion of the CASE tool were considered as effectively implemented. Overall, the respondents indicated shortcomings in management of the political dynamics and political tensions which could have slowed down the implementation process.

Table 4.53: Management of the Transition Process at Organization F

* clear image of the envisioned system development environment

	frequency	percent		frequency
excellent	0	0	least important	0
very good	1	25	most important	1
good	0	0		
neutral	0	0		
fair	1	25		
poor	1	25		
very poor	1	25		

* feedback about progress of implementation process from management

	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	0
good	0	0		
neutral	0	0		
fair	2	50		
poor	2	50		
very poor	0	0		

* provision of special project groups for the implementation process

	frequency	percent		frequency
excellent	0	0	least important	2
very good	0	0	most important	0
good	1	25		
neutral	2	50		
fair	0	0		
poor	1	25		
very poor	0	0		

* complete and consistent management of the implementation process

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	0
good	0	0		
neutral	2	50		
fair	2	50		
poor	0	0		
very poor	0	0		

* feedback about progress of implementation process for management

	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	0
good	0	0		
neutral	0	0		
fair	3	75		
poor	1	25		
very poor	0	0		

Table 4.54: Management of the Political Dynamics at Organization F

* support of all key power groups within the organization				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	4
good	0	0		
neutral	0	0		
fair	2	50		
poor	1	25		
very poor	1	25		

* active guidance by established leaders				
	frequency	percent		frequency
excellent	0	0	least important	1
very good	0	0	most important	3
good	0	0		
neutral	1	25		
fair	1	25		
poor	2	50		
very poor	0	0		

* promotion of the CASE tool by management				
	frequency	percent		frequency
excellent	0	0	least important	0
very good	0	0	most important	2
good	0	0		
neutral	1	25		
fair	0	0		
poor	0	0		
very poor	3	75		

* management's explicit emphasis on continuity and stability				
	frequency	percent		frequency
excellent	0	0	least important	3
very good	0	0	most important	1
good	1	25		
neutral	0	0		
fair	1	25		
poor	1	25		
very poor	1	25		

Evaluation of the CASE Tool

a) Relative Advantage of CASE Tool and Demonstrability of its Results

The majority of respondents judged the new development environment superior to the previous one (Table 4.55). They agreed on its positive impact on their quality of work and job effectiveness. Most of them cited improvements in their productivity. Although the value of using the tool was apparent to most developers, only 50% of them did not experience difficulties telling others about the benefits of using this tool.

Table 4.55: Perceived Relative Advantage of the CASE Tool and Demonstrability of its Results at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Relative Advantage							
* Using this CASE tool improves the quality of my work	0(0)	4(100)	0(0)	0(0)	0(0)	0(0)	0(0)
* Using this CASE tool enables me to accomplish tasks more quickly	0(0)	2(50)	1(25)	0(0)	1(25)	0(0)	0(0)
* Using this CASE tool enhances my effectiveness on the job	0(0)	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)
* Using this CASE tool makes it more difficult for me to do my job	0(0)	1(25)	0(0)	0(0)	1(25)	1(25)	1(25)
* Using this CASE tool gives me less control over my work	0(0)	0(0)	2(50)	0(0)	2(50)	0(0)	0(0)
Result Demonstrability							
* The value of using this CASE tool is apparent to me	1(25)	2(50)	0(0)	0(0)	0(0)	0(0)	1(25)
* The value of using the methodology is apparent to me	0(0)	2(50)	1(25)	0(0)	0(0)	0(0)	1(25)
* I would have difficulties telling others about the benefits of using this CASE tool	1(25)	0(0)	1(25)	0(0)	0(0)	1(25)	1(25)

(Note: Numbers in parentheses refer to percentage)

b) Organizational and Individual Compatibility

All developers felt that their system development work was compatible with the requirements of the tool (Table 4.56). Therefore, it is not surprising that they liked the work style imposed by the CASE tool.

Most of them did not judge the changes caused by its introduction as minor. All of them cited the need for changes in their software development methodology only half of them stated that no changes in their hardware architecture were required. While the innovation resulted in changes in the tasks of all respondents, it apparently resulted in few changes in organizational structure and style.

Table 4.56: Organizational and Individual Compatibility of the CASE Tool at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
Individual Compatibility							
* I think that using this CASE tool fits well with the way I like to work	2(50)	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)
* Using this CASE tool is not compatible with all aspects of my system development work	0(0)	0(0)	0(0)	2(50)	0(0)	2(50)	0(0)
Organizational Compatibility							
* The nature of the changes caused by the introduction of the CASE tool were minor	0(0)	0(0)	1(25)	0(0)	1(25)	2(50)	0(0)
* Implementation of this CASE tool resulted in changes in our tasks	1(25)	3(75)	0(0)	0(0)	0(0)	0(0)	0(0)
* Implementation of this CASE tool did not result in changes in org. structure or style	0(0)	1(25)	1(25)	0(0)	2(50)	0(0)	0(0)
* Implementation of this CASE tool did not require changes in our hardware architecture	0(0)	0(0)	2(50)	1(25)	0(0)	0(0)	1(25)
* Implementation of this tool required changes in the software development methodology	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

c) Ease of Use

Most of the developers considered the CASE tool as easy to use (Table 4.57). All of them regarded the tool and its methodology as easy to learn and to interact with. Overall, the tool was regarded as easy to use.

Implementation Experiences

a) Level of Use

Most of the responding developers had experience with the CASE tool (Table 4.58). They did a large portion of their work with the help of the tool and used it for more than three years. It is surprising that all of them used it only infrequently.

Table 4.57: The CASE Tool's Ease of Use at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* Learning to operate this CASE tool has been difficult for me	0(0)	0(0)	0(0)	0(0)	0(0)	1(25)	3(75)
* Learning to use the underlying methodology has been difficult for me	0(0)	0(0)	0(0)	0(0)	0(0)	3(75)	1(25)
* My interaction with this CASE tool is clear and understandable	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)	0(0)
* The methodology underlying the CASE tool is clear and understandable	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)
* Overall, I believe that this CASE tool is easy to use	1(25)	2(50)	0(0)	0(0)	0(0)	1(25)	0(0)

(Note: Numbers in parentheses refer to percentage)

Table 4.58: Level of Use of the CASE Tool at Organization F

Frequency of using this CASE tool on the job

very often	regularly	some-times	a little	hardly	never	use not required
0(0)	0(0)	0(0)	4(100)	0(0)	0(0)	0(0)

The portion of work that has been done with the help of this tool, relative to all of work that could be supported by this CASE tool.

< 20%	20-39%	40-59%	60-79%	80-100%
0(0)	0(0)	0(0)	3(75)	1(25)

The portion of tool functionality that is actually used, based on the functionality of this CASE tool that is applicable to their work in system development.

< 20%	20-39%	40-59%	60-79%	80-100%
0(0)	1(25)	0(0)	2(50)	1(25)

Length of CASE tool use

< 14 days	14 days - 3 months	3 - 12 months	1 - 3 years	> 3 years
0(0)	0(0)	0(0)	0(0)	4(100)

(Note: Numbers in parentheses refer to percentage)

b) Impact of the Use of the CASE Tool

Overall, most respondents did not report a negative impact on their system development work (Table 4.59). Most of them cited improvements in their quality of work and maintainability

of the generated systems. Developers were either neutral or positive regarding customer and manager satisfaction with their performance. However, only 50% of them experienced an easier determination of business requirements and increased productivity. None of the respondents observed lower costs in system development.

Table 4.59: Impact of the Use of the CASE Tool at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The tool makes it easier for me to gain knowledge of the business requirements	1(25)	0(0)	1(25)	0(0)	0(0)	0(0)	2(50)
* Quality (e.g. number of design changes or run-time errors) has increased because of this CASE tool	1(25)	1(25)	1(25)	0(0)	0(0)	1(25)	0(0)
* The tool reduces the effort to maintain new systems	0(0)	2(50)	1(25)	0(0)	0(0)	1(25)	0(0)
* My productivity has increased because of this CASE tool	1(25)	0(0)	1(25)	0(0)	1(25)	1(25)	0(0)
* Overall costs for system development are lower	0(0)	0(0)	0(0)	2(50)	1(25)	0(0)	1(25)
* My customers are more satisfied with my performance	0(0)	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)
* My manager is more satisfied with my performance	0(0)	0(0)	3(75)	1(25)	0(0)	0(0)	0(0)
* The tool facilitates planning and controlling	1(25)	0(0)	1(25)	0(0)	1(25)	0(0)	1(25)

(Note: Numbers in parentheses refer to percentage)

c) Satisfaction with the Tool and its Use

Most of the developers were satisfied with the CASE tool (Table 4.60). Most of them thought that the benefits derived from using this tool far outweighed the costs. Therefore, it is not surprising that most of them wanted not only to continue, but to increase using the tool. However, most of the respondents used the tool not only because they liked it, but also because they thought that there would be no way to complete their job without it. Only 50% of them felt that the tool provided them with all the functions they needed for their job.

Table 4.60: Satisfaction with CASE Tool at Organization F

	strongly agree	moderate. agree	somewhat agree	neutral	somewhat disagree	moderate. disagree	strongly disagree
* The benefits derived from using this tool far outweigh the costs	1(25)	2(50)	0(0)	0(0)	0(0)	0(0)	1(25)
* I would like to continue using this CASE tool	2(50)	1(25)	0(0)	0(0)	0(0)	1(25)	0(0)
* I would like to increase the use of this CASE tool	1(25)	2(50)	0(0)	0(0)	0(0)	1(25)	0(0)
* I use this CASE tool because there is no way to complete my job without it	2(50)	0(0)	1(25)	0(0)	0(0)	0(0)	1(24)
* I use this CASE tool because I like it	1(25)	2(50)	0(0)	1(25)	0(0)	0(0)	0(0)
* For me, it is very easy to utilize the capabilities of this CASE tool	3(75)	1(25)	0(0)	0(0)	0(0)	0(0)	0(0)
* I completely understand use of the tool	1(25)	2(50)	1(25)	0(0)	0(0)	0(0)	0(0)
* The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	0(0)	0(0)	3(75)	0(0)	0(0)	1(25)	0(0)
* The system provides me with all the functionality that I need	0(0)	1(25)	1(25)	0(0)	1(25)	1(25)	0(0)
* This CASE tool provides all the functions I need for my job	1(25)	0(0)	1(25)	1(25)	1(25)	0(0)	0(0)
* Since the introduction of the tool, my job performance has increased	1(25)	0(0)	1(25)	0(0)	2(50)	0(0)	0(0)
* The tool sufficiently integrates different parts of the software development process	0(0)	2(50)	2(50)	0(0)	0(0)	0(0)	0(0)
* Because of this CASE tool, the results of my work are more up to date	1(25)	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)
* I am satisfied with the tool interface and the display of the output content	1(25)	1(25)	0(0)	0(0)	2(50)	0(0)	0(0)
* The output of this CASE tool is consistent and dependable	1(25)	1(25)	2(50)	0(0)	0(0)	0(0)	0(0)
* This CASE tool helps me to achieve my personal objectives	1(25)	1(25)	1(25)	0(0)	1(25)	0(0)	0(0)

(Note: Numbers in parentheses refer to percentage)

Summary of Survey Results

The responding developers indicated shortcomings in management of the implementation process. These problems provided the potential for confusion, chaos, and political tensions which could have slowed down the CASE tool's implementation process. Despite these problems, most

of them reported a positive impact on their system development work and were satisfied with its use.

Comparison of Management's and System Developers' Responses at Organization F

Management and developers agreed in their criticism of the strategies used to manage the implementation process. Considering that management acknowledged significant shortcomings in managing resistance to change, it is surprising that developers were not more dissatisfied. Both parties agreed on serious weaknesses in managing the transition process and its political dynamics.

Overall, neither group considered IEF as an implementation success. The tool was used much less frequently than originally expected by management and there were no plans to use it for major future development projects. Management stated that it was used only occasionally for maintaining existing applications. System developers were more satisfied with the tool and its impact on the system development process than management. Their satisfaction with the CASE tool was confirmed by management's statement that the implementation failure was not primarily the fault of the tool, but the way in which it was implemented.

4.3 Discussion of Implementation Success

The theoretical background for assessing the CASE tool's implementation success at the organizational and individual level were discussed in section 3.3. Organizational diffusion of the CASE tool, or its utilization relative to management's expectations, was defined (Table 3.5). Additionally, the tool's organizational impact, or management's satisfaction with the tool and its use, were evaluated (Table 3.5). However, the interviewed managers at most organizations did not have enough information to assess the individual criteria. These managers provided only general information about the organizational diffusion and their satisfaction with the tool.

Therefore, both success factors were only assessed at the aggregate level. Planned future utilization of the tool was added as a third factor to assess organizational implementation success. All three factors were used to summarize organizational implementation success for each of the six organizations (Table 4.61). Organizations D and E were categorized as successful, while Organizations A, B, and F were considered as unsuccessful. It was difficult to assess organizational implementation success at Organization C, since management only indirectly addressed implementation problems and management's positive reports were contradicted by information received from system developers. Because success at the organizational level was defined based on management's perspective, the organization had to be categorized as an implementation success.

Table 4.61: Implementation Success at the Organizational and Individual Level

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F
Success at the Org. Level:						
* Level of Use	low	low	high	mediocre	high	low
* Satisfaction	mediocre	low	mediocre	high	high	low
* Used for New Applications	for specific projects	probably not	yes, until better tool is available	yes	yes	probably not
Success at the Indiv. Level:						
* Level of Use	mediocre	high	high	high	high	mediocre
* Satisfaction	mediocre	high	mediocre	high	mediocre	high

Implementation success at the individual level was assessed, based on developers' utilization of and satisfaction with the CASE tool. Level of use was evaluated, based three items (Table 3.6). Satisfaction with the tool and its use were estimated, based on thirteen items. Both

of these constructs were evaulated for each organization by averaging the responses across all the measures of a construct and across all respondents. To make the results more comparable with the organizational results, the numeric values were replaced by a qualitative expression. The highest implementation success at the individual level was observed at Organizations D and B, followed by Organizations F, C, and E (Table 4.61). The least success was reported by the developers at Organization A.

4.4 Other Data Sources

This research was based on the adoption and implementation experiences from Organizations A to F. To increase the external validity of the derived results, two consultants were independently interviewed. Both had supported multiple organizations in adopting and implementing IEF, providing substantial expertise relevant to the investigated research questions.

4.4.1 Consultant A

The first consultant was a senior partner in an international consulting company. His specialty was data modeling and database support. He had worked with both U.S. and European companies.

He felt that most organizations bought the CASE tool based on TI's promises. The tool was marketed as a "magic solution" or "silver bullet". Many organizations thought that their programmers would have to worry less about database design and programming languages. They felt that they could turn most of their technical people into analysts and stop worrying about technical changes, because "everything" could be done by pointing and clicking in their GUI-based environment. They hoped that most problems would be solved by pressing a button.

However, according to the consultant, these organizations were wrong. They did not realize that IEF was just a tool with its own strengths and weaknesses. In his experience, the tool was only successfully adopted by organizations that knew how to implement and use it.

Organizations were more successful if they chose a pragmatic and long-term perspective. They realized that database administrators and technical expertise were still required, and they were cognizant of the significant up-front learning-curve and the long-term benefits.

The consultant assumed that there was a learning-curve of at least one year. During that time period, constant training and effective reviews have to be provided within a controlled environment. To be successful, the pilot project has to be well managed and well defined. He observed that organizations that started with small pilot projects experienced productivity improvements very soon. However, with bigger pilot projects, initial productivity usually suffers.

Learning the CASE tool's basics was considered easy. TI's "boot camps", as the major provider for basic training, were considered very effective. However, it is very difficult to learn the tool well. He felt that most organizations failed in providing advanced training. TI's advanced training was judged as ineffective because it taught how to use the tool, but not its underlying principles.

The consultant stated that significant productivity improvements can be expected after completing four to six projects. He assumed that after completing ten applications, a project that was originally rated at 200 days to complete would take fifteen to twenty days. These improvements would be enabled by developers' experience and by code and design reuse. He concluded that, for successfully implementing IEF, organizations need to stick with it throughout a long learning curve and they need to have realistic expectations. Benefits can only be expected in the long term, through reduced maintenance costs and increased design reuse.

Different implementation strategies were observed to manage the transition process. Some organizations started out with a major bureaucratic infrastructure, while others

implemented small pilot projects. Based on his experience, the consultant recommended starting with a few small pilot projects and from there setting-up the infrastructure required for IE and IEF. He emphasized the importance of a long-term strategy to manage training and overblown expectations.

The consultant met very few developers and managers that resisted the adoption of this CASE tool. In most organizations, management overcame resistance by force and some training. He felt that most people lost their resistance if they opened their mind and recognized that IEF was only a tool for certain types of applications. He observed most resistance by database administrators that were very technically oriented and resisted the tool because of its technical limitations.

Problems in the political dynamics of the implementation process are frequently caused by too high expectations. For example, the consultant did not know any organization that used this tool successfully to develop an enterprise data model. Usually, these attempts failed because of political difficulties in integrating previously independent "kingdoms" in a top-down manner. He felt that a decentralized bottom-up approach might cause less political tension and work better.

He considered the CASE tool very effective for certain types of applications because it provided efficient and bug-free code. However, because of shortcomings in its functionality (e.g., support for dynamic SQL), it was more appropriate for the development of general business applications (e.g., data entry, "look-up" applications, and "listing-type" applications). It was considered to be less suitable for decision support systems or applications for ad hoc reporting.

Overall, the consultant felt that organizations more successfully implemented the CASE tool if they selected a long-term and pragmatic strategy. Using this approach their expectations would be more realistic and they would not lose commitment because of the tool's very long

learning-curve. The tool would not be regarded as a "silver bullet", but as a tool useful for the development of certain types of applications.

4.4.2 Consultant B

The second consultant had worked for five years in sales and sales support for Texas Instruments before accepting her present position. She is currently a Managing Director for a nationally operating consulting company.

Based on her experiences, most organizations bought IEF to improve system development productivity by reusing design models and alleviating system maintenance. However, many organizations expected a fast return on their investment. When productivity stayed below initial expectations, many organizations stopped using the CASE tool. Management of these organizations did not recognize that initial productivity improvements would be small. Return on their investment would be in the form of long-term cost savings derived from higher quality of the generated systems.

Occasionally, she observed managers and developers resisting the adoption of this tool. They did not want to learn something new or were afraid of losing their job. Top management usually attempted to address resistance by communicating the tool's benefits and providing training. If the employees still resisted, they were frequently given the choice of either biting the bullet or to looking for a different job. However, most managers and developers liked the tool after working with it for a while.

Training was considered the most important factor for managing the transition process. Some organizations started with too large or too critical pilot projects. In these situations, there was so much pressure on project teams that there was not enough slack to effectively learn the tool.

The consultant considered the CASE tool more appropriate for the development of larger applications. Because of its high cost and steep learning curve, it was regarded as overkill for department-size applications. However, its usability was restricted by shortcomings in its functionality (e.g., support for middleware and the development of client-server systems). Overall, the consultant felt that, at most, an organization's implementation failure was caused by underestimating the time and cultural changes required to adopt this CASE tool.

CHAPTER 5

CROSS-ORGANIZATIONAL ANALYSIS

5.1 Introduction

The observations from the individual organizations are summarized in Tables 5.1 to 5.3. The qualitative ratings for implementation strategies and innovation related factors were derived from developers' mean responses for each construct. Based on these results, a cross-organizational analysis was conducted. It was observed that successful and less successful organizations differed in the manner in which they adopted and implemented the CASE tool.

Implementation success was judged primarily at the organizational level. Only the impact of managing change and innovation-related characteristics were assessed at the individual level. It was assumed that resistance toward the adoption of an innovation occurs at this level. The effects of innovation-related characteristics were not investigated at the organizational level because of two reasons. First, it was assumed that management's evaluation of the tool was less relevant for its utilization after it was adopted. At all the investigated organizations, project managers together with their developers decided which of the available development tools to use for specific projects. Second, at most organizations, management's evaluation of the CASE tool was, at times, fuzzy and incomplete. Whenever they addressed this issue, they stated that lack of implementation success was not the tool's fault. Overall, it was regarded as inappropriate and there was insufficient information to identify relationships at the organizational level.

5.2 Results of Cross-Organizational Analysis

5.2.1 Relationship between Original Expectations and Implementation Success

In recent years, information systems (IS) managers have become increasingly aware of the urgent need for improving the productivity of their staff, particularly those engaged in developing new systems and maintaining existing systems. This concern was a result of management's desire for using IS for competitive advantage, shortening the application development backlog, and lowering cost and development time of system development.

In the late 1980's, CASE technology was marketed as a "silver bullet" to address all these problems [Abi, 1987; Yuen and Spurgeon, 1992]. Organizations, such as the ones investigated in this study, bought CASE tools with the hope of significantly improving quality and productivity of their system development work. However, successful and unsuccessful adopters differed in the way they wanted to achieve these objectives.

Very high expectations preceded the implementation failures at Organization A, B, and F (Table 5.1). The manager interviewed at Organization F stated that his organization had much too high expectations of the tool. Developers at Organizations A and B felt that their top management bought the tool because they regarded it as a "silver bullet" to address all system development problems. All three organizations intended to use the tool to develop an organizational information infrastructure. In addition, Organization F wanted to use the tool to create a structure for their previously unstructured system development environment. However, these organizations failed in their attempt. A later interview with a consultant confirmed that, based on his experience, most organizations have failed in attempting to use the CASE tool in a strategic way by failing to create an overall Information Systems Plan (ISP). He agreed that they frequently bought the CASE tool as a panacea to solve all their problems in system development. These organizations failed to recognize that it is only a tool that needs to be used in the right way, in the right environment, and for the right purpose. Based on his observations, organizations that

used a project-by-project approach for implementing the tool were more successful. He assumed that a decentralized bottom-up implementation process is usually more successful than a centralized top-down approach.

Organizations C, D, and E were more successful in achieving their original expectations. Their initial expectations were not as high as that of the previous three companies. They did not plan to standardize the tool. Organizations D and E had rudimentary ISPs in place when the tool was adopted, and Organization C de-emphasized its development. Therefore, the tool's implementation success did not depend on the success of an information architecture. They only considered it as another tool for system development and used it on an "as needed" bases for separate projects.

Table 5.1Adoption-Related Factors and Implementation Success

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F
Adoption-Rel. Factors:						
* Year of Adoption	1990	1988	1990	1992	1992	1989
* Planned Scope of Adoption	for information architecture	for information architecture	on a project by project basis	on a project by project basis	on a project by project basis	for information architecture
* Learning Curve	under-estimated	under-estimated	accounted for	accounted for	accounted for	under-estimated
Success at the Org. Level:						
* Level of Use	low	low	high	moderate	high	low
* Satisfaction	moderate	low	moderate	high	high	low
* Used for New Applications	for specific projects	probably not	yes, until better tool is available	yes	yes	probably not

These observations have been supported by reports in practitioner journals. Yuen and Spurgeon [1992] stated that CASE has been tremendously oversold to some user audiences. Besides all the confusion caused by the marketing hype, those users have formulated their own unrealistic high expectations. However, for many organizations, CASE has not lived up to its expectations [Information Week, 1991]. It is usually not because of the CASE tool itself, but because of the applications development environments in which it is installed and because of unrealistic beliefs of the IS user community that there is some kind of magic in the tool itself. The unavoidable outcome of having unrealistic expectations is disappointment when expectations are not reached. Many organizations quickly become skeptical and cynical of the technology and dropped it before it reached its fullest potential [Yuen and Spurgeon, 1992].

5.2.2 Relationship between Learning Curve and Implementation Success

The adoption of a CASE tool usually requires significant changes in the system development environment of most organizations and in the skill repertoire of most users and project managers. Developers from all the investigated organizations cited major changes in the system development process of their organizations and their system development work. This indicates the need for learning both at the organizational and individual levels.

The severity of problems with the CASE tool's learning curve differed among the investigated organizations (Table 5.1). Managers at Organizations A, B, C, and F stated that the surprisingly long learning curve negatively affected the tool's implementation success. At Organization A, several project managers felt that they could not afford the steep learning-curve because of their organization's long application development backlog. At Organization B, management lost their commitment to the tool before developers could move down the learning-curve and at Organization F, many developers were so frustrated with management's overblown expectations that they left the organization. In all three cases, management knew that a lot of

time and effort was required to learn the use of the tool. However, they did not provide sufficient time for their developers and project managers. At all three organizations, the tool was used much less than originally expected by management. Management at Organization C did not claim that the learning-curve was too long, but that is was time consuming to get sufficient developers trained for each new project.

The problems with the long learning curve appeared to be less significant at Organizations D and E, which were less dissatisfied with the tool and its level of use. Although management at Organizations D and E did not mention significant problems with the learning curve, the developers at Organization E indicated dissatisfaction with the available time and opportunity to learn the tool's use. However, one developer stated that the lack of support during the learning process was the true problem.

These observations were supported by the experience of two IS consultants who were interviewed independently. The first one stated that organizations are more successful if they not only take a pragmatic approach, but actually stick with it and use a long-term strategy. Significant improvements in the system development process cannot be expected in the short-run, but require the experience of at least four to six completed projects and consistent training. None of the investigated organizations were beyond this break-even point. However, management at Organizations D and E appeared to have more realistic expectations with regard to the required learning-curve. The second consultant agreed that many organizations stopped using the CASE tool because they mistakenly expected a fast return on their tremendous investment and they underestimated the required cultural changes.

The reports of other practitioners also supported this conclusion. They stated that organizations frequently underestimated the need for training [Information Week, 1991]. In addition, they tend to look at CASE more in terms of the technological issues rather then in the managerial and organizational issues. It has been suggested that management would be

disappointed if they expected radical improvements in productivity and cost savings without considering a long learning curve [Spurgeon and Yuen, 1992].

5.4 Relationship between Managing Resistance to Change and Implementation Success

An individual developer within an organization may resist an innovation like a CASE tool for various reasons [Markus, 1983; Kotter and Schlesinger, 1979]. Resistance may be caused by a perceived loss of stability, autonomy, or job security. A developer may also resist because of ideological reasons, because of the way it is presented, or simply because no improvements are perceived in the adoption of the tool. While there might be organizational reasons for resistance, it occurs at the individual level.

At all the examined organizations, there was potential for resistance. The majority of developers at each organization observed significant changes in their system development work and in their overall system development processes. In addition, system developers at all organizations cited problems with management's approach toward resistance to change. Most respondents felt that their organizations were not effective in explaining the need for change, in providing sufficient time and opportunity to learn the use of the tool, in involving users in the acquisition and implementation process, and in providing rewards.

However, the inference of resistance was not supported by the data (Table 5.2). Dissatisfaction with managing resistance to change was neither related to system developers' utilization of nor to their satisfaction with the tool. Developers at Organizations D and E experienced less problems with the strategies used to manage resistance to change than developers at Organizations A, B, C, and F. However, there was no obvious difference in their utilization of the tool or satisfaction with its use. Despite the shortcomings in managing resistance across all organizations, no significant resistance toward the tool itself was observed. The majority of respondents at all organizations wanted not only to continue, but to increase

using the tool. It is unlikely that a significant portion of intended adopters of the tool rejected its use and, therefore, were not included in our sample. Managers at most organizations mentioned that they had significantly more developers trained in the tool than were actually needed. Overall, developers of all organizations evaluated the strategies used to manage resistance to change as relatively less important for the CASE tool's implementation success than the strategies used to manage the transition process and its political dynamics.

The results are not supported by the literature on innovations. Based on the literature, resistance to change needs to be managed to successfully adopt an innovation. An innovation achieves higher implementation success if its users understand the need for change [Lewin, 1952; Lucas et al., 1990]. They need to be trained in its use and must have access to help [Leonard-Barton, 1987a]. Various articles stated that user participation in the acquisition and implementation process would reduce resistance by informing individuals about the change process and its implications, as well as by building ownership [Kotter and Schlesinger, 1979; Brancheau and Wetherbe, 1990; Leonard-Barton, 1988]. The need for an appropriate reward system for overcoming resistance and motivating change has also been emphasized [Kerr, 1991; Quinn, 1992].

Why were these recommendations for managing resistance to change not supported by this study? The data at this level of aggregation indicate that the shortcomings in managing the implementation process did not result into significant resistance toward the adoption of the tool, because the developers' initial motivation was very high. Developers at all organizations recognized the relative advantage of using the CASE tool, and most of them felt that it would help them in achieving their personal objectives. Almost nobody expected formal or informal rewards for adopting and using the tool. Several interviewed developers and managers stated

Table 5.2: Implementation Management and Implementation Success

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F
Impl. Mgt Strategies:						
* Mgmt of Resistance	moderate	moderate	ineffective	effective	effective	ineffective
- expl. change	effective	effective	ineffective	effective	effective	moderate
- time to learn	moderate	moderate	effective	effective	moderate	moderate
- user involv.	moderate	moderate	ineffective	effective	moderate	moderate
- rewards	ineffective	ineffective	ineffective	ineffective	effective	very ineffec.
Mgmt's Perception	ineffective	moderate	moderate	effective	effective	ineffective
* Mgmt of Transition Proc.	ineffective	ineffective	ineffective	moderate	moderate	ineffective
- complete & consist. mgt	ineffective	ineffective	ineffective	moderate	ineffective	ineffective
- clear vision	ineffective	ineffective	ineffective	effective	effective	ineffective
- proj. groups	moderate	effective	ineffective	effective	effective	moderate
- feedback	moderate	moderate	ineffective	moderate	moderate	ineffective
Mgmt's Perception	ineffective	ineffective	moderate	moderate	effective	ineffective
* Mgt of Political Dynamics	moderate	ineffective	ineffective	moderate	moderate	ineffective
- support of all power groups	moderate	moderate	ineffective	moderate	ineffective	ineffective
- act. guidance	moderate	ineffective	ineffective	effective	effective	ineffective
- promotion	moderate	ineffective	ineffective	moderate	effective	ineffective
- continuity	ineffective	ineffective	ineffective	moderate	moderate	ineffective
Mgmt's Perception	moderate	ineffective	moderate	moderate	moderate	ineffective
Success at the Org. Level:						
* Level of Use	low	low	high	moderate	high	low
* Satisfaction	moderate	low	moderate	high	high	low
* Used for New Applications	for specific projects	probably not	yes, until better tool is available	yes	yes	probably not
Success at the Indiv. Level:						
* Level of Use	moderate	high	high	high	high	moderate
* Satisfaction	moderate	high	moderate	high	moderate	high

that using this tool was perceived as positive for their resume. Most respondents appeared to be very satisfied with the tool itself (e.g., like to continue using the tool). Overall, it is unlikely that individual developers were able to resist using the tool, because most of them were required to use it by their supervisor or job requirements. It is also unlikely that they wanted to resist, because, after getting to know the tool, they liked to use it.

5.2.3 Relationship between Transition Process Management and Implementation Success

The transition process during the implementation of an innovation frequently disrupts existing formal and informal organizational arrangements [Nadler, 1991]. This can negatively affect the organization's ability to coordinate and direct its work effectively. To avoid chaos and confusion, the transition process needs to be carefully managed.

Although none of the transition processes at the investigated organizations was without shortcomings, there were differences in the quality of their management (Table 5.2). While developers and management observed only minor shortcomings in the strategies used to manage the transition process at Organizations D and E, they were more severe at Organizations A, B, C, and F. Most developers from the latter group of organizations stated that the image for the envisioned system development environment was not clear. Therefore, it is not surprising that management of the transition process at these organizations was regarded as incomplete and inconsistent. In addition, many developers mentioned problems with the special project groups provided for the implementation process and with the effectiveness of the communication process between developers and management. A clear vision and thorough management were considered as relatively more important for the tool's implementation success.

Based on these results, there was probably more chaos and confusion during the transition process at Organizations A, B, C, and F. Therefore, it is not surprising that their management was less satisfied with the use of the CASE tool. In addition, Organizations A, B,

and F reported a relatively lower utilization of the tool. Organization C's utilization of the tool was regarded as relatively high, because management pushed through the development of a mission critical system under such difficulties that they would not do it again. The developers' utilization of the tool and satisfaction with its use did not appear to be related to the quality of transition management.

These results are supported by previous studies. The communication of a clear vision as well as consistency and completeness in the management of the transition process have been judged to be important for the implementation success of an innovation [Ball et al., 1987; Brancheau and Wetherbe, 1990]. The importance of special interim structures [Alexander, 1989; Leonard-Barton, 1987a, 1988] and of an effective communication process between adopters and management [Ball et al., 1987; Nilakanta and Scamell, 1990] have been suggested for successfully implementing an innovation.

5.2.4 Relationship between Political Dynamics and Implementation Success

Every organization is a political system, composed of individuals, groups, and coalitions aiming for political power [Tushman, 1977]. During change processes, like the adoption of an innovation at the organizational level, this struggle for power frequently becomes more intense. This is more likely when the temporary ambiguity before the emergence of a new order promises the possibility of changing the balance of power among the stakeholders. The adoption of a CASE tool promises this possibility because it frequently changes the interdependency and distribution of power among the organizational power groups.

Managers and system developers at the analyzed organizations reported on political tensions caused by the adoption of the CASE tool (Table 5.2). Developers at all organizations stated that the strategies used to address these political tensions were more important for the implementation success of the CASE tool than the strategies used to manage resistance and the

transition process. However, the organizations differed in their effectiveness in managing these political tensions. Managers and developers at Organizations D and E reported fewer problems with political tensions at their organizations then their counterparts at the other organizations. Developers at both organizations praised the active guidance by their leaders. They were satisfied with the tool's promotion by management and with the emphasis on continuity and stability. At Organization E, problems with top management support were perceived, but otherwise the respondents at both organizations were content with the support by their organizational power groups.

Therefore, it is not surprising that management at these two organizations was more satisfied with the tool and reported a relatively higher level of use than management at the other organizations. In contrast to the other organizations, they wanted to use it for the development of many future applications.

These results are supported by the literature on the diffusion of innovations. Various studies emphasized the importance of actual and perceived management guidance for the successful adoption of various IT innovations [Leonard-Barton, 1987a; Leonard-Barton and Deschamps, 1988; Lucas et al., 1990; Meyer and Goes, 1988; Zmud, 1984; Bush et al., 1987]. Other studies emphasized that management needs to effectively sell IT innovations to achieve their successful adoption [Ball et al., 1987; Brancheau and Wetherbe, 1990; Nilakanta and Scamell, 1990]. Finally, Raghavan and Chand [1989] stressed that an innovation can only be successfully adopted, if the support for change by various power groups reaches a critical mass.

5.2.5 Relationship between Tool Related Characteristics and Implementation Success

A diversity of individual, organizational, and technical variables have been explored as being potentially relevant to IS implementation effectiveness. In the context of classical diffusion theory, an innovation can be described by a few key characteristics (i.e., relative advantage,

compatibility, triability, result demonstrability, and ease of use). The theory proposes that depending on how they are perceived by adopters of an innovation, they determine its utilization and satisfaction with its use.

At all the investigated organizations, the majority of developers judged the new development environment superior to the previous one and they did not experience problems telling others about these benefits (Table 5.3). There was agreement on its individual and organizational compatibility. Developers at all organizations described the tool as easy to learn and to use. These key characteristics were evaluated very similar across the examined organizations.

Previous studies investigated the relationship between the perception of these characteristics and an innovation's implementation success. As shown in section 2.1, the importance of these attributes for a successful adoption process has been proposed by various authors for different types of innovations.

However, the results of previous studies were not supported by the observations of this research. At the organizational level of analysis, developers' perceptions of these factors were not related to their utilization of the tool or satisfaction with its use. Two explanations are proposed to explain the discrepancy between the observed results and literature. First, in contrast to most previous studies, the adoption of a CASE tool occurs at the organizational level and is not left to the discretion of an individual user. Therefore, level of use depends on the organizational utilization of the innovation and not on any personal preferences. Most respondents confirmed that they were required to use the tool by either their supervisor or job. Because a CASE tool is not independently used by developers, their satisfaction with its use is affected more by the organizational context of its adoption and use than by the perceived characteristics of the innovation. Second, this study examined the relationships of constructs which were aggregated at the organizational level. By reasoning at the organizational and not at

the developer level potentially existing relationships could have been overlooked. Further studies at the system developer level might uncover existing relationships. Both of these propositions would explain the lack of results. However, both require further research to be confirmed or rejected.

Table 5.3: CASE Tool Related Factors and Implementation Success

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F
CASE Tool Related Factors:						
* relative advantage	moderate	high	high	high	moderate	moderate
* individual compatibility	moderate	moderate	moderate	moderate	moderate	moderate
* organizational compatibility	moderate	moderate	moderate	moderate	moderate	high
* triability	low	low	very low	low	low	low
* result demonstrability	high	high	high	high	high	moderate
* ease of use	moderate	moderate	moderate	high	high	high
* perceived functionality and flexibility	unsatis-factory	moderate	unsatis-factory	moderate	unsatis-factory	moderate
Success at the Indiv. Level:						
* Level of Use	moderate	high	high	high	high	moderate
* Satisfaction	moderate	high	moderate	high	moderate	high

5.2.6 Relationship between Perceived Functionality and Flexibility and Implementation Success

During the early 1990s, there was a significant paradigm shift from mainframe-centered to client-server based applications. This required changes in tool support and the utilized system development methodology. However, the investigated CASE tool did not account for these

changes until the end of 1994, when an updated version will support the development of event-driven client-server applications.

System developers at the examined organizations were less than satisfied with their CASE tool's functionality and flexibility to adjust to changing development needs (Table 5.3). Managers of all the investigated organizations stated that the tool frequently could not be used, because it did not provide the required functionality. After significant investments in this tool, management's dissatisfaction with the tool is not surprising.

However, the responding developers at Organization B and F appeared to be less dissatisfied with the functionality and flexibility of the tool than developers from organizations where it was more successfully implemented. This is not surprising, because in these two organizations the tool was only used for maintaining a few existing applications which were developed before the trend toward client-server based systems started. At the other organizations, the CASE tool is still used for the development of new systems.

Interviews with consultants confirmed that organizations frequently overestimated the applicability of the CASE tool. One consultant stated that this tool was overkill for many departmental applications, but lacks functionality for many enterprise-level applications. Another consultant considered it appropriate for general business applications (e.g., data entry and listing-type applications), but not for decision support or heavy batch-oriented systems. It was stated that the tool lacked sufficient support for dynamic SQL which was required for ad-hoc reporting and queries.

5.3 Summary of Findings

Based on the prior cross-organizational analysis, several factors were identified which appeared to be related to a CASE tool's implementation success at the organizational level.

Organizational diffusion relative to management's initial expectations and management's satisfaction with its use were related to:

* Initial expectations regarding the tool's benefits
* Sufficient time and opportunity to move down the learning-curve
* Management of the transition process
* Management of the political dynamics
* Usability for organizational system development needs

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 Lessons Learned

The prior cross-organizational analysis and the interviews with consultants resulted in several findings. Based on these observations, recommendations were derived for more successfully implementing innovations with characteristics similar to CASE tools (e.g., contingent adoption decision after being acquired at the organizational level, significant organizational impact, significant learning curve). The recommendations are listed as adoption-related and implementation management-related (i.e, managing change, the transition process, and political dynamics) recommendations.

Adoption-Related Recommendations

* Do not imitate other organizations when acquiring an innovation because organizations differ significantly in their context and needs. Instead, ensure that organizational problems and opportunities are addressed.

* Assess the innovation's compatibility with the existing organizational infrastructure and knowledge base for more realistically assessing the required investment and learning-curve.

* Do not consider only present needs, but try to anticipate future needs because the innovation may become outdated before the investment costs could be recovered.

* Consider the investment in any major innovation as part of a long-term strategy to reach an organizational vision. Although specific innovations may become outdated, they may leave an impact (positive or negative) on organizational learning and infrastructure.

* Obtain as much information as possible regarding the organizational implications of adopting and using the innovation (e.g., from other organizations, from news media, and through pilot

projects). Otherwise, unrealistic expectations may lead to disappointment and political tensions.

Recommendations Relating to Managing Resistance to Change:

* Provide sufficient time and opportunity to become familiar with the innovation and learn its use because otherwise its users cannot or will not not want to use it.

* Improve training effectiveness by conducting it in a controlled environment (e.g., with small and well-defined, but realistic pilot projects and effective reviews) and by explaining the innovation's underlying principles.

* Explain the reasons for adopting the innovation because most users are more resistant toward change when they do not know its purpose.

* Involve all people in the acquisition and implementation process that are directly or indirectly affected by its adoption because their expertise and opinions are valuable. Additionally, prior exposure to an innovation makes it more likely that they would support the innovation.

Recommendations Relating to Managing the Transition Process:

* Communicate a clear image of the innovation's function within the envisioned organizational environment to focus the development of new formal and informal organizational arrangements.

* Actively seek complete and consistent management of transition process (e.g., with "road map") because frequently existing organizational arrangements are inappropriate to coordinate, direct, and control the process effectively (e.g., to ensure availability of required infrastructure).

* Provide special project groups because they can support the transition process by providing knowledge transfer and coordinating the innovation's utilization by establishing and enforcing standards.

* Ensure active communication between management and users because management needs to be aware of the progress of the implementation process to remain committed to its implementation and to provide sufficient time and resources. Additionally, users need feedback about the implementation process to more effectively direct their efforts.

Recommendations Relating to Managing the Political Dynamics:

* Continuously seek the political support of all relevant organizational power groups because otherwise the resulting political tensions could slow down or stop the implementation process.

* Establish change agents and actively identify and involve opinion leaders to gain and maintain the political support from all power groups.

* Have top management promote the innovation because their visible commitment can avoid political tensions by influencing power groups that otherwise would have been reluctant to support the innovation.

6.2 Contributions

The exploratory characteristics of the research make a contribution. While several studies have investigated the adoption of information technologies (IT) at the user level, little was known about how organizations adopt and implement IT. In contrast to most previous innovation diffusion research in the field of information systems, an innovation's implementation success was not only explained in terms of innovation related characteristics, but also in terms of the strategies used for implementation management. Similarly, very little was known about the reasons why many CASE tools end up as "shelfware". Therefore, the results of this study contribute to the knowledge in these areas.

Without combining management's and system developers' perspectives in Chapter 4, the observations would have been incomplete and misleading. The integration of both perspectives provided a more thorough description of the organizational adoption and implementation processes. Without investigating both viewpoints, the observations at Organization A and C would have been biased. Management of both organizations described an almost flawless implementation process. However, system developers disagreed. In addition, the investigation of both perspectives demonstrated that observations of the tool's level of use at the organizational level can be different from its level of use at the developers' level. Management's satisfaction with the use of the tool can be different from developers' satisfaction. The integration of both perspectives granted a more thorough and less biased understanding of the examined phenomena.

This research provides a starting point for the development of theory-based guidelines to manage the adoption and implementation of new IT. This contribution is especially relevant in the area of system development, because IS departments of most organizations are still searching

for effective tools to tackle their existing application development backlog and dissatisfaction of management and end-users with their performance. Overall, understanding how information technologies can be successfully introduced in an organizational context would enable management to develop and maintain a functional strategy that guides the steps of IT planning.

Another contribution of this research is the testing of innovation diffusion theory and change management theory in a new context. The usefulness of these theories has already been supported by previous studies. However, CASE technology is different from the types of innovations that have been investigated before, because it is an organizational innovation which needs to be accepted at the user level and because the promises of this innovation have not been proven yet. Therefore, the application of these theories to explore the adoption and implementation of CASE technology would offer help to company management by identifying which factors and strategies are important in the adoption and implementation of such an innovation.

6.3 Key Assumptions and Limitations

A key assumption of this study is that innovation diffusion theory was a good starting point for investigating the implementation success of CASE technology. Since innovation diffusion theory is based on voluntary adoption decisions, one of its primary limitations is its incompleteness in the area of organizational implementation of innovations after authoritarian or contingent adoption decisions. Innovation researchers have neglected this area, leaving the definition of independent and dependent variables very exploratory.

Because innovation diffusion studies for other organizational innovations (e.g., Alexander, 1989; Lai, 1992; Gurbaxani, 1990) did not provide full support for classical diffusion theory [Rogers, 1983], the proposed innovation-related characteristics were complemented with implementation strategies which were proposed by change management theory [Nadler, 1991].

However, this research did not consider other potential implementation success factors such as characteristics of individual developers, project groups, and organizations.

Another assumption of this research, as in practically all existing innovation diffusion research, is that the innovation itself is not the cause of implementation problems and successes. This factor was controlled by investigating the adoption and implementation of one specific CASE tool. Additionally, the developers and managers were asked about problems and shortcomings of this tool. However, very few problems were mentioned; these were primarily related to the tools' functionality and flexibility. Most respondents stated that most of their problems were in the way the tool had been implemented or was used, not with the tool itself.

It is assumed that CASE technology is within the domain of diffusion theory and change management theory. Prior research which supported the proposed innovation-related characteristics and implementation strategies was conducted with innovations that were mostly "successful". While there were differences in the CASE tool's implementation success among the investigated organizations, none of them was "very successful" in its adoption. Therefore, CASE technology has not been proven to have the potential of being a "successful" innovation for its potential users. In addition, the limited variations in implementation success made it more difficult to identify significant relationships.

This study is characterized by several limitations. Because of the sample selection criteria, two types of sampling bias were expected. First, the cases sampled for observation might not be representative. The choice of participants was not random, but depended upon their accessibility and willingness to participate in the study. In addition, only one specific integrated CASE tool was considered to increase internal validity of the findings. Second, the findings could have been distorted because of the people selected for interviews and those willing to answer the questionnaires. Therefore, one must be careful to limit any conclusions to those situations, persons, and purposes for which the data are applicable.

The intended case study approach resulted in the analysis of only six organizations. This tends to limit the possibility of identifying existing relationships and the generalizability of identified results, as they relate to the organizational adoption of CASE tools. However, because of the context dependency of a case study, it was preferable to think in terms of extrapolation than in terms of generalization of results. Extrapolations are speculations regarding the probable applications of the results to other situations under similar, but not identical, conditions. The low response rate at several of the investigated organizations prevented a statistical analysis of the data for each individual organization.

Since the study was conducted in a field environment, no experimental controls were possible. Therefore, any causal statements about the relationships between the independent and the dependent variables could only be made very carefully.

Data collected from interviews and surveys may be incomplete, biased, or inaccurate. Historical bias might have affected the internal validity of this study. This was especially critical for examining the acquisition process, as by nature it involves the oldest data and the memories of the questioned people might have changed over time or be incomplete. There are also a variety of ways that the presence of an evaluator or the evaluation process could have distorted the data collection process. First, the questioned individuals might have tried to "show off" or tried to conceal their problems to overemphasize their achievements. Second, new insights by the investigator, resulting in a changed understanding of the problem, might have impacted the collection and analysis of qualitative data over time. Additional insights over time might have affected the estimation and reasoning process. Finally, there might have been a predisposition or basic bias of the evaluator. In the context of diffusion of innovation studies, there is the potential risk of a pro-innovation bias. It is frequently not possible to control completely for these biases [Patton, 1990], but they need to be considered and reported.

6.4 Suggestions for Further Research

This study provided a starting point for identifying success factors for implementing CASE technology. However, it was explaining implementation success more effectively at the organizational level than at the individual level. It is suggested that future research should attempt to explain system developers' utilization of and satisfaction with CASE technology not at the organizational, but at the individual level of analysis. If the number of respondents for each organization is about the same or if their organizations do not significantly differ in the nature of their adoption and implementation process, responses from different organizations should be combined. Statistical methods (e.g., regression analysis or discriminant analysis) should be used to explain implementation success at the user level.

This research should be replicated. The same approach can be re-applied to a different population. The results of this study would gain in significance, if they could be confirmed with a different set of organizations.

Future research should investigate a larger number of potential implementation success factors. Since the adoption of CASE technology occurs frequently at the work group level, the impact of work groups needs to be examined. Since the implementation of CASE tools interacts with their organizational context, it is recommended to more thoroughly assess the impact of organizational factors. For example, larger and more hierarchically structured IS departments appeared to be less successful in adopting the CASE tool at the organizational level. However, this study provided insufficient information for deriving conclusions.

Since the adoption and implementation process occurs over time, a longitudinal study would be appropriate to track the relevant processes. While the case study approach allowed to collect in-depth data, it did not avoid the risk of having the data affected by historical bias. In addition, without collecting data over a longer time period it is very challenging to derive causal relationships. A longitudinal approach would address both of these problems.

In order for the research results to be generalized to develop theory for managing IT adoption and implementation processes, further research with other information technologies is very important. So far, research has been conducted only on database machines, ISDN, Bitnet, and CASE technology at the organizational level. If future research can be conducted with other information technologies, the results may be synthesized across these technologies to derive new innovation diffusion theories that explain technologies that are acquired at the organizational level but adopted at the individual level.

APPENDIX A

PREVIOUS ADOPTION AND DIFFUSION STUDIES IN THE AREA OF INFORMATION TECHNOLOGY

Study	Significant Indep. Variables	Innovation Examined
Adams et al. (1992)	Ease of Use Usefulness	Voice and Electronic Mail
Agarwal et al. (1991)	CASE STUDY	Expert System Charac.
Alexander (1989)	Champion Complexity Perceived Mgt. Support	Database Machines
Ball et al. (1987)	Communication Effectiveness # of Opinion Leaders	DBMS
Brancheau & Wetherbe (1990)	Age Education Media Exposure Interpers. Communication Opinion Leadership	Spreadsheet Software
Gurbaxani (1990)	# of Previous Adopters Time	Bitnet
Kwon (1990)	Network Behavior MIS Climate	IT Technology in University
Lai (1992)	Compatibility Rel. Advantage Complexity Champion Technology Awareness Org. Structure Org. Size Openness Norms Encouraging Change Training Vendor Involvement Time of Adoption	ISDN

Leonard-Barton (1987a)	Perc. Innov. Charac. Access to Help Training Supervisors Support Advocates for Innov. Experience in Field	Structured Analysis
Leonard-Barton (1987b)	CASE STUDY	Expert Systems
Leonard-Barton (1988)	Innov. Transferability Innov. Impl. Complexity Innov. Divisibility User Involvement Leadership Org./Innov. Adoption	Various Technologies
Leonard-Barton & Dschamps (1988)	Perc. Mgt Support Perc. Mgt Commitment	Expert System
Lucas et al. (1990)	Perc. of Mgt. Support Org. Change Caused Problem Urgency System Charac. User Demographics Org. Support	DSS
Moore & Benbasat (1991)	Relative Advantage Compatibility Ease of Use Result Demonstrability Image Visibility Triability Voluntarism	Personal Workstation
Nilakanta & Scamell (1990)	Information Source	Database
Premkumar et al. (1992)	Rel. Power Rel. Dependency Interorg. Climate Interorg. Support	EDI

Wynekoop (1991)	Perc. Rel. Advantage Perc. Complexity Expectations Org. Resources	CASE
Zargorsky (1990)	CASE STUDY	CASE
Zmud (1982)	Org. Size Professionalism Decision Type	Software Development Practices
Zmud (1984)	Mgt. Attitude Receptivity to Change	Software Development Practices

Study	Outcome Measures		Innovation Examined
	Organizational	Individual	
Adams et al. (1992)		Level of Use	Voice and Elec. Mail
Agarwal et al. (1991)	CASE STUDY		Expert System
Alexander (1991)	Extent of Implementation		Database Machines
Ball et al. (1987)	Adoption		DBMS
Brancheau & Wetherbe (1990)		Adoption	Spreadsheet Software
Gurbaxani (1990)	Adoption over time		Bitnet
Kwon (1987)	Adoption		IT in Universities
Lai (1992)	Adoption Level of Use Competitive Adv.		ISDN
Leonard-Barton (1987a)		Level of Use	Structured Analysis
Leonard-Barton (1987b)		Level of Use	Expert Systems
Leonard-Barton (1988)	Level of Use		Various IT
Leonard-Barton & Deschamps (1988)		Adoption	Expert Systems
Lucas et al. (1990)		Acceptance Level of Use Satisfaction	DSS
Moore & Benbasat (1991)		Adoption	Personal Workstations

Nilakanta & Scamell (1990)	Level of Use	Level of Use	Database Design Tools
Orlikowski (1993)	CASE STUDY		CASE Tools
Premkumar et al. (1992)	Adoption Initial Diffusion Internal Diffusion External Diffusion Impl. Success		EDI
Wynekoop (1991)	Routinization Diffusion Infusion	Acceptance Level of Use	CASE Tools
Zargorsky (1990)		Level of Use Performance	CASE Tools
Zmud (1982; 1994)	Level of Use		Software Develop. Practices

APPENDIX B

SURVEY INSTRUMENT FOR SYSTEM DEVELOPERS

Adoption of CASE Technology

The research is being conducted by Mr. Bernhard Reeh, University of Texas at Arlington, to assess various issues associated with the selection, adoption, and use of CASE tools. Your organization has agreed to participate in this study in order to obtain a better understanding of the nature of CASE tools today, their selection, adoption and use. This study addresses the adoption and implementation of IEF by Texas Instruments.

This survey instrument is addressed to all system developers that are using IEF by Texas Instruments or that have used it at some point of their career. Your participation in this study is crucial to its success, and it is greatly appreciated. Please answer **ALL** the questions. Answer them either by circling your choice, writing your response, or checking the appropriate box. Please return the questionnaire in the enclosed self-addressed, postage-paid envelope. If you have any questions feel free to give me a call. My address is:

Bernhard Reeh
Box 19437
Department of Information Systems
University of Texas at Arlington
Arlington, TX 76019-0437
Tel.: (817)274-7481

Please remember that your responses to this questionnaire will be held in strict confidence. No individual or organization will be identified, and your responses will only be combined with others for statistical purposes.

THANK YOU FOR YOUR PARTICIPATION !

Part One - Implementation Strategies

1 How effective has your organization been at taking the following steps to support the implementation process of this CASE tool? Assess only how well the steps were implemented, but not their importance for the implementation process! *Please differentiate carefully*

1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor N/A=not applicable

a.	explaining the need for changing the prior system development process	1	2	3	4	5	6	7	N/A
b	user participation in the acquisition and implementation process	1	2	3	4	5	6	7	N/A
c.	formal rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
d.	informal rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
e.	sufficient time and opportunity to learn its use	1	2	3	4	5	6	7	N/A
f.	clear image of the envisioned system development environment	1	2	3	4	5	6	7	N/A
g.	complete and consistent management of the implementation process	1	2	3	4	5	6	7	N/A
h.	provision of special project groups for the implementation process	1	2	3	4	5	6	7	N/A
i.	feedback about progress of implementation process for management	1	2	3	4	5	6	7	N/A
j.	feedback about progress of implementation process from management	1	2	3	4	5	6	7	N/A
k.	support of all key power groups within the organization	1	2	3	4	5	6	7	N/A
l.	active guidance by established leaders	1	2	3	4	5	6	7	N/A
m.	promotion of this CASE tool by management	1	2	3	4	5	6	7	N/A
n.	management's explicit emphasis on continuity and stability throughout the change process	1	2	3	4	5	6	7	N/A

2a. From the implementation strategies listed in question 1, what, in your opinion, are the three or four **most important** steps (both supportive or detrimental) for implementing a CASE tool? *Please list the appropriate letters.*

___ ___ ___ ___

b. From the implementation strategies listed in question 1, what, in your opinion, are the three or four **least important** steps (both supportive or detrimental) for implementing a CASE tool? *Please list the appropriate letters.*

___ ___ ___ ___

1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor

Please indicate to what degree you agree with the following statements using the above scale.

3a.	I received sufficient training in the CASE tool's methodology	1	2	3	4	5	6	7
b.	I received sufficient training in utilizing this CASE tool	1	2	3	4	5	6	7
c.	If I have problems with this CASE tool, there is sufficient support available	1	2	3	4	5	6	7
4a.	I use this CASE tool because my supervisor requires me to use it	1	2	3	4	5	6	7
b.	I use this CASE tool because there is no way to complete my job without it	1	2	3	4	5	6	7
c.	I use this CASE tool because I like it	1	2	3	4	5	6	7

5a. Other than the issues mentioned above, what management issues or actions had a positive impact on the implementation of your CASE tool?

b. Other than the issues mentioned above, what management issues or actions had a negative impact on the implementation of your CASE tool?

Part Two - Evaluation of the CASE Tool

Please assess the following statements based on your personal experiences with the CASE tool.

1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor

a.	Using this CASE tool enables me to accomplish tasks more quickly	1	2	3	4	5	6	7
b.	Using this CASE tool improves the quality of my work	1	2	3	4	5	6	7
c.	Using this CASE tool makes it more difficult for me to do my job	1	2	3	4	5	6	7
d.	Using this CASE tool enhances my effectiveness on the job	1	2	3	4	5	6	7
e.	Using this CASE tool gives me less control over my work	1	2	3	4	5	6	7
f.	Using this CASE tool is not compatible with all aspects of my system development work	1	2	3	4	5	6	7
g.	I think that using this CASE tool fits well with the way I like to work	1	2	3	4	5	6	7
h.	Implementation of this CASE tool did not require changes in our hardware architecture	1	2	3	4	5	6	7
i.	Implementation of this CASE tool required changes in the software development methodology	1	2	3	4	5	6	7
j.	Implementation of this CASE tool resulted in changes in our tasks	1	2	3	4	5	6	7
k.	Implementation of this CASE tool did not result in changes in organizational structure or style	1	2	3	4	5	6	7

	1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor							
l.	Before deciding whether to use this CASE tool, I was able to properly try it out	1	2	3	4	5	6	7
m.	I would have difficulties telling others about the benefits of using this CASE tool relative to our traditional software development approach	1	2	3	4	5	6	7
n.	The value of using this CASE tool is apparent to me	1	2	3	4	5	6	7
o.	The value of using the methodology of this CASE tool is apparent to me	1	2	3	4	5	6	7
p.	In my organization, this CASE tool is available from many computers	1	2	3	4	5	6	7
q.	This CASE tool is easily accessible in my organization	1	2	3	4	5	6	7
r.	Learning to operate this CASE tool has been difficult for me	1	2	3	4	5	6	7
s.	Learning to use the underlying methodology has been difficult for me	1	2	3	4	5	6	7
t.	My interaction with this CASE tool is clear and understandable	1	2	3	4	5	6	7
u	The methodology underlying the CASE tool is clear and understandable	1	2	3	4	5	6	7
v.	Overall, I believe that this CASE tool is easy to use	1	2	3	4	5	6	7

What other CASE tool related characteristics affected you decision to use or not too use the CASE tool?

Part Three - Implementation Experiences

1 Are you using the CASE tool for a current project? ☐ yes ☐ no
If you answered this question with 'yes', please continue with the next question.
If you answered this question with 'no', please continue with the following questions assuming the situation when you used this CASE tool the last time.

2a. Please estimate the portion of tool functionality that you actually use, based on the functionality of this CASE tool that is applicable to your work in system development.
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

b. Please estimate the portion of your work that has been done with the help of this tool, relative to all of your work that could be supported by this CASE tool.
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

c. How frequently are you using this CASE tool in your job?

use very often	use regularly	use sometimes	use a little	use hardly	never	use not required
1	2	3	4	5	6	7

3 Please evaluate, to the best of your knowledge, the changes that have occurred in your work since you started using this CASE tool:
Please indicate your level of agreement to the following statements.

	1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor							
a.	My productivity (measured e.g. by lines of code or function points) has increased because of this CASE tool	1	2	3	4	5	6	7
b.	Quality (measured e.g. by number of design changes or run-time errors) has increased because of this CASE tool	1	2	3	4	5	6	7
c.	My customers are more satisfied with my performance	1	2	3	4	5	6	7
d.	My manager is more satisfied with my performance	1	2	3	4	5	6	7
e.	The tool reduces the effort to maintain new systems	1	2	3	4	5	6	7
f.	Overall costs for system development are lower	1	2	3	4	5	6	7
g.	The tool makes it easier for me to gain knowledge of the business requirements	1	2	3	4	5	6	7
h.	The tool facilitates planning and controlling	1	2	3	4	5	6	7

3 Please express your opinion about the CASE tool in regard to the following questions? *Do not reflect about each proposition, but answer based on your first impression. Please indicate your level of agreement to the following statements.*

	1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor							
a.	The benefits derived from using this tool far outweigh the costs	1	2	3	4	5	6	7
b.	The system provides me with all the functionality that I need	1	2	3	4	5	6	7
c.	Since the introduction of the tool, my job performance has increased	1	2	3	4	5	6	7
d.	The tool has the flexibility to be changed or adjusted in response to new conditions, demands, or circumstances	1	2	3	4	5	6	7
e.	I completely understand use of the tool	1	2	3	4	5	6	7
f.	For me, it is very easy to utilize the capabilities of this CASE tool	1	2	3	4	5	6	7
g.	The tool sufficiently integrates different parts of the software development process	1	2	3	4	5	6	7
h.	This CASE tool provides all the functions I need for my job	1	2	3	4	5	6	7
i.	I am satisfied with the tool interface and the display of the output content	1	2	3	4	5	6	7
j.	Because of this CASE tool, the results of my work are more up to date	1	2	3	4	5	6	7
k.	The output of this CASE tool is consistent and dependable	1	2	3	4	5	6	7
l.	I would like to continue using this CASE tool	1	2	3	4	5	6	7
l.	I would like to increase the use of this CASE tool	1	2	3	4	5	6	7
m.	This CASE tool helps me to achieve my personal objectives	1	2	3	4	5	6	7

Part Four - General

1 What (in your opinion) was the reason for introducing this CASE tool?

	very likely			probable			very unlikely
a. improve systems and data quality	1	2	3	4	5	6	7
b. decrease reliance on system developers	1	2	3	4	5	6	7
c. decrease costs	1	2	3	4	5	6	7
d. enhance skills and practices	1	2	3	4	5	6	7
e. increase productivity	1	2	3	4	5	6	7
f. get quick return on the investment	1	2	3	4	5	6	7
g. other, please specify: _____							

2 How fundamental were the changes caused by the introduction of this CASE tool? How minor or major were the changes with regard to:

	very minor changes						very major changes
the system development process	1	2	3	4	5	6	7

3 How long have you used this CASE tool?
☐ < 8 hour ☐ 1 - 14 days ☐ 14 days - 3 months ☐ 3 - 12 months ☐ 1 - 3 years ☐ > 3 years

4 How long have you been working in software development? _____ years _____ months

5 By whom were you trained in the use of the CASE tool? *Please mark all that applies.*
☐ university ☐ tool vendor ☐ in-house training ☐ outside training center
☐ other, please specify: _____

Who provided the most effective training? _____

6 What is your current job title? _____

7 Which parts of the software life cycle are you primarily supporting? *Please mark all that applies.*
☐ Planning ☐ Analysis ☐ Design ☐ Coding ☐ Testing
☐ Implementation ☐ Maintenance ☐ Documentation ☐ Project Management
☐ other, please specify: _____

Please briefly describe your major job duties: _____

_____

8 How long have you held this job? _____ years _____ months

9 How do you evaluate human resource policy within your organization with regard to:

	very positive			neutral			very negative
a. support of individual growth and development	1	2	3	4	5	6	7
b. job security	1	2	3	4	5	6	7
c. availability of multiple, alternative career paths	1	2	3	4	5	6	7
d. job / role rotation	1	2	3	4	5	6	7

10 What is your age? _____ years

11 What is your highest educational degree?

☐ junior college ☐ undergraduate degree ☐ graduate degree

☐ other degree; please specify: _____

12 If you went to college or university, what were your majors? *Please mark all that applies.*

☐ electrical engineering ☐ computer science ☐ information systems ☐ another business degree

☐ other, please specify: _____

13 Assuming that you used IEF in more than one work group, please specify the department and/or work group in which you have the most experience with IEF development? _____

14 What is the title of your current department and/or work group? _____

To improve the quality of the results of this study, it would be useful to interview CASE tool users about the issues addressed in this questionnaire. Would you be willing to be interviewed: ☐ yes ☐ no

If you are willing to be interviewed please leave your name, phone number, and best time to call:

_____

_____

If you wish to receive an executive summary of this study, please provide your name and corresponding address:

_____

_____

_____

_____

THANK YOU AGAIN FOR YOUR PARTICIPATION !

APPENDIX C

SURVEY INSTRUMENT FOR MANAGERS

Questionnaire about Adoption of CASE Technology

Note: This questionnaire is addressed to managers that have been directly involved the acquisition process of the IEF CASE tool and that are familiar with the way it is presently used.

Your participation in this study is crucial to its success, and it is greatly appreciated. Please answer **ALL** the questions. Answer them either by circling your choice, writing your response, or checking the appropriate box. Please return the questionnaire in the enclosed self-addressed, postage-paid envelope. If you have any questions feel free to give me a call. My address is:

Bernhard Reeh
Box 19437
Department of Information Systems
University of Texas at Arlington
Arlington, TX 76019-0437
Tel.: (817)274-7481

Please remember that your responses to this questionnaire will be held in strict confidence. No individual or organization will be identified, and your responses will only be combined with others for statistical purposes.

THANK YOU FOR YOUR PARTICIPATION !

Part One - Implementation Strategies

1. How **effective** has **your organization** been at taking the following steps to support the implementation process of this CASE tool? Assess only how well the steps were implemented, but not their importance for the implementation process! *Please differentiate carefully.*

1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor N/A=not appl.

a.	explaining the need for changing the prior system development process	1	2	3	4	5	6	7	N/A
b	user participation in the acquisition and implementation process	1	2	3	4	5	6	7	N/A
c.	**formal** rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
d.	**informal** rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
e.	sufficient time and opportunity system developers to learn its use	1	2	3	4	5	6	7	N/A
f.	clear image of the envisioned system development environment	1	2	3	4	5	6	7	N/A
g.	complete and consistent management of the implementation process	1	2	3	4	5	6	7	N/A
h.	provision of special project groups for the implementation process	1	2	3	4	5	6	7	N/A
i.	feedback about progress of implementation process **for** management	1	2	3	4	5	6	7	N/A
j	feedback about progress of implementation process **from** management	1	2	3	4	5	6	7	N/A
k.	support of all key power groups within the organization	1	2	3	4	5	6	7	N/A
l.	active guidance by established leaders	1	2	3	4	5	6	7	N/A
m.	promotion of this CASE tool by management	1	2	3	4	5	6	7	N/A
n.	management's explicit emphasis on continuity and stability throughout the change process	1	2	3	4	5	6	7	N/A

2. What do you think about the **importance** of the following factors (both supportive or detrimental) for implementing this CASE tool? *Please answer based on your own experiences and differentiate carefully.*

1=excellent 2=very good 3=good 4=neutral 5=fair 6=poor 7=very poor N/A=not appl.

a.	explaining the need for changing the prior system development process	1	2	3	4	5	6	7	N/A
b	user participation in the acquisition and implementation process	1	2	3	4	5	6	7	N/A
c.	**formal** rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
d.	**informal** rewards for implementing and / or using this CASE tool	1	2	3	4	5	6	7	N/A
e.	sufficient time and opportunity for system developers to learn its use	1	2	3	4	5	6	7	N/A
f.	clear image of the envisioned system development environment	1	2	3	4	5	6	7	N/A
g.	complete and consistent management of the implementation process	1	2	3	4	5	6	7	N/A
h.	provision of special project groups for the implementation process	1	2	3	4	5	6	7	N/A
i.	feedback about progress of implementation process **for** management	1	2	3	4	5	6	7	N/A
j.	feedback about progress of implementation process **from** management	1	2	3	4	5	6	7	N/A
k.	support of all key power groups within the organization	1	2	3	4	5	6	7	N/A
l.	active guidance by established leaders	1	2	3	4	5	6	7	N/A
m.	promotion of this CASE tool by management	1	2	3	4	5	6	7	N/A
n.	management's explicit emphasis on continuity and stability throughout the change process	1	2	3	4	5	6	7	N/A

	1=strongly agree	2=moderately agree	3= somewhat agree	4= neutral	5=somewhat disagree	6=moderately disagree	7=strongly disagree
3a. Users received sufficient training in the CASE tool's methodology	1	2	3	4	5	6	7
b. Users received sufficient training in utilizing this CASE tool	1	2	3	4	5	6	7
c. If users have problems with this CASE tool, there is sufficient support available	1	2	3	4	5	6	7
4a. Present users of the CASE tool are required to use it	1	2	3	4	5	6	7
b. Present users of this CASE tool use it because there is no way to complete their job without it	1	2	3	4	5	6	7
c. Present users work with this CASE tool because they like it	1	2	3	4	5	6	7

5a. In addition to the issues mentioned above, what other management issues or actions had a **positive impact** on the implementation of your CASE tool?

b. In addition to the issues mentioned above, what other management issues or actions had a **negative impact** on the implementation of your CASE tool?

Part Two - Evaluation of the Selected CASE Tool

1. What factors affected the decision of your organization to acquire this specific CASE tool? *Please list all factors that you can remember and indicate their importance for the adoption decision with assigning a number between one and seven (with 1=relative unimportant and 7=extremely important).*

a. relating to software engineering functions:

b. relating to tool integration:

c. relating to methodology dependence:

d. relating to hardware and software requirements:

e. relating to vendor profile and cost considerations:

2. Please assess the following statements based on your personal opinion about the CASE tool and its use.

1=strongly agree	2=moderately agree	3= somewhat agree	4= neutral	5=somewhat disagree	6=moderately disagree	7=strongly disagree

a. Using this CASE tool speeds up system development	1	2	3	4	5	6	7
b. Using this CASE tool improves the quality of the developed systems	1	2	3	4	5	6	7
c. Using this CASE tool makes system development more difficult	1	2	3	4	5	6	7
d. Using this CASE tool enhances the effectiveness of system developers on their job	1	2	3	4	5	6	7
e. Using this CASE tool provides less control over the system development process	1	2	3	4	5	6	7
f. Using this CASE tool is compatible with the way we do system development in our organization	1	2	3	4	5	6	7
g. The CASE tool supports a system development approach that is desirable for our organization and its needs	1	2	3	4	5	6	7
h. Implementation of this CASE tool did not require changes in our hardware architecture	1	2	3	4	5	6	7
i. Implementation of this CASE tool required changes in our software development methodology	1	2	3	4	5	6	7
j. Implementation of this CASE tool resulted in changes in our tasks	1	2	3	4	5	6	7
k.Implementation of this tool did not result in changes in our organizational structure and style	1	2	3	4	5	6	7
l. Before deciding whether to use this CASE tool, its intended users were able to properly try it out	1	2	3	4	5	6	7
m. System developers would have difficulties telling others about the benefits of using this CASE tool relative to their previous software development approach	1	2	3	4	5	6	7
n. The value of using this CASE tool is apparent to everyone in the organization	1	2	3	4	5	6	7
o. The value of using the methodology of this CASE tool is apparent to everyone in the organization	1	2	3	4	5	6	7
p. In my organization, this CASE tool is available from many computers	1	2	3	4	5	6	7
q. This CASE tool is easily accessible in my organization	1	2	3	4	5	6	7
r. Learning to operate this CASE tool has been difficult for our developers	1	2	3	4	5	6	7
s. Learning to operate the underlying methodology has been difficult for our developers	1	2	3	4	5	6	7
t. I believe that for our developers the interaction with this CASE tool is clear and understandable	1	2	3	4	5	6	7
u. I believe that the methodology underlying the CASE tool is clear and understandable for our developers	1	2	3	4	5	6	7
v. Overall, I believe that for out developers this CASE tool is easy to use	1	2	3	4	5	6	7

3. Has your opinion about the CASE tool and its use changed since it was adopted? If so, how? Have these changes affected the level of the CASE tool?

Part Three - Implementation Experiences

1a. What percentage of potential users of this CASE tool are actually using it for their daily work?
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

b. What percentage of systems that could be developed with this CASE tool are actually developed with its help?
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

c. What percentage of people that need to be trained in the use of the CASE tool are already sufficiently trained?
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

d. What percent of the functionality of this CASE tool is your organization using?
☐ < 20% ☐ 20-39% ☐ 40-59% ☐ 60-79% ☐ 80-100%

	1=strongly agree	2=moderately agree	3= somewhat agree	4= neutral	5=somewhat disagree	6=moderately disagree	7=strongly disagree
2a. Through the use of the CASE tool we are better able to support the business objectives of our organization	1	2	3	4	5	6	7
b. The tool has totally fulfilled our expectations with regard to its potential to support the business of our organization	1	2	3	4	5	6	7

3. In which way does the CASE tool support the business objectives of your organization?

4. Please indicate how this CASE tool has affected system development in your organization.

	1=strongly agree	2=moderately agree	3= somewhat agree	4= neutral	5=somewhat disagree	6=moderately disagree	7=strongly disagree
a. This CASE tool has improved the quality of the developed systems	1	2	3	4	5	6	7
b. This tool has improved system documentation	1	2	3	4	5	6	7
c. The tool has eased system maintenance	1	2	3	4	5	6	7
d. The CASE tool has improved system development productivity	1	2	3	4	5	6	7

5. What additional benefits have occurred because of the use of this CASE tool?

6. What, if any, expected benefits from the use of the CASE tool have not materialized?

Part Four - General

1. How do you evaluate human resource policy within your organization with regard to:

	very positive						very negative
a. support of individual growth and development	1	2	3	4	5	6	7
b. job security	1	2	3	4	5	6	7
c. availability of multiple, alternative carrier paths	1	2	3	4	5	6	7
d. job / role rotation	1	2	3	4	5	6	7

2. What (in your opinion) was the strategy behind the introduction of the CASE tool?

	very likely			probable			very unlikely
a. improve systems and data quality	1	2	3	4	5	6	7
b. decrease reliance on system developers	1	2	3	4	5	6	7
c. decrease costs	1	2	3	4	5	6	7
d. enhance skills and practices	1	2	3	4	5	6	7
e. increase productivity	1	2	3	4	5	6	7
f. get quick return on the investment	1	2	3	4	5	6	7
g. other, please specify: _____							

3. Did your organization prototype the CASE tool before its wide-spread implementation?

☐ yes ☐ no

If so, what was the extend ot the prototyping phase?

4. Overall, how fundamental were the changes caused by the introduction of the CASE tool with regard to:

	minor						major
a. the system development process	1	2	3	4	5	6	7
b. the final information system	1	2	3	4	5	6	7

5. How do you evaluate the system development environment in your organization?

	highly agree		somewhat agree		somewhat disagree		highly disagree
a. We do have sufficient resources to experiment with new technologies	1	2	3	4	5	6	7
b. We have considerable investment bound in a traditional system development environment (e.g., technology, IS skills, existing systems)	1	2	3	4	5	6	7
c. There are methodology and CASE tool specialists in our organization	1	2	3	4	5	6	7
d. We have blended the job roles of system analysis and programming	1	2	3	4	5	6	7
e. End users are regarded rather as part of the development team than as "external" clients	1	2	3	4	5	6	7
f. We regard CASE as a task automation technology	1	2	3	4	5	6	7
g. We consider CASE as a process redesign technology	1	2	3	4	5	6	7

6. What were, or are, your functions during the adoption and implementation process of the CASE tool?

7. What is your current job title? _____

8. Please describe briefly describe your present job: _____

_____

9. How long have you held this job? _____ years _____ months

10 What is your age? _____ years

11 What is your highest educational degree?

☐ high school ☐ junior college ☐ undergraduate degree ☐ graduate degree

☐ other professional degree; please specify: _____

12 If you went beyond high school, what were your majors? *Please mark all that applies.*

☐ electrical engineering ☐ computer science ☐ information systems ☐ another business degree

☐ other, please specify: _____

Name of your organization: _____

To improve the quality of the results of this study, it would be useful to interview you about the issues addressed in this questionnaire.

Would you be willing to be interviewed: ☐ yes ☐ no

If you are willing to be interviewed please leave your name, phone number, and best time to call:

_____

_____

If you wish to receive an executive summary of this study, please provide your name and corresponding address:

_____

_____

_____

_____

THANK YOU AGAIN FOR YOUR PARTICIPATION !

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