ASSIMILATING CASE TOOLS IN ORGANIZATIONS: AN EMPIRICAL STUDY OF THE PROCESS AND CONTEXT OF CASE TOOLS

Michael E. Friesen
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ABSTRACT

This paper describes a study into how CASE [Computer Aided Software Engineering] tools are deployed by information systems units within organizations. The study explored the process by which CASE tools are assimilated by organizations, and how this process is influenced by various organizational and technological factors. Case studies of eleven companies who have adopted a single CASE tool were conducted, and the findings from this investigation were analyzed in terms of the conceptual frameworks of innovation research. The data reveal that nominal amounts of time and effort are spent on evaluating the CASE tools prior to their adoption, and that as a result, organizational consequences of these tools are poorly apprehended. Further, a number of key factors facilitating and inhibiting the process of CASE tools assimilation were identified. The implications of these findings for research and practice are discussed, and specific recommendations for managing the implementation of CASE tools are provided.
1. INTRODUCTION
The aim of the study reported in this paper was to systematically examine the deployment of CASE (Computer Aided Software Engineering) tools in Information Systems (IS) divisions of organizations. While much has been written about CASE tools, there appears to be little empirical evidence to support the extravagant claims being made for these systems development aids. The few studies that have been undertaken of the use of CASE tools in organizations have typically focused on the features of the CASE tools, or on the performance outcomes accruing from their utilization. While these are interesting issues, we need to remember that tools are not used in a vacuum, but rather in a social context. And the interaction of a technology with its organizational context plays a significant role in shaping outcomes. Hence we propose that questions about the use of CASE tools need to take account of organizational dimensions, for example, how are CASE tools being implemented and used in organizations? what changes are being occasioned by this new technology? and how should IS organizations accommodate to and manage these changes?

The purpose of our study was to increase understanding of the process by which organizations implement and assimilate CASE tools. We examined the CASE tools implementation processes of a number of different organizations, and on the basis of the field data we (i) identified the sequence of stages by which CASE tools are implemented and assimilated into organizations, (ii) articulated the factors that facilitate and inhibit this implementation and assimilation process, and (iii) gained some insight into the organizational consequences of CASE tools' deployment. This paper describes the study, and the implications for research and practice that stem from it.

This paper is organized as follows. Section 2 provides the groundwork for the study by discussing CASE tools and the prior research that has been undertaken on them. Section 3 explains the research activities we pursued to investigate the process of CASE tools implementation in eleven organizations. Section 4 describes the data analysis and results, and section 5 provides some implications and recommendations. The article is concluded in section 6 with suggestions for future research.

2. SETTING THE SCENE
2.1 CASE Tools
CASE tools mean many things to many people. There is no well-accepted definition, but most commentators agree that they encompass all or some subset of the following features: for the front-end conceptual stages of systems development, such as analysis assistance, data modeling tools, data dictionaries, text and diagram editors (known colloquially as upper CASE); and for the back-end implementation stages of systems development, such as screen/report design aids, code
generators, testing and debugging tools (known colloquially as lower CASE) [Henderson & Cooprider 1988; Rochester 1989]. Some CASE tools are bundled together (with or without explicit integration) and sold as CASE packages or toolsets. There is currently a wide range of CASE tool products being offered in the market (over 100 products have been estimated from as many vendors), varying from stand-alone first-generation tools (e.g., code generators, or diagramming aids) to integrated, second-generation toolsets (e.g., tool environments with centralized data dictionaries).

2.2 Prior Research
Little research has been conducted into the use of CASE tools in organizations, and none into the process of deploying and assimilating the tools. Most of the general literature involves a discussion of the potential of CASE tools to eliminate software backlogs and augment the quality of systems and the productivity of systems developers [Case 1985; Freedman 1986; Russell 1989; Stamps 1987]. While some of these benefits may be realizable, most of the discussions do not provide detailed analyses of any actual CASE technology implementations. The mechanisms through which CASE tools are to be successfully deployed so as to accomplish the promised benefits are not identified. There is little empirical data on the various organizational and systems development changes that result from using automated means to develop information systems. The few available discussions of this topic raise more questions than they answer [Loh & Nelson 1989; Rochester 1989]. The paucity of research on these issues means that little is understood about what are the options, what are the problems, and what are the implications, of deploying CASE tools. In the next section we describe a study that provides some insight and suggests a series of recommendations for practitioners using, or contemplating investment in, CASE tools.

3. RESEARCH STUDY
Given the tremendous diversity in capabilities, size, scope, price, functionality, computer requirements and education demands of CASE tool products, a comparison across different tools seems futile. A standard survey across tools would embody too much variation, noise, and confounding effects to provide useful knowledge about CASE tools in general. Hence we decided to restrict our attention to a single CASE toolset product, and to perform a series of comparative case studies that would examine how different organizations implemented and assimilated the same CASE tool. To maximize exposure to different facets of CASE tools, we chose to focus on one of the more advanced products, a second-generation toolset that is integrated across multiple stages of
the systems development life-cycle: Information Engineering Workbench (IEW). The IEW toolset is produced by KnowledgeWare Inc., and was first developed in 1984.¹

3.1 Background on the IEW toolset
The Information Engineering Workbench has two primary organizing principles: (i) that all the tools (whether for planning, analysis, design, or programming) are linked to a central “encyclopedia” (storing data descriptions); and (ii) that the tools are based on the concepts and precepts of a systems development methodology, Information Engineering (IE) which was developed by Martin and his colleagues [Martin & Finkelstein 1982]. The premise of this methodology is that information systems should revolve around the design of an organization’s data, hence it has been termed a “data oriented” methodology as distinct from more traditional systems development methodologies that are “process oriented.” The IEW set of tools attempts to provide automated support for all aspects of the systems life cycle, from strategic planning down to code generation and maintenance [Desmond 1988]. The platforms on which IEW can operate include microcomputer as well as mainframe computers. KnowledgeWare has sold over 8000 units of the IEW product worldwide [Desmond 1988], and currently has 16% of the installed CASE tools base, second behind Excelerator with 29% market share [Gane 1988].

3.2 Sample
We obtained a list of IEW customers from KnowledgeWare who met the following criteria: substantial financial investment in IEW, medium to large sized company, a diversity of industries, two to three years experience with IEW, and extensive use of the toolset across the system life cycle. All eleven of the companies we contacted agreed to participate. The distribution of companies by industry, size, and extent of use with IEW are indicated in Tables 1 through 4. Semi-structured interviews were conducted with IS directors or senior IS managers designated as responsible for IEW. Subsequent to these initial interviews, a second round of data collection was conducted during which we circulated transcripts of interviews to participants and requested their comments and clarification. During this second round the participants gave us feedback on their prior respondents and updated us on other issues that they thought relevant. We further interviewed a number of key users from the participating companies in order to obtain an alternative perspective on the implementation of CASE tools in the companies.

¹ While currently having the second largest share of the CASE tools market [Gane 1988], the future viability of IEW seems certain given the recently announced marketing partnership between KnowledgeWare and IBM, the purchase by IBM of a minority equity interest in KnowledgeWare, and the intention of KnowledgeWare to interface with IBM’s new CASE tool offering (a Repository product).
Table 1: Distribution of Companies by Industry

<table>
<thead>
<tr>
<th>INDUSTRY TYPE</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>1</td>
</tr>
<tr>
<td>Financial Services</td>
<td>3</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>1</td>
</tr>
<tr>
<td>Transportation</td>
<td>2</td>
</tr>
<tr>
<td>Utilities</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 2: Distribution of Companies by Size

<table>
<thead>
<tr>
<th>SIZE (Revenues)</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $100 million</td>
<td>1</td>
</tr>
<tr>
<td>$100 - $499 million</td>
<td>1</td>
</tr>
<tr>
<td>$500 - 999 million</td>
<td>0</td>
</tr>
<tr>
<td>$1 - $10 billion</td>
<td>5</td>
</tr>
<tr>
<td>Over $10 billion</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>
Table 3: Length of time IEW used by Organizations

<table>
<thead>
<tr>
<th>MONTHS</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 12</td>
<td>0</td>
</tr>
<tr>
<td>12 - 24</td>
<td>6</td>
</tr>
<tr>
<td>24 - 36</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 36</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 4: Number of Production Systems Developed using IEW

<table>
<thead>
<tr>
<th>SYSTEMS DEVELOPED</th>
<th>NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3 - 4</td>
<td>1</td>
</tr>
<tr>
<td>5 - 6</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
<tr>
<td>Average # of Systems</td>
<td>3.9</td>
</tr>
</tbody>
</table>
3.3 Research Questions
No existing model or hypotheses of CASE tools assimilation and use are available, so our study is an exploratory one. We wanted to probe a series of topics and issues regarding the implementation of CASE tools with the participants. These topics and issues reflect prior research into CASE tools specifically, and the literature on systems development and implementation more generally. Our research interests guided our discussion of topics with participants, ensuring our attention to issues of implementation, consequences and the factors that seemed to promote or constrain the successful deployment of CASE tools. The interviews thus addressed the following broad areas: implementation process, organizational changes (including structural, performance, and personnel), and technical issues. While an agenda informed our interviews, the data collection process was sufficiently open-ended to allow for the discussion of other topics and issues. Given the exploratory nature of our study, we emphasize that the results obtained and discussed below are impressionistic, and are to be understood as suggestive rather than as rigorous or definitive. Follow-up research to refine the ideas presented here is clearly needed in the future.

4. DATA ANALYSIS
4.1 Stage I: Searching for Patterns
We initially examined the data on content alone, to identify general themes that seemed related to the implementation process, and factors that facilitated or constrained this process. Having articulated some themes across the companies, we attempted to make some sense of the patterns of data that had emerged. In this analysis and interpretation process we found the conceptual apparatus of innovation research to be particularly useful. Adopting Rogers’ [1983:22] notion of “innovativeness” we found that the companies we had investigated could be differentiated by the extent to which they had adopted and diffused the CASE tools within their units or organizations. While the innovation framework was useful, simply ranking companies on their “degree of innovativeness” was not particularly informative. We also had to be careful which studies of organizational innovativeness we relied on, as many have been criticized for oversimplifying the process of diffusion of innovations within organizations, and for inappropriately transferring models and methods of innovativeness from the individual to the organizational level [Rogers 1983:355].

Given our primary interest in the process of CASE tools implementation, we found those innovation studies that focused on the process of innovation to be most valuable, as these were most compatible with our focus on how different organizations implement the same CASE toolset. We were interested in the process an organization engages in when assimilating a new innovation,
and on the attributes of organizations and innovations that influence this assimilation. We were less concerned with identifying variables that discriminate between more and less innovative organizations. Thus we adopted a process, as opposed to a variance orientation. We examined a number of innovation process frameworks [Ginzberg 1979; Kolb & Frohman 1970; Lucas 1981; Meyer & Goes 1988; Rogers 1983; Rousseau 1989; Schein 1969], all of which appear to extend and elaborate Simon's [1960] three stage model of the decision-making process (intelligence - design - choice) to the level of organizational innovation. The frameworks differ primarily in how specifically they detail the innovation process, whether they deal with innovation in general or with technological innovation in particular, and whether they focus only on rational human action or allow for non-rational (political and symbolic) action. The framework that seemed to best fit our data and predilections about organizational processes was Meyer & Goes' [1988] framework, which is highly articulated, deals exclusively with technological innovation, and recognizes not only economic and strategic aspects of innovation, but also social, cultural and political aspects.

Meyer & Goes [1988] framework of the process of innovation assimilation is based on that articulated by Rogers [1983:361-366], but goes beyond it by focusing not only on the innovation process, but also on the factors that influence assimilation. The underlying premise of Meyer & Goes' framework is that innovations in general are seen to trigger a predictable sequence of cognitive, social, and organizational events. The framework is depicted in Table 5. It should be noted that the stages are presented as ideal types, hence the sequence and outcomes of innovation adoption and assimilation can and typically do depart from this representation. The framework, however, does provide a useful structure within which to begin to interpret empirical data.

Meyer & Goes [1988:901] elaborate their general model of technological innovation, suggesting that three types of factors influence the process of innovation assimilation in organizations, and that these factors operate within the framework of the stages articulated in Table 5. The three factor types are: (i) attributes of innovations, which include how risky the technology is, or what level of skill and training is needed to use the technology; (ii) attributes of organizational contexts, which include the size of the organization, the complexity of the product/service delivered, and characteristics of employees; and (iii) attributes arising from the interaction of innovations and organizational contexts, which include the compatibility of the technology with the characteristics of the employees, and the extent of managerial support for the technological innovation.
Table 5: General Stages in the Assimilation of Technological Innovations
[from Meyer & Goes 1988: 903]

<table>
<thead>
<tr>
<th>KNOWLEDGE-AWARENESS STAGE</th>
<th>1. Apprehension: Individuals learn of an innovation's existence.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Consideration: Individuals consider the innovation's suitability.</td>
</tr>
<tr>
<td></td>
<td>3. Discussion: Individuals engage in conversations concerning adoption.</td>
</tr>
<tr>
<td>EVALUATION-CHOICE STAGE</td>
<td>4. Acquisition Proposal: Adoption of technology is proposed formally.</td>
</tr>
<tr>
<td></td>
<td>5. Rational Evaluation: The proposed investment is evaluated according to functional and financial criteria.</td>
</tr>
<tr>
<td></td>
<td>6. Political-Strategic Evaluation: The proposed investment is evaluated according to political and strategic criteria.</td>
</tr>
<tr>
<td>ADOPTION-IMPLEMENTATION STAGE</td>
<td>7. Trial: The technology is acquired but remains under trial evaluation.</td>
</tr>
<tr>
<td></td>
<td>8. Acceptance: The technology becomes well accepted and frequently used.</td>
</tr>
<tr>
<td></td>
<td>9. Expansion: The technology is expanded, upgraded, or replaced with a second-generation model.</td>
</tr>
</tbody>
</table>
4.2 Stage II: Searching for Meaning

Using the framework of Meyer & Goes [1988], we returned to the data, and analyzed and categorized the interview transcripts searching specifically for the following references:

- stage in the assimilation process followed;
- factor influencing innovation assimilation, namely, attribute of the CASE toolset, attribute of the organizational context, and attribute of the interaction between the CASE toolset and the organization.

All of the companies we studied, by virtue of having acquired CASE tools while the majority of U.S. firms have not yet done so,\(^2\) could be seen to be innovative. Where they differed, however, was in their assimilation processes. We thus distinguished the companies on their degree of assimilation which we took to be the extent of CASE tools penetration in their systems development operations. As a gauge of this we examined the number of production systems that had been completed with the IEW toolset over the past two or three years. Of the eleven companies we studied, three clearly stood out in their implementation of CASE tools, having five or more production systems completed with the IEW toolset. Adapting Rogers’ [1983:248-251] innovation adopter categories to the case of innovation assimilation, we will call them early assimilators, as they are eager to implement the CASE tools and reap their benefits, without taking unnecessary risks. Of the remaining eight companies, six fall into the deliberators group, as they are slower and more cautious in their assimilation of CASE tools, only having completed a few production systems (one to four) with a few others in progress. The final two companies are part of the late assimilators group,\(^3\) having completed no production systems with IEW yet, and being skeptical and more reluctant to assimilate CASE tools into their operations. In the following sections we examine the patterns that emerged from our data in terms of these categories of assimilators, with respect to the stages of the assimilation process, and the factors that influenced this process.

Stages in the Assimilation Process of CASE innovations

Of the eleven companies we examined none followed exactly the nine substage process of technological innovation assimilation, outlined in Table 5. Most of the differences occurred in the later stages, and seemed to be influenced by managers’ perceptions of the role to be played by CASE tools in their organizations.

\(^2\) It is estimated that only some 2 percent of organizations in the U.S. have purchased CASE tools, and that only 40 percent of the purchasers are continuing users of this innovation [Vitalari 1988].

\(^3\) We decided not to employ Rogers [1983] label “laggards” for this final group, to prevent confusion between this categorization of assimilation and his categorization of innovativeness, and also to avoid the unintended pejorative connotation of the “laggards” label.
Knowledge-Awareness Stage:
In most of the cases, the knowledge-awareness stage was followed as outlined, with one or two senior information systems managers considering and discussing the viability of adopting CASE tools in their company. Most of the managers appeared to learn of CASE tools from the trade press and their contact with contemporaries in other companies. In one of the deliberators, a new information systems manager was hired in from outside, and he brought with him knowledge of and interest in the IEW toolset. This boosted the assimilation process as the chief advocate of the innovation had prior experience with it, and could speak with authority about its likely effects and consequences.

Evaluation-Choice Stage:
The next stage was typically not followed as outlined. None of the companies undertook benchmarks comparing CASE tools with their current development practices. In only two of the companies, one from the early assimilators and one from the deliberators group, was a financial evaluation completed, with costs and benefits formally analyzed. Some respondents cited difficulty in assessing benefits as the reason for not pursuing formal feasibility studies. That these respondents did not also find costs difficult to assess reveals a lack of appreciation for the potential impacts of CASE tools, an issue we return to in section 5. This underestimation is an indicator of the general finding that IS managers do not perceive deployment of CASE tools as a significant technological innovation, certainly not significant enough to warrant a formal feasibility analysis, the mechanics of benefits assessment aside. One company in the late assimilator group had attempted a costs-benefits analysis primarily for symbolic reasons to appease senior decision-makers. The respondent from this company noted that the costs and particularly the benefits are so difficult to calculate that the exercise was "a waste of time." The overwhelming motivation for implementing CASE tools appears to be the quality of systems development, with nine of the companies citing this concern. Given the difficulty of quantifying the notion of quality, it is clear why so many companies felt it unnecessary to perform a financial evaluation of their CASE innovations.

Functional and political-strategic considerations did, however, play a role in promoting investment in CASE tools, although these served more as rationalizations than as documentary evidence for the need to innovate. Managers cited, as their reasons for adopting IEW, concern with the quality and length of the systems development effort, the productivity of systems development and maintenance personnel, and the desire to enforce data modeling and improve data management. None of these rationalités for adopting CASE tools however, were formally documented or
quantified, and seemed to depend less on rational evaluation than on dissatisfaction with the existing state of affairs in systems development or concern about the future. The choice to invest in CASE tools seemed to be based on one or more of three types of perceptions of CASE tools: (i) as functionally necessary - "... to reduce the amount of redundant data ... to bring our company to a shared data environment that met the needs of the corporation"; (ii) as politically important for the survival of the information systems unit - "IS management believes that it [CASE tools] is a critical success factor; that we need to automate ourselves to stay competitive. There are a lot of ways we compete with outside vendors for the business of our clients within the company"; or (iii) as strategically important for the success of the company - "... all we have is information [the company provides information services to its customers] ... If we can’t change these systems with quality, that is do it right and do it fast, if we can’t do it with speed and quality, someone else is going to."

**Adoption-Implementation Stage:**

Breakdowns and short-cuts were observed in the third and final stage as well. First, only one of the companies, an early assimilator, has fully accepted the CASE innovation, and has started to upgrade their version of the IEW toolset with an expanded version. In most of the other companies, the process of assimilation seems to be stuck in an extended phase of trial evaluation. Adopting units or organizations appear to be equivocal about widespread use of CASE tools, and have tended to implement IEW in only a few projects, or only one division. And this is two to three years after acquiring the innovation. Choice of pilot project emerged as a key decision, with some companies choosing a critical system to pilot, reasoning "The pilot project has to prove to the organization that there is a great quality improvement, not necessarily just improved productivity in a pilot project", while others preferred the less risky but, also potentially, less informative strategy of piloting small and simple systems. The decision to pilot a critical system does not reflect the degree of assimilation of the company (two are from the early assimilator group, two from the deliberators and one from the late assimilators groups), but may reflect managers’ individual risk preferences, or their views of the importance of CASE tools. In the latter case, those managers who believe in the strategic importance of tools are anxious to test them on major projects, while those deploying CASE tools for more conventional reasons adopt them incrementally, starting with limited, routine systems.

An important phase in this stage that emerged from the data, and that is not explicitly covered by Meyer & Goes’ [1988] assimilation model (except in the name of the third stage; see Table 5), is that of implementation. By this we mean the decisions, strategies, and activities engaged in in order to put the innovation into routine use in the organization. As research on information systems
implementation has shown [Ginzberg 1979; Lucas 1981; Markus 1983; Rousseau 1989] introducing new information technology into an organization is a nontrivial endeavor, permitting alternative strategies, involving multiple constituencies, and generating conflicting perspectives.

Rogers [1983:364-365] in his original model of the assimilation process does, however, include implementation, suggesting it is constituted by the three phases of: restructuring, clarifying, and routinizing. Restructuring involves the modification of the innovation to fit the organization, and the reciprocal change in the organization structure to accommodate the innovation. During clarification, the meaning of the innovation becomes clearer to the organization members, and organizational practices stabilize around it as it achieves wider use. Finally the innovation is routinized, and it becomes fully integrated into the organization, losing its distinct identity. This last phase of routinization resembles Meyer & Goes' [1988] substage of acceptance. The eleven companies we studied had not moved through all these three phases, and the most significant implementation phase appeared to be restructuring. The final substages of the third assimilation stage, acceptance and expansion, have not yet been experienced by any company. One company appears to have moved into a form of acceptance phase by mandating the use of IEW on all new projects. However it is not clear how much acceptance the innovation has in reality, and only time will reveal whether the innovation persists, becoming routinized and commonplace, or whether it is discontinued through not having sufficient support from organizational members.

Most of the eleven companies have embarked on some restructuring, both of the CASE tools and of their own organizations. All of the companies reported customizing the methodology, information engineering (IE), that guides the IEW toolset. In the opinion of the respondents, there were no “off-the-shelf” IE methodologies that provided adequate depth and coverage for the entire systems development and maintenance life cycle. As a result most of the companies had developed their own set of standards, procedures, and plans, that accompanied their use of IEW on projects. One organization, in the late assimilators group, had adapted its prior systems development methodology - based on Yourdon & Constantine’s [1979] structured systems development - to play this role. The respondents also reported that reciprocal, structural and procedural changes had been initiated to accommodate the deployment of CASE tools in their companies. Five of the companies (one early assimilator, three deliberators, and one late assimilator) have reorganized their systems development units, with two companies (both deliberators) contemplating restructuring in the near future. The primary reorganization involves the concentration of personnel interacting with the CASE tools, and their distinction from other systems personnel by the
formation of a new structural unit. For example, some companies have grouped the applications developers who use IEW together, while others have grouped the personnel who support and train on IEW to form a staff unit.

We found it interesting that of the seven companies reporting current or proposed organizational changes to accommodate CASE tools, early assimilators were under-represented. Early assimilator companies have progressed the quickest through the assimilation process yet they seem furthest behind in accommodating to CASE tools. It is possible that these early assimilators are so intent on implementing the innovation and getting widespread acceptance that they spend less time contemplating organizational change. It is feasible that a company or unit that is assimilating an innovation more slowly and deliberately, has the luxury to reflect on the organizational adjustments needed to integrate the innovation. From discussions with the respondents it appears that the deliberate action of information systems managers, in structuring the deployment of CASE tools, plays an important role in enacting their assimilation and shaping people’s expectations.

The above has examined an idealized model of the innovation assimilation process in the context of eleven companies attempting to implement the same innovation, the IEW CASE tools. The model appears to be useful in identifying disjunctures and differences, and we see that in the assimilation of CASE innovations more time and attention is focused on the implementation stage, while less energy and resources are expended on formal evaluation. The appropriateness of this process is addressed in section 5.

Factors influencing the Assimilation of CASE Innovations
The innovation literature has identified a number of organizational and technological factors that influence the process of innovation assimilation. In this section we examine those factors that emerged from the data obtained in our study. In discussing the factors that are associated with implementing CASE tools, we will employ the model of factors proposed by Meyer & Goes [1988]. Hence we examine the factors in terms of: attributes of innovations, attributes of organizational contexts, and attributes of the interaction between innovations and contexts.

Attributes of CASE Innovations:
Meyer & Goes first identified the risk associated with use of the innovation as a negative influence on the assimilation process. None of the companies we studied considered this factor as significant.

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4 In some organizations such groups have been labeled “Development Centers.”

5 One of two late assimilators, five out of six deliberate assimilators, and only one of the three early assimilators had instituted or were about to initiate organizational changes in response to CASE tools.
in their adoption behavior, although one company [an early assimilator and provider of information services] was concerned with not adopting CASE tools for fear of losing customers. Interestingly the risk of decreasing the morale of systems developers as a consequence of CASE tools was not considered a significant attribute of the innovation, despite the dissatisfaction of many information systems personnel to CASE tools (see the discussion of IS personnel below). It appears, at least for the managers we interviewed, that dissatisfaction by the systems development workforce is considered a personnel problem, and hence an attribute of the organizational context, rather than something associated with or engendered by the technology.

The second attribute articulated by Meyer & Goes [1988], skill, was invoked by many managers as a relevant attribute of CASE tools, in particular the nature and amount of training that systems developers and users need before they can interact usefully with IEW. Meyer & Goes [1988] found that those innovations that required relatively little skill and training were more readily assimilated than other innovations. In our study we found concern with the lack of available training by outside vendors. Those companies that established their own internal training programs appear to be more satisfied with the rate and manner of transferring IEW skills to their personnel. Providing in-house training allows companies to retain control over the content, timing, and frequency of courses. It also allows them to tailor training to their customized IE methodologies, and to particular project teams. An interesting result that emerged was that the best education results were obtained from training entire project teams together. Such group training apparently allows educators to target project-specific issues, and permits participants to learn about CASE tools in a relevant context, in contrast to being exposed to the innovation abstractly or with reference to some minor problem.

The final innovation attribute identified by Meyer & Goes [1988], observability, played an important role in the companies we studied. We interpreted observability in this context to mean the impact of CASE tools on the performance and quality of systems development - the targets of most systems development improvement efforts. Nine of the companies reported improvements in quality of systems development, particularly user satisfaction, while only two noted improvements in performance. None of the companies had instituted measures of quality or user satisfaction, and only one was tracking systems development productivity (via function point measures), so most of the impact assessments were based on perceptions. However it is often the subjective impressions rather than the objective results of an innovation that influence action. This phenomenon seems to be operating in the companies we studied, for despite the lack of measurable improvements following early experiences with CASE tools, the motivation to continue using this innovation was high across all assimilator groups.

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Attributes of the Organizational Context:
Some of Meyer & Goes [1988] organizational context factors were specific to their study of hospitals, and hence will not be considered here. One of the criteria for selecting the organizations in our sample was size, so we could not consider its role in the assimilation process, although this may be an interesting variable for future research. Some other factors indicated by Meyer & Goes' [1988] research such as market strategy, complexity of product/service, and personnel education and tenure may also be appropriate. Because information on these attributes or their surrogates was unavailable in our study, we had to exclude them from consideration. However, we speculate on why and how these attributes may be significant in section 6.

The following discussion refers to the particular organizational context within which CASE tools are implemented. We examined the data to determine the significance of a number of possible attributes that characterize the context around systems development, such as IS department organization (centralized, decentralized, or mixed), size of IS department, type of information processing (transactions, control, decision support, etc.), but none of these appeared in our dataset to be significant influences of the process of CASE tools assimilation. Two attributes however, did emerge as key organizational influences. The first we term orientation of information systems personnel. Prior research [Orlikowski 1988] has shown that systems development personnel respond differentially to the deployment of CASE tools depending on their orientations to their work and their careers. Personnel having a process orientation to systems development work, tend to be more technically inclined and tend to have data processing career aspirations. They are much more resistant to CASE innovations, perceiving these as threats to their skills, status, job security and work autonomy. Results oriented systems developers tend to have more functional interests and career aspirations that are not localized in the data processing occupation. They have a closer affinity to users and are less threatened by CASE innovations as the skills and status potentially displaced are not highly valued. The findings from this study support these expectations. More traditional (usually implying older or more tenured) systems development personnel or more technical personnel were reported to be reluctant to utilize CASE tools, while those personnel being more analysis oriented were eager to try them out. Further, all systems developers were found to be somewhat resentful of the increased role played by users in projects. As we discuss below, the particular CASE tool we examined, IEW, facilitates greater user participation in and responsibility for the front-end of projects. This shift in control is typically problematic for the systems developers to adjust to.
A surprising result was the degree of reluctance of many systems development managers to adopting CASE tools. This led to the second organizational context factor, which we term territorialism of the information systems department. By this we mean the extent to which systems developers and managers are protective of their traditional areas of control. Prior research [Orlikowski 1988] had found project managers to be sufficiently concerned with efficiency, productivity and “getting the system out the door” to be enthusiastic supporters of CASE tools. However some of the companies we examined were experiencing resistance to the innovation from management ranks. One respondent explained, “The DP [Data Processing] management has really been the group that has not reacted to it [IEW] with open arms. You’ve got a lot of older people who have developed systems for years, and we think we know how to do it. Just like our users, we resist change.” It is likely that the discrepancy between this finding and that of the prior research rests on the difference in companies examined, with the latter focusing only on software consulting projects, where project managers may be expected to be less tied to traditional skills and familiar ways of doing things. Resistance to the CASE innovation by IS managers is likely to restrict the assimilation process, for they are typically the key operational decision-makers when it comes to initiating and executing projects. Non-cooperation from these players may well thwart the entire innovation assimilation effort.

Attributes of the Interaction between CASE Innovations and Organizational Context: 
Both of Meyer & Goes’ [1988] factors in this category proved relevant in our study. In addition, we believe two others are also significant. First, the Meyer & Goes’ attribute of compatibility, by which they mean the congruence of the technology to the existing pattern of work and specialization. We interpreted this to refer to the role of systems development methodology, and examined how the methodology-in-use in the IS unit is compatible with that of the CASE tools. Methodology is critical to the use of the CASE innovation for it mediates between the division of labor in the systems development process and the automated tools that facilitate task execution. Thus we examined the extent to which companies had adapted their existing pattern of systems development work, as represented by their methodology-in-use, to conform to that informing the CASE tools, in the case of IEW, the IE methodology. We found that all the early assimilators and all but one of the deliberators had specifically adopted the IE methodology either before or at the same time as the acquisition of IEW. For these eight companies a compatibility between the methodology-in-use and that inherent in the CASE tools had been accomplished. This provided advantages of consistency in terminology, standards, concepts, learning and familiarity of users and developers. Both of the late assimilators and one deliberator had deliberately chosen not to adopt the IE methodology, preferring to retain their own traditional (process-oriented) methodologies. Maintaining two different methodologies (even though one is more implicit, being
embodied in the CASE tools) adds a conceptual and logistic burden on systems development. Inconsistencies in approaches, timing, milestones, deliverables, standards, terminology, and assumptions need to be resolved, translated and communicated. This takes time, energy, and coordination.

Meyer & Goes' [1988] second interaction factor, CEO advocacy, is similar to what we termed senior management advocacy.\(^6\) This factor appeared consistently in the data as an important facilitator of the CASE tools assimilation process in all of the companies we examined. By senior management we mean both senior functional or user managers and the IS director. By advocacy, we follow Meyer & Goes [1988:910] in referring to (i) the extent to which senior managers personally support the acquisition of CASE tools and (ii) the extent to which senior managers exert influence and expend resources during the assimilation process. Regardless of who made the initial decision to acquire the CASE tools, those companies reporting greater success in diffusing the CASE tools (all three early assimilators, and one deliberator) reported exceptionally high degrees of senior management involvement and commitment to the innovation.

Two other factors emerged as relevant in the interaction between organizational context and the CASE innovation. One of these is highly predicted by the implementation literature, user involvement, while the other is implementation strategy. In this study, user involvement emerged as the most consistent finding across all the companies, whatever their state of CASE assimilation. Given this result, it is interesting to note that the role of the user or client in the assimilation process has warranted little attention from the general innovation literature. All companies in this study reported a significant increase in the extent of user involvement in systems development following the use of CASE tools. More interesting is the finding that this user involvement augments the assimilation of CASE tools, because users begin to pressure the IS departments for greater use of the IEW CASE tools. Indeed, in some companies senior users have started to be project managers on those projects employing CASE tools.

Users appear to be highly appreciative of the CASE tools' requirements determination phase, known as Business Area Analysis (BAA) in IE parlance. This phase is a conceptual, highly functional analysis of the business requirements of a particular system, in terms that are easily understood by the users. Users reported that the BAA process had taken much of the mystery out of requirements definition, and it allowed an integrated view of the entire system before

\(^6\) We have deliberately adopted Meyer & Goes' [1988] term "advocacy" rather than the more common one of "commitment" used in the IS literature, as it captures more of the championing activity required of senior managers, than does the more passive endorsement implied by "commitment."
development began. Further users reported increased completeness of requirements, decreased ambiguity, more comprehensive documentation, and greater enthusiasm. A user noted that the process involves the users in the front end and forces them to address the business problems, while keeping the systems developers in focus about what the business needs are. A critical benefit of greater user involvement is that it provides users with a level of control over systems development they have typically not experienced before. One user commented about BAA: "It was the first time in my experience at [name of company], and that's been twenty-six years in and out of data processing, that the users had the first say so as to how they wanted the system designed." However this shift in control has not always been well received by the system developers or their managers. One company, an early assimilator, was experiencing negative reactions from IS managers about the fast pace of development fueled by the CASE tools and the user demand. One such manager explained the resentment: "We think we know better than the users do as to what they need. We don't like all this user involvement. We like to protect our territory. We kind of liked it when there was a lot of mystery."

As users appreciate BAA more, they become more insistent about the use of CASE tools on their systems development efforts, hence pressuring the IS department to speed up their assimilation of the CASE innovation. However, this influence is not only one-directional, for often the IS directors play an important role in ensuring user involvement, hence facilitating user participation in and understanding of the innovation. One IS manager, responsible for integrating the CASE tools in his company explained: "If they [the users] are not involved, there is no project. If they don't have time to put a good person on the project, the project is cancelled. We have cancelled I don't know how many projects, but it is not unreasonable to see that a project is cancelled because clients don't take interest or don't have the time."

As indicated above, the implementation stage is not treated in any depth by Meyer & Goes [1988] or Rogers [1983], and neither is the particular strategy that companies follow during implementation. This attribute of the implementation stage however, proved to be a dominant aspect of the process followed by companies in assimilating CASE innovations. In particular, the presence of an explicit and phased implementation strategy appears to facilitate the diffusion of the CASE tools through systems development operations. One of the companies, a late assimilator, had no explicit implementation strategy, which may account for some of the delay in getting a production system completed. The rest of the companies all appeared to have explicit implementation strategies. Three different implementation strategies were identified among the ten companies. One we refer to as the vertically phased implementation strategy, which is premised on implementing the CASE tools incrementally via individual projects. Another strategy,
which we refer to as the *horizontally phased implementation strategy*, is premised on implementing
the CASE tools incrementally stage by stage, across the development life cycle of all projects. The
final strategy we label the *combination phased implementation strategy*, and this is premised on
diffusing the CASE tools in two directions: incrementally project by project (as in the vertically
phased strategy), and laterally, stage by stage, (as in the horizontally phased strategy). All these
strategies appear to have merit in that they structure the diffusion of the innovation, generating a
decomposition logic and time-based plan to organize the implementation activities. We suggest that
the strategies need not be followed to the letter, as their value lies in their symbolic and organizing
function rather than in their detailed prescriptions.

The *vertically phased strategy* was by far the most prevalent, detected among eight of the
companies. For each project initiated, the CASE tools are used during the entire life cycle. The
companies adopting this strategy started with one or two pilot projects to demonstrate viability of
the CASE approach, then followed this with the vertically phased strategy whereby an increasing
proportion of the systems development projects use CASE until it becomes the standard for all
systems development projects (see Figure 1). One company, an early assimilator, is already at the
point where 100 percent of its new development projects use CASE tools, while another early
assimilator is at the 70 percent mark. The rest of the companies we studied displayed much lower
rates of diffusion.

An advantage of the vertically phased implementation strategy is that companies can exploit the
learning curve, making adjustments to their methodology and development standards and
procedures as a result of lessons learnt on prior CASE tools projects. Another advantage is the
development of critical mass. That is, system developers gaining expertise with the CASE tools on
the first projects can be used on subsequent projects. This allows project teams to leverage the
experience they gained on prior development efforts.

The *horizontally phased strategy* was evident in only one company, a late assimilator. Here the
CASE tools are introduced functionally, first the analysis workbench across projects, then the
design workbench across projects, and so on (see Figure 1). CASE tools are thus not being
introduced in an integrated fashion, rather particular tools are being brought in one by one to be
used in combination with existing manual methods. Eventually all the phase tools will have been
implemented and the advantages of an integrated toolset can be derived. The company which has
adopted this strategy is one of the late assimilators. Progress has been slow, and no production
system has yet been built with CASE tools.
Figure 1: Implementation Strategies
The advantages of the horizontally phased strategy is that it allows the implementation of the innovation in conceptual chunks. Rather than inundating system developers with a whole new approach to the entire development life cycle, this approach allows developers to gain expertise and familiarity with one piece of the innovation at a time. Only when all system developers are experienced with a tool, is the next one implemented. The other advantage of this approach is that it diffuses the innovation to all developers at the same time. It does not create an elite group of system developers who gain exclusive experience with CASE tools and then tend to dominate automated development projects. The “crack team” approach to innovation diffusion is efficient, in that the expertise and experience of a few developers, is highly leveraged. It may however encourage resentment and resistance from the rest of the developers who get left with the maintenance work, and who perceive themselves as no longer in the mainstream of development activities. The horizontally phased strategy can help to avoid this potential human resource problem.

The combination phased strategy was observed at one company, an early assimilator. In this strategy the requirements definition stage of the IE methodology (BAA) is used for all projects, whether these will use the IEW tools during development or not. Thus not only are individual projects incrementally adopting the CASE tools over time, but all projects are adopting one aspect of the CASE innovation, the BAA, for the up-front requirements determination activities.

The combination phased strategy thus gains the advantages of the vertically phased strategy, as well as that of the horizontally phased strategy. It greatly increases user enthusiasm and involvement, for the BAA phase is the most visible and most relevant to the users. It increases pressure from users to diffuse the CASE tools, for as the company using this strategy reported, the users get so excited by the BAA process that they start spreading positive information about the innovation throughout the company. The company has completed approximately 70 BAA’s in the past two years, while still making the same relative progress as other early assimilators in the implementation of CASE tools in the entire development life cycle.

4.3 Summary of Results
Based on the detailed findings discussed above, the process of assimilation of CASE innovations can be seen to mirror that of other innovations, except with different emphases. Assimilation of CASE tools appears to involve more time in the implementation stage, with less formal evaluation. While this is what companies are doing it is not clear that this necessarily is the appropriate procedure. In the following section we will argue that companies may be underestimating the potential impact of their CASE innovation, and that more careful evaluation and weighing of
consequences may be in order. Table 6 summarizes the factors that emerged from our case studies as important attributes influencing the assimilation process of CASE innovations. We emphasize that this is a preliminary model, whose elaboration and verification awaits future research.

Table 6: Factors influencing the Assimilation of CASE Innovations
[adapted from Meyer & Goes 1988:908]

<table>
<thead>
<tr>
<th>ATTRIBUTES OF CASE INNOVATIONS</th>
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<tbody>
<tr>
<td>(-) Skill/Training: Extent of skill or specialized training required.</td>
</tr>
<tr>
<td>(+) Observability: Extent of perceived impact on systems development quality and performance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTRIBUTES OF ORGANIZATIONAL CONTEXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-) Orientation of IS Personnel: Extent to which systems developers are process-oriented and committed to data processing careers.</td>
</tr>
<tr>
<td>(-) Territorialism of IS Department: Extent to which systems developers and managers are protective of their traditional areas of control.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CASE INNOVATION-CONTEXT ATTRIBUTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+) Senior Management Advocacy: Extent of senior managers influence, personal support, and commitment of resources.</td>
</tr>
<tr>
<td>(+) Methodology: Extent to which the methodology-in-use is consistent with that inherent in the CASE tools.</td>
</tr>
<tr>
<td>(+) User Involvement: Extent to which users are involved and directing systems development projects utilizing CASE tools.</td>
</tr>
<tr>
<td>(+) Implementation Strategy: Extent to which an explicit and phased implementation strategy is employed.</td>
</tr>
</tbody>
</table>

5. IMPLICATIONS OF FINDINGS AND RECOMMENDATIONS
In this section we attempt to translate some of the specific findings into more general terms, and propose some of the implications of our study for practice. We caution that these interpretations are tentative and based on our exploratory analysis of data from a limited sample. The implications are in two parts, the first set refer to the assimilation process itself and are more general, while the second refer to the factors that may influence the success of the process and are more specific to particular organizational contexts.
5.1 Recommendations on the CASE Tools Assimilation Process

In the discussion of results we noted that in distinction to other innovation processes, the process followed by companies assimilating CASE tools seems to be focused on implementation with less attention being paid to the evaluation phase. Just as the systems development community is beginning to accept the need to spend more time and energy on the front-end aspects of systems, so we recommend that potential adopters of CASE tools spend more time up-front evaluating the tools, determining their compatibility with existing methodological, structural and cultural characteristics of the organization. As a major innovation, and as this study has shown, CASE tools can and do interact with all these dimensions. Thus we suggest that CASE tools be treated as a major information system whose successful implementation will need careful justification, planning, user involvement and training.

We suggest that the real intended and unintended consequences of integrated CASE tools are sufficiently substantial that treating them as significant organizational interventions is warranted in most cases. CASE tools are premised on the automation of systems development activities; their intention is to substantially alter systems development and maintenance processes [Norman & Nunamaker 1988; Orlikowski 1988]. Ignoring their innovative aspects ignores their very essence. Little attention seems to be paid to the costs and benefits of CASE tools. Difficulty in quantifying them should not preclude considering them and carefully weighing their advantages and disadvantages within the particular organizational context. Many of the companies studied seemed unaware of the many intangible costs that are often associated with CASE tools. The costs are not only those of purchasing the software, developing training programs, and educating all the systems developers. There are also organizational costs such as restructuring the IS organization: possible declining morale of systems developers who may feel threatened and alienated by CASE tools; changing career paths and evaluation mechanisms to accommodate changed jobs and expectations of systems developers; and introducing a new methodology and new standards to ensure compatibility with the underlying philosophy of the CASE toolset. Our general process recommendation is that the activities of evaluation be taken more seriously, and that managers contemplating investing in CASE tools spend time carefully evaluating the particular factors in their organizations that may facilitate or constrain the CASE implementation process (see below).

We also recommend that companies consider organizational restructuring to accommodate the CASE tools. The accommodation of organizations to an innovation has significant benefits for a number of reasons. It expedites the introduction and use of the CASE tools by structurally concentrating expertise, committing resources, and facilitating assistance and training. Further, it allows the
organization to establish appropriate policies, standards, and practices, hence smoothing the assimilation of the innovation into the organization. This procedural accommodation, while instrumental, is also useful motivationally, forcing deliberation on how the innovation will be employed, and focusing energy and attention on its potential use and consequences. Finally, and possibly most significantly, it is useful symbolically, for it sends a powerful message to organizational members that this innovation is sufficiently significant that it warrants modifying the organization to utilize it. The innovation is given credibility and legitimacy. We suspect that there is a relationship between organizational accommodation to the innovation and "success" of the assimilation process. Success in this regard is understood to be more than merely quick assimilation, for speedy innovation can bring disruption, insecurity, and ambiguity if these are not tempered by structural alterations. In this exploratory study it was not possible to determine the "success" of CASE tools assimilation, and the role of organizational restructuring in facilitating this. It is, however, an important topic for future research.

5.2 Recommendations on Factors that Influence the Assimilation Process
In section 4.2 we identified and discussed eight factors (presented in Table 6) that were found in our study to influence, either positively or negatively, the process of assimilating CASE tools in organizations. We now re-examine these factors more practically, in terms of how they can be manipulated to obtain a desired assimilation result. In our discussion we argue that of the eight factors identified above, six are critical to the assimilation process. The extent to which each of these is critical within a particular company varies, of course, as different factors will be more or less critical in different organizational contexts.

Thus, before an organization can perform an effective evaluation of CASE tools, a careful assessment of the organizational context and potential CASE tools are in order. Managers need to have a good sense of the conditions under which CASE tools will be deployed, and the circumstances within which they will operate, to be able to assess the potential success or impact of CASE tools in their organization. Having understood the organizational conditions, practitioners should assess which of the factors critical in their context can be engineered to create a conducive environment for the assimilation of CASE tools.

Each of the factors can be understood to either promote, constrain or be neutral to the success of a CASE tools assimilation process. For example, we argue that compatibility between the systems development methodology and that of the tools can facilitate the assimilation process, while incompatibility appears to be neutral as far as success is concerned. Other factors however, appear to operate in opposing ways, that is, either promoting the assimilation process or constraining it.
For example, the presence of senior managers' advocacy may be critical to facilitating assimilation, while its absence could be a significant inhibitor. We believe that practitioners need to understand the workings of these factors in the assimilation process generally, and in their particular organizational contexts specifically. Such understanding should allow them to realize or augment the influence of those factors that facilitate successful assimilation of CASE tools, while minimizing or eliminating the effect of those factors that constrain successful assimilation of CASE tools. Table 7 presents a summary of these factors, and the direction of their influence.

Table 7: Factors affecting the Successful Assimilation of CASE tools

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>Facilitating Successful CASE Assimilation</th>
<th>Constraining Successful CASE Assimilation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS Personnel</td>
<td>System developers are result oriented and seek functional or analysis careers</td>
<td>System developers are process oriented and seek technical data processing careers</td>
</tr>
<tr>
<td>IS Culture</td>
<td>IS unit is not protective of its turf; sharing responsibility with and relinquishing control to users</td>
<td>IS unit is protective of its turf; retaining responsibility and control vis-à-vis users</td>
</tr>
<tr>
<td>Senior Management Advocacy</td>
<td>Senior Managers champion CASE tools, expending personal effort, influence, and resources</td>
<td>Senior Managers do not support CASE tools, nor commit time and resources to them</td>
</tr>
<tr>
<td>Methodology</td>
<td>Methodology-in-use and that of CASE tools are compatible</td>
<td>Indifferent</td>
</tr>
<tr>
<td>User Involvement</td>
<td>Users are actively involved and even directing systems projects</td>
<td>Indifferent</td>
</tr>
<tr>
<td>Implementation Strategy</td>
<td>Implementation is explicit, phased and incremental</td>
<td>Indifferent</td>
</tr>
</tbody>
</table>

The following are our recommendations for assessing and dealing with these factors.

**IS Personnel Orientation**

CASE tools potentially disrupt the way in which system developers work, changing their skill and task requirements, and threatening their job security. Many system developers react defensively, particularly those who have an investment in their technical knowledge and experience, and who
derive satisfaction from the technical activity of building systems. Resistance from system developers can be handled in a number of ways. One approach is to give system developers the option to move into more technical work, such as tools support or database maintenance. The expectation here is that self-selection will guarantee that process-oriented types will move out of applications development, while those more functionally oriented will remain to use the CASE tools and interact with users. Another approach is to change the career paths and expectations within the systems development unit. Developers will then realize that to have successful careers in the firm, they will have to become analysis-oriented, be users of tools, and forego images of technical wizardry. Those who are not comfortable with this change in orientation can seek careers elsewhere, but at least they are informed that their prior expectations and experiences are no longer appropriate guidelines for success in this firm. Their choice is theirs: “adapt or leave.”

This approach needs to be coupled with strong IS management support for the CASE tools, for if these are perceived to be an uncertain strategy, developers are unlikely to commit to an orientation change. One IS manager commented: “They [the IS personnel] are willing to ... almost become rookies again, because they know management really wants it, and will stick by them and reward them. When the professional sees that the boss understands that it is going to take a year, that it is going to take some pain, then they will do it.” This approach clearly depends on the availability of education and training courses, and on management allowing for the training time, the learning curve, and the readjustment problems that inevitably ensue. One company has, in addition to normal training courses, instituted an information campaign whereby CASE tools and their implications are explained at a general level to system developers and users. This tactic may help to dispel some of the rumors and misinformation that typically accompany a controversial innovation.

Culture of Systems Development
This factor concerns the extent to which the systems developers and managers are willing to relinquish or at least share control and responsibility for systems with users. Many companies reported a deeply rooted territorialism within the IS culture, which serves as a critical barrier to allowing users to take responsibility for systems. For those CASE tools that depend on comprehensive and accurate requirements definitions (to drive subsequent screen/report design and code generation), the lack of user involvement will inhibit their successful use and assimilation in the organization. While we believe that users should be involved in all systems development efforts, not all CASE tools and not all organizations operate under this premise. However, for those organizations that want to encourage shared responsibility, and where turf lines have been carefully delineated in the past, cultural change can be encouraged through education, joint task forces at multiple levels, and management advocacy of the changed work norms.
Methodology
We believe that the relationship between a well-articulated systems development methodology and a set of CASE tools should be a mutually reinforcing one. That is, the methodology should inform the assumptions and conceptual structure of the tools, so that they operate consistently, in an integrated fashion, and in concert according to some common logic. On the other hand, the tools should enforce the logic and assumptions of the methodology (e.g., through ensuring compliance to standards), and provide automated means to support the labor intensive activities required by the methodology. Given this symbiotic relationship, it is clear that there are advantages to having the methodology-in-use in an organization’s systems development practices be compatible with the methodology underlying a set of CASE tools. Interactions between these methodologies will be transparent, and there will be less training requirements and less need to enforce different standards. These advantages can decrease the development times, as there is no need to translate between different world views. One systems developer commented about the ease of transition among the development stages: “The programming was like falling off a log. It really was a mirror translation process of the design deliverables ...”

We recommend that, where possible, companies attain consistency between their CASE tools and the methodology-in-use in their IS organizations. This will mean either acquiring a set of CASE tools that conform to the existing methodology-in-use, or changing the methodology-in-use to reflect the methodology of the CASE tools adopted. The latter approach is clearly the more radical action and needs to be carefully justified. It may be an opportunity to adopt a more appropriate methodology (for example, if a data-oriented methodology is seen as more suitable to the new database architecture of the organization), on the other hand it may be disruptive and expensive (provoking resistance and lowering morale).

Senior Management Advocacy
With regards to senior management advocacy our contention is that as with any major organizational innovation, managerial commitment is a necessary (although not sufficient) condition for successful implementation. It is clearly an important facilitator of success, in that it can expedite the assimilation of a new endeavor through motivational as well as financial and institutional resources. We believe that its presence is critical, and where it is unavailable the CASE assimilation process will be problematic and outcomes will be uncertain. Thus, if senior managers do not advocate an innovation, this can serve as a significant constraint on successful assimilation.
User Involvement

The role of users in the use of CASE tools was an important outcome as well as a facilitator of CASE assimilation in all of the companies we examined. Some of this interaction is a consequence of the IEW CASE tools we investigated, as they encourage and depend on significant amounts of user participation. However, we suspect that user pressure on the IS unit can be an important influence on the manner and speed with which any set of CASE tools are deployed in an organization. The users in our study felt that one of the most important implications of the CASE innovation was that it finally put control of the system characteristics in the hands of the users. Through their participation and direction of the BAA phase of the IE methodology, users were finally able to exert influence on how their systems turned out. While the IE methodology with its BAA phase can be used without CASE tools, we found that the BAA's were greatly facilitated by the capabilities of the IEW. In those companies using IE before IEW, enthusiasm with BAA was much less as all the information being generated had to be recorded manually. The tediousness and error-prone nature of this endeavor served to discourage extensive emphasis on this phase. The IEW CASE tools have greatly facilitated this activity and given users a meaningful voice in their systems. While we believe it is possible to implement CASE tools in organizations without drawing on user participation, we do recommend that IS managers encourage and expedite the active engagement by users in systems development as much as possible. Not only will responsibility for systems be shared and the quality of systems should improve, but the use and assimilation of CASE tools should be promoted.

Implementation Strategy

In the section above we described three kinds of implementation strategy that our sample of companies displayed. We suggest that which implementation strategy (vertically phased, horizontally phased, or combination phased) is adopted is less important than that some explicit strategy be followed. Carefully articulating the manner, timing, and phases of diffusing the CASE tools structures the way in which people, both systems developers and users, perceive and use the tools. It also serves to organize training activities and creates the impression that the company is systematic about its adoption of the innovation. Along with articulating, choosing and following an implementation strategy, organizations will need to customize the methodology and the use of CASE tools to reflect their specific contexts. Standards, procedures, controls, and policies have to be drawn up to specify changes in deliverables, time-frames, and expectations, as well as to clearly delineate the role to be played by the automated aids, the system developers, and the users. CASE tools change the ground on which systems are built, and these changes must be formalized and communicated to realize their benefits.
6. CONCLUSION
There have been few previous studies of the deployment of CASE tools, and even fewer of the processes by which these tools are assimilated into organizations. In the study reported here, we found a process of assimilating the CASE tools that differed in emphasis from that found with other innovations. We also identified a number of factors that appear to influence, sometimes substantially, the process of assimilation. We believe that the articulation of these factors, and an understanding of their role in facilitating and constraining successful assimilation, are useful to practitioners who are, or are considering implementing, CASE tools in their organizations.

The study also has some implications for future research. First, the factors identified in Table 7, and their expected influence on the process of CASE assimilation is exploratory and needs extensive verification and application in other settings. Further, many potential factors for which there was insufficient information in this study may well be relevant influences on the assimilation process. These need to be investigated. For example, one of the criteria for selecting the organizations in our sample was size, so we could not consider its role in the assimilation process. This may be an interesting variable for future research, as might CEO (and even CIO) tenure, education, and attitude towards innovation. Market strategy of the organization was not considered relevant as the concern in this study was the assimilation of CASE tools by IS departments to build systems for users, rather than with assimilating a technology to service outside customers. However it is feasible that where an organization’s business is to provide information products and services to outside clients, market strategy may well affect the process of assimilating CASE tools. Further, if a different view is taken of the IS department, as a unit servicing clients (even though these are internal clients), then some measure of departmental service strategy may be a significant influence on why and how CASE tools are assimilated.

Finally, future research should examine other CASE tools, as this study only investigated one particular CASE toolset, IEW. While we believe that the assimilation process and many of the factors we identified are relevant across CASE toolset types, our findings can only cautiously be applied to CASE tools in general. As we noted earlier, the varieties and flavors of CASE tools are many, and attributes of the technological innovation, the CASE tools, can be expected to influence the assimilation process. Careful, comparative studies across this range are needed.

In this paper we articulated a process by which CASE tools are assimilated into organizations, and explored how this process is influenced by various organizational and technological factors.
Findings from an empirical investigation revealed that nominal amounts of time and effort are spent on evaluating the CASE tools prior to their adoption, and that as a result, organizational consequences of these tools were poorly understood and dealt with. We identified and discussed a number of key factors that we believe facilitate and constrain the process of CASE tools assimilation in organizations. We discussed the implications of these findings for research and practice, and proposed some recommendations for managing the implementation of CASE tools.

REFERENCES


