

Reskilling IS Professionals:
Individual and Organizational Adaptation
to Software Process Innovations

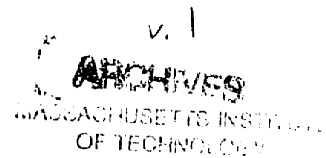
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Abstract

As corporations enter the next millennium, managers need to understand what factors influence the implementation outcomes of new information technology (IT). This research focuses on a particular class of IT — software process innovations. Formally defined as new tools, technologies, and methodologies that change the process of developing software (Fichman, 1995), such innovations can enable firms to implement changes to the skills and abilities required for software development, as well as the work processes, coordination requirements and relationships between the IS department and business unit employees.

This study examines the implementation of client/server development, a software process innovation that changes the nature of system development. Client/server development alters the system development processes in many ways: by requiring knowledge about client/server hardware, by facilitating the use of new toolsets and methodologies to create systems, and by changing the relationship between business users and IS developers.

This study has three objectives: first, to portray the many changes that can occur in IS departments when client/server development is adopted; second to describe the myriad *reskilling* processes required to instill the necessary changes in skills, abilities and behaviors among IS professionals; and third, to investigate whether individual attributes can explain the different reactions of individual IS employees to client/server development.

The *Theory of Work Adjustment* (Dawis & Lofquist, 1984) is used as the theoretical framework for this study. This framework characterizes employee job satisfaction and performance as each determined by the fit between a pair of constructs: job satisfaction is determined by identifying the employee's needs and values, and comparing them to their level of fulfillment in the employee's job. Similarly, performance is explained by identifying the importance of various skills required for the job, and identifying the level of fit between an employee's skills and these requirements. The Theory of Work Adjustment has been widely used in management and psychology research, but has received limited use in the IS literature (McLean, Tanner & Smits, 1993; Goodhue, 1988).

The research methodology for this study combined qualitative field study research with survey data collection and hypothesis-testing. Both research phases were conducted in two large firms that were in the process of implementing client/server

development. Despite the comprehensive nature of the Theory of Work Adjustment, the field studies suggested that additional constructs might improve the explanatory power of the framework: specifically, the individual attributes tolerance of ambiguity, resilience to stress, and an innovative creative style. Each of these attributes was proposed as an additional variable to explain employees' satisfaction and performance, following implementation of client/server development.

Based on the survey data from IS developers and their managers, statistical analyses first examined the fit of the basic Theory of Work Adjustment to the data, and then added the individual attributes as additional explanatory variables. While the basic Theory of Work Adjustment adequately explained the survey data, adding each of the individual attributes (separately), significantly improved the model's fit to the data. The data show that each of these individual attributes (tolerance of ambiguity, resilience to stress, and innovative creative style), contributes to an understanding of differences in IS developers' job satisfaction but not performance, subsequent to adoption of client/server development.

This research provides insights for IS managers by identifying the many changes in work processes associated with adoption of software process innovations. Both the field studies and the survey data illustrate the importance of having a workforce that is characterized by flexibility in their willingness and ability to accommodate changes in skills and work processes. The outcomes suggest to managers the importance of recognizing differences among IS employees that may predispose them to more readily accept and adapt to changes in technology and work processes.

This research suggests to both managers and researchers that adoption of organizational-level technological innovations can impact the skill requirements and work processes of individual employees. Finally, it underscores the importance of combining research at both individual and organizational levels to create frameworks that examine the reciprocal influence of constructs across levels (individual and organizational levels). Future research can expand on this integrated framework to describe how individual differences in acceptance of software process innovations may influence organizational-level outcomes.

Dissertation committee: John F. Rockart (Chair), Lotte Bailyn, John S. Carroll, Wanda J. Orlikowski, and Jeanne W. Ross.

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Chapter 1

Introducing the Innovation: Client/Server Development

Setting the Scene

Imagine this scenario: You are the manager of an information systems (IS) division in a Fortune 500 company. The arrival of the 21st century is imminent. A new class of technology has recently been introduced with great fanfare. This new technology is promoted as better, cheaper and faster than those it will allegedly replace. It will allow companies to reduce their costs dramatically, generating higher profits. With increased ease-of-use and increased flexibility for business department employees, this means happier and more efficient workers. Given the technology's ability to "speed" systems development, multi-year cycle times are reduced to mere months. The prevailing wisdom is that, given the savings in time and money, companies who adopt the technology cannot go wrong. Product names and features change each year but the predictions are similar. Each year a new IT innovation promises to transform ease-of-use for computer users, to accelerate application cycle times, or to revolutionize the cost structure of IT within the corporate world.

If this scenario appears familiar, the decade is the 1990s, and the subject matter is definitely information technology (IT). Benefits of the innovation are obvious in the promotional brochures, while the risks are as yet unknown or confided discreetly. Depending on the actual year of the decade, the technology would vary from: CASE tools (1990), pen-based computers (1991), client/server technology (1992), groupware (1993), object-oriented programming (1994), Windows '95 (1995), the world wide web (1996), to Java *applets* (1997).

The year was 1992 when I began the research for this dissertation. Client/server was cutting-edge technology. Hardware, software, and even *middleware*¹ vendors promised great things

¹ Middleware is the software that permits interoperability among different hardware configurations (King, 1992).

for the technology. Like many of the other technological innovations, the day was full of promise -- and promises.

This research focuses on client/server *development*, rather than client/server *technology* — the processes, behaviors, and skill sets necessary for developing applications that run on the client/server platform. This distinction is explained in greater detail below. This research provides statistical data, in addition to two detailed case studies of firms that were implementing client/server development and analyzes these two distinct data sets — both to validate and to elaborate a theoretical framework for explaining the required adjustments in IS professionals' skills, abilities, needs and values. The framework used is the *Theory of Work Adjustment* (Dawis & Lofquist, 1984, 1994), which itself represents a consolidation of constructs from other theories explaining employee adaptation and outcomes.

As with its technical forerunners, client/server technology was hailed as a radical change not only for IS employees, but for line managers and users, as well. Many proclaimed the paradigm shift inherent in client/server technology as "the new promise of information technology"² (Tapscott & Caston, 1993). This was a technology that would fundamentally impact how IS departments worked and how they could take the lead for providing business solutions in the future. One IS researcher studying client/server development concluded that the technology can trigger:

... substantial changes in the nature of work in the IS group. These changes range from new philosophies, methodologies, and technologies to shifts in the skills, communication patterns, and control structures required to develop and manage information systems.

— Nance, 1994:78

Not content to merely make systems easier to use, or to accelerate application cycle times, client/server technology was expected to transform the skill sets required to develop software. Furthermore, not only was the structure of software applications different in client/server

² Tapscott & Caston's title was explicit — *Paradigm Shift: The New Promise of Information Technology* (1993).

from prior centralized computing environments, but managers anticipated it would require significant reskilling of system developers. The software code itself was intentionally fragmented — with some components running on desktop PCs (the *client* machine) and others running on the *server* (workstations specialized to operate database management software). New jargon proliferated: the new hardware platform was variously described as "downsized," "rightsized," or "everything-sized" (Peri, 1992) and the relationship (or *architecture*) between hardware components architecture was variously labelled "cooperative," "distributed," or "enterprise" processing. Consultants and vendors provided frameworks explaining how all the pieces fit together and attached proprietary labels to them: Gartner Group (1992) had its "five-layer model," Sybase proposed its four layers of functionality (Sybase, 1992), and Sun (1993) proposed its three-level architecture. Meanwhile, savvy client/server developers compared the advantages of *fat* clients and *skinny* servers versus *skinny* clients and *fat* servers.

It was a brave new world of computer processing. Unfortunately, the computer trade press predicted that it wasn't for everyone. More to the point, while all *companies* were advised to seek the benefits of client/server development, the realization was that many programmers in these firms might not succeed in making the transition from the structured, orderly process of developing mainframe applications to the emerging chaotic processes characterizing the client/server platform.

Challenge awaited in two stages: stage one was the firm's decision to adopt and diffuse client/server technology as a replacement for their current mainframe infrastructure.³ Stage two was the adoption and routinization of client/server development by some groups of application developers. These stages correspond to implementation research which specified primary and secondary adoption (Leonard-Barton, 1987) or two-stage implementation of information technology (Lucas, Ginzberg & Schultz, 1990). While stage one was assumed

³ Some guidelines evolved for which system applications would best be ported to the client/server platform — those with high-volume transaction processing.

as given, stage two posed difficult questions: which groups of individual developers should be chosen for this innovation? Could or should all developers migrate to the new platform?

Early answers to similar questions appeared in the IS trade press, rather than in the academic literature. By 1993, conventional wisdom had emerged in the trade press, arguing that the mainframe to client/server *migration* posed serious obstacles for IS developers (Cusak & Keefe, 1992; O'Leary, 1992a; Violino & Appleby, 1991). Within a few years of client/server's debut, the rhetoric was increasingly focused on implementation obstacles. With titles such as *Client/Server Strategies: A Survival Guide for Corporate Reengineers* (Vaskevitch, 1993), "The Death Knell" (Cavanaugh, 1995), or "No roadmap for training in the distributed '90s," (King, 1993), the obstacles to successful implementation of client/server and reskilling of IS professionals loomed ahead. Without any guidance or insight from IS academics which might link these issues to frameworks from prior research, this conventional wisdom took on a life of its own. Increasingly, there was a recognition that some current developers had the capability to make the transition, while others lacked it (Mello, 1995; O'Leary, 1992b). One IS consultant who chose anonymity claimed "It's very traumatic for people, and it's a totally different way of doing something.... It's pretty brutal out there" (King, 1995:46).

Speculation arose as to whether and why certain IS professionals would make the transition. Some experts assumed this migration to be a probability game: one "optimistic" journalist sought to encourage IS managers to adopt client/server technology, seemingly recognizing the promise of target adopters (programmers), while damning them with faint praise.

Contrary to a widely held myth that it's difficult — if not impossible — for mainframe developers to make the transition to new technologies, *half or more* of those who receive the proper training can and do make the jump from highly-centralized host-based computing [mainframes] to decentralized, event-driven computing environments [client/server development].

— Gene Raphaelian, Gartner Group (in King, 1995: 46).

In many firms, mainframe systems assumed the dubious honor of being called "legacy systems" and IS professionals who developed and supported them now had "legacy skill sets." Many writers identified a divergence between the skill sets or "schema development" (Manns & Nelson, 1993) — not only for programming in client/server — but for all phases of the system development life cycle. In many cases, IS managers' reluctance to invest resources in training veteran developers served as its own validation. Since managers perceived many older developers to lack the necessary enthusiasm or skills, such developers were not offered the chance to try and — not surprisingly — few successfully made the transition on their own.

Other writers became more pointed in their predictions: Many focused on the age of the developers' or their number of years of service in the IS field, perceiving these as liabilities to their ability to adapt. Several experts suggested that companies investigate hiring new employees, because it was impossible to "remake" a traditional mainframe programmer into an innovative client/server developer (Mello, 1995). Some experts instead urged IS managers to hire fresh college graduates, who lack the "cognitive blinders" that accrue from years of mainframe design and programming (Wilde, 1994). Although some evidence has emerged, showing that the cognitive processes for developing client/server systems (Manns & Nelson, 1993; Liu, Goetze & Glynn, 1992) *do* vary from traditional design and development skills (Vessey & Weber, 1984; Jenkins, Naumann & Wetherbe, 1984), what was lacking was an explanation why experienced IS developers were presumed likely to fail. The above recommendations that IS departments look for fresh talent because veteran employees were not agile enough did not specify whether it was due to their inability to learn, a lack of initiative, or outright resistance. In fact, this assumption (that older IS employees will fail) contradicts the evidence that employees gain valuable judgment and maturity from performing in their jobs over time. How could skills in designing systems, understanding the business, and working with users now become liabilities?

Given the pervasiveness of the notion that older, more experienced mainframe developers will perform worse than neophyte college graduates with recent client/server training (Melymuka,

1994), this research seeks to build upon prior research and frameworks to explain how new technologies influence the organizations and individuals who adopt them. In addition, this study will examine the factors that explain individual adjustment to the different work environments. I will elaborate on prevailing notions about the determinants of employee satisfaction and performance on the job, while venturing to characterize personal attributes that may explain employees' acceptance or resistance to change.

Purpose and Structure of the Research

This research has three overarching objectives: First, I seek to portray the many changes that can occur in IS departments when client/server development is adopted and implemented. Second, I attempt to describe the myriad reskilling processes required to instill the necessary changes in skills, abilities and behaviors. Third, I investigate whether and how organizational-level and individual attributes can explain the patterns of adaptation that occur among IS employees to the new work environment, or whether new constructs are required to explain their outcomes.

The structure of the study is follows: Chapter 2 provides a review of literature on implementation of technological innovations in organizations, as well as a summary of frameworks that have been employed to explain individual work outcomes — such as job satisfaction, performance, and turnover intentions (desire to quit). The contribution and limitations of each framework are reviewed in this chapter, as precursors to the conceptual framework to follow in Chapter 3.

Chapter 3 introduces the *Theory of Work Adjustment* (Dawis & Lofquist, 1984, 1994), the conceptual framework used to analyze the qualitative and quantitative studies that follow. The Theory of Work Adjustment provides a correspondence framework to explain individual adaptation to new skills required and new work processes employed on the job. This chapter describes the relationships among constructs that are implicit within the Theory of Work Adjustment.

Chapter 4 describes a field study of two organizations that were implementing client/server development. It describes the data collection, analysis, and results. Results of these field studies are analyzed to provide an informal validation of constructs in the Theory of Work Adjustment, while also suggesting some elaborations to the framework to capture individual differences that may explain differential adaptation to client/server development.

Chapter 5 links the elaborations suggested by the field studies to the prior literature on individual attributes that have been studied in the management and IS literatures. In addition to integrating these individual attributes to existing research, Chapter 5 concludes by presenting a series of propositions to be tested through survey research.

Chapter 6 describes the design and administration of the survey. It explains the scale development, based on both pre-existing some original measures, and creation of the disk-by-mail survey. The benefits of disk-by-mail surveys are briefly summarized, and steps for administering separate versions of the survey to IS employees and then IS managers in two firms is described. These are the same two firms, Chemco and Insureco described in the field studies in Chapter 4.

Chapter 7 provides descriptive results of the survey research. It presents overall patterns in the data, comparing responses from Chemco and Insureco employees. Although this chapter is a precursor to the formal testing of propositions in Chapter 8, some key insights are identified for additional analyses and discussion.

Chapter 8 evaluates the survey data in light of the propositions stated in Chapters 3 and 5. It first presents the methodology for statistically analyzing the data, including procedures for analyzing scale reliability (Cronbach alpha), identification of factors (factor analysis), and testing propositions (multiple regression analysis).

Chapter 9 discusses the results from Chapters 7 and 8. Results of hypothesis-testing are interpreted in light of both the preceding descriptive data analyses and the field studies. This chapter also evaluates these findings, in light of the prior frameworks for understanding individual work adjustment and adaptation to technological change. It also provides insights for IS managers to consider when contemplating the introduction of client/server — or other technological innovations that may change the skill requirements, work processes, expectations and rewards of IS professionals.

Terminology Distinctions

Before describing the prior literature on technology adaptation, some comments about technical terminology are necessary — client/server *technology* versus *development*, and *training* versus *reskilling*. First, there is an important distinction between the terms client/server *technology* and client/server *development*. Client/server *technology* refers specifically to a type of hardware platform or architecture, while client/server *development* describes a broader set of processes for developing systems that can run on this platform.

Client/server *technology* denotes an application where the user interface (presentation layer) and some of the application logic operate on the user's desktop PC or workstation (the client). Most of the transaction processing, including any validation logic (necessary for data integrity), and the details of database management run on a centralized server.⁴ This definition of client/server *technology* focuses on the distributed nature of the two hardware platforms and the separate — but interdependent — software components running on each platform. In contrast, client/server *development* addresses several changes in the system development process for designing and developing such systems. Client/server development refers to the creation of application software *on* a PC or workstation which will later run on the client/server platform (following the principles of fragmented, but interdependent software code described above). Client/server development thus refers to a set of processes for

⁴ The server may be a mainframe, minicomputer, or powerful workstation. The server is centralized for access by many client machines. In principle and in practice, the server is a faster, more powerful machine than the client.

developing systems, specifying both the platform where the developers conduct their work, as well as how the system will later operate, when completed.

This definition of client/server development suggests many changes that are associated with — but transcend — the different hardware architecture: First, because software development occurs on a client PC or workstation, and since a graphical user interface (GUI) has become the dominant operating system interface for such client machines (such as Windows on the PC), then GUI-based application development tools can be utilized.⁵ These popular application development tools are implicitly part and parcel of the definition of client/server development, since this is where the productivity gains in developing client/server applications arise (Vaskevitch, 1993). In using a GUI interface and these application toolsets, some aspects of developing software code are easier and faster, compared to writing procedural computer code for mainframe systems.⁶ The overall system development methodology follows a more iterative, *prototyping* approach (Janson & Smith, 1985) in the client/server environment, rather than the structured and sequential system development methodology used for mainframes. Such prototyping (or rapid application development) is enabled by the flexibility of the GUI tools described above, which increase the speed and ease with which new versions of the system can be modified and generated. Such ease-of-use for developing software functionality allows non-technical employees (such as line managers or business users) to assume a more active role throughout the system development life cycle. Developing computer code does not require the knowledge of programming language syntax, and thus users can be more involved in the details of translating user requirements into

⁵ These GUI-based application development tools include Powersoft's *PowerBuilder*, Microsoft's *Visual Basic*, and other tools which are marketed as client/server CASE (*Computer Aided Software Engineering*) tools. Such CASE tools are not, by definition, client/server based. However, the vendors of many CASE tools have modified their products to create client/server systems, acknowledging that the client/server platform is here to stay. Some examples of CASE tools updated for creating client/server applications are Texas Instruments' *Information Engineering Facility (IEF)*, Andersen Consulting's *Foundation for Cooperative Processing*, and Oracle CASE.

⁶ Procedural code denotes any computer language where instructions to the computer must be specified step-by-step (procedurally), such as COBOL, Basic, Pascal, C, PL/1. According to Mead (1991), developing systems in a client/server mode is faster because more intelligence is embedded into the application development tools (such as Powerbuilder).

workable system code. Although expanded user involvement is not inherent in the definition of client/server technology per se (nor in the GUI toolsets), such changes in the division-of-labor are facilitated by the GUI tools.

Many IS departments have exploited this opportunity to include line managers and users more closely in the system development process, based on past experience showing that greater user and line manager involvement leads to better implementation outcomes (Barki & Hartwick, 1992; Ives & Jarvenpaa, 1991; Rockart, 1987).⁷ Lastly, while not a direct consequence of the client/server platform, the use of business process reengineering (BPR) was an innovation adopted in many firms concurrently with client/server development. BPR was not only a parallel (*concurrent?*) innovation, but provided synergies with the objectives of client/server development. Due to the opportunity for BPR to include users in the system design and implementation processes, and due to the need to deliver something workable and fast, there are many synergies between the objectives of client/server and BPR. (Both seek improvements by creating either systems or business processes, respectively, which are better, faster, cheaper, and more flexible). Thus, while BPR is not an inherent feature of client/server development, it represents the backdrop and paradigm within which most systems development occurred in the early 1990s, when this research took place.

In summary, while client/server *technology* has a distinct definition, client/server *development* includes a broader set of changes that are not intrinsically part of the technology platform. The latter process changes are either consequences of using the tools and methodologies facilitated by the new platform (the GUI development tools, prototyping methodology, and greater user involvement) or are shaped by the business and social context in which system development now occurs.

⁷ Whether these improved outcomes, in terms of system acceptance and use are due to better system designs or stronger levels of user commitment to the systems has not been resolved and is not relevant here. Regardless of the mechanism, such increased user and line manager involvement leads to visible improvements in system outcomes.

The importance of understanding these broader changes in the tools, methods, and context associated with client/server development is exemplified by the fact that most writers who reference the "skills" required to work in a client/server environment allude to these much broader changes in "philosophies, methodologies, technologies .. skills, communication patterns, and control structures" — as previously cited (Nance, 1994). These changes transcend specific knowledge regarding hardware explicitly contained in the phrase client/server *technology*. This broader set of skill and behavior changes to the context in which system development occurs may shed light on the difficulty of managing this transition, as predicted by technology experts (Tapscott & Caston, 1993; Vaskevitch, 1993).

The nature of the new system development paradigm includes changes in the coordination requirements for interpersonal and interdepartmental relationships within a firm, and often external partnerships with trainers, vendors, and consultants. These broader changes are foreshadowed but not documented in this chapter.⁸ Given these broader changes in the software development context, the transition from developing systems in the mainframe environment to the client/server environment encompasses far more than creating a training program to teach developers how PCs and networks operate, or explaining the difference between procedural languages and GUI development tools like *PowerBuilder*. The transition required for developers and IS project managers is not merely a technical skill change — although this is one hurdle. The fact that client/server development occurs within a context of greater user involvement requires that developers have stronger interpersonal, business, and system life cycle skills as well (Lee, Trauth & Farwell, 1995; Todd, McKeen & Gallupe, 1995; Ziff, 1993b). But even this broader definition of skills as knowledge that can be taught does not acknowledge the adaptations in behavior and processes that are required.

⁸ Additional evidence for these changes is provided in Chapter 2, which summarizes the literature on implementing IT innovations and described in Chapter 4, the field study data.

Training versus Reskilling

One additional comment about terminology is warranted. These fundamental changes in skills, abilities and work processes represent domains of learning and behavioral change that IS professionals cannot be simply "trained" to undergo. For this reason, the term "training" is rarely used in this dissertation. While it may be possible to "train" IS employees in the principles of what client/server technology *is*, the behavioral changes required for IS employees, their managers, and users to function in a client/server environment requires shifts in behaviors that cannot be "trained," but must be disseminated through management leadership, experience, and encouraging IS developers to model the behavior of experts. Many writers who have commented on the required changes in IS departments have used terms such as *reskilling*, *retooling*, *remaking* or *reengineering* IS employees and the organizations in which they work (Stokes, 1995; Ziff, 1993a; Vaskevitch, 1993). I use the term *reskill* (as in "reskilling IS professionals"), in part because it's the most common of these terms, but also because it provides some necessary ambiguity about *who* is doing the reskilling to whom — whether the agent is management, external consultants, or IS employees themselves.⁹

Lessons Learned between 1992 and 1997

The initial scenario in this chapter introduced client/server technology in 1992. It is now 1997, and client/server technology has been widely adopted as a platform for corporate application systems in most firms (Ross, Beath & Goodhue, 1994). Yet there still has been little academic research that describes the implementation challenges that organizations confront. Even today, the trade press fails to recognize the complexity of the individual and organizational changes required to transform the system development processes to exploit the benefits of the client/server platform. Unfortunately, the trade press still oversimplifies the

⁹ Use of the term *reskilling* also avoids the connotation of the terms *reengineering* or *retooling* with business process reengineering or configuring machine tools, respectively. Furthermore, use of the word *training* is reserved for those situations where there is a clear differentiation between the provider versus the recipients of learning. For other scenarios when not explicitly referring to formal classroom training, the phrase *learning activities* is used in this dissertation to suggest a more active role for IS developers themselves, and to encompass the broader set of processes in which IS developers engage to modify their knowledge and behavioral repertoire.

challenge by speaking of "training" IS professionals or "sending them to boot camp" (Computerworld, 1992) to achieve this transformation. I believe that this dissertation offers a bridge between the client/server development phenomenon and some of the accumulated insights from the management, IS and psychology literatures. I believe that this research offers a framework for understanding the complex changes in developers' competencies, work processes, expectations and rewards which the introduction of client/server development into an existing system development culture entails.

Chapter 2

Literature Review

Introduction

This chapter reviews the literature that is relevant to understanding how IS organizations implement technological innovations and how different employee characteristics may influence their reactions to these innovations. The objective is to draw upon research that has been conducted, both at the organizational level and at the individual level. I believe that the organizational-level and individual-level research each provide only a partial view of how individuals react and adapt to innovations that are implemented within organizations. I draw upon research from both levels in order to identify the components that can be used to construct a theoretical framework.

The structure of this chapter is as follows. First, I identify the importance of understanding changes in the nature of IS employees' jobs, then I portray such changes as resulting from the introduction of innovations in IS departments, known as software process innovations (SPIs). I define SPI, present examples, and review the literature on implementation of SPIs. These studies are grounded in the broader literature which has studied the implementation of technological innovations at the macro-organizational level. The contributions of this research are highlighted, while drawing attention to its limitations for understanding individual differences in terms of adaptation to technological innovations. Examples of individual differences are suggested, drawing upon observations from both academic research and the IS trade press.

The last part of this chapter summarizes research that examines the micro-level predictors of job satisfaction and performance in the workplace. Drawing upon research from both management and IS literature, a progression of theories are summarized, while underscoring the chronological progression of these increasingly specified models. By reviewing first the macro-level literature on technology implementation and then the micro-level literatures

individual adjustment to the workplace, this chapter suggests potential gaps in each set of studies, which can only be remedied by joining their contributions into an integrated framework. In particular, the micro-level theories of employee fit to the workplace are static frameworks that have not attempted to model changes that occur in job requirements, in response to triggers (such as technological innovations). This prompts a set of questions regarding how organization-level literature may be combined with the micro-level literature to develop an integrated framework which can explain the factors that determine individual attitudes and responses to technological innovations that are adopted by the firms in which they work. The actual synthesis of these ideas is deferred until Chapter 3, which introduces the *Theory of Work Adjustment* as the source for such an integrated theory.

Research on the Changing Roles and Requirements of IS Professionals

There has been considerable research on the topic of IS careers and related issues over the past decade. Recently, several authors have noted the fundamental changes that are ongoing in the skills, work processes, and personal attributes required for IS professionals (Farwell et al., 1992; Leitheiser, 1992; Watson et al., 1990; Green, 1989). Researchers have suggested that these changes have the potential to render previous findings on IS professionals and careers obsolete. For example, Myers (1991) identified a new breed of IS employees which she labelled *nontraditional participants* — those who may not share the same motivations and personal attributes as the traditional IS employees studied by Couger & Zawacki (1980) or Ferratt & Short (1986). Smits, Tanner & McLean (1994) suggested that a new type of worker may be entering the IS field, one who values interpersonal skills, working in groups, and service to the organization over technical sophistication. In addition to the new skills and attributes, the roles for IS professionals are predicted to change as well. Keen (1992) suggested that future roles will consist of four *career trajectories* — business support, development support, business services, and technical services, each requiring a different combination of skills. These findings are all variations on the theme that change is coming to the IS workplace and that the future will be different from the past.

While several studies have offered predictions for the impending changes in skill requirements, roles, and work environment of IS professionals, there has been less attention to how the current generation of IS professionals will weather these shifts. How will these changes affect those IS employees who currently occupy these jobs? Can existing IS professionals meet the challenges posed by these changes, or is a new generation of IS workers required? If the existing workers can adapt to the changing requirements, what must occur to facilitate this transition?

While there is a descriptive literature on the changes being made to the IS organization, there has been little research explaining what skills, capabilities or employee attitudes are necessary to succeed in accommodating these changes. The literature on IS careers is notably silent on the issue of what processes and factors influence how IS professionals adapt to such changes in their jobs over time.

Despite a growing literature describing the changing IS skill requirements and new personality attributes necessary for effectively deploying IT within organizations (Leitheiser, 1992; Green, 1989), the literature on IS skills has been largely atheoretical. It is primarily descriptive in nature, offering neither a theory of technology-based change, nor a framework of individual learning. Nevertheless, there is one research stream that has explored such changes from a theoretical standpoint -- the adoption of new tools and methods for software development. These new approaches have been labelled *software process innovations* (SPIs).

Software Process Innovations

Fichman & Kemerer (1994) defined software process innovations (SPIs) as "changes to an organization's process for producing software applications — changes in tools, techniques, procedures or methodologies." Examples of SPIs that have been studied include integrated-CASE tools (Gallivan, Hofman, and Orlikowski, 1994; Orlikowski, 1993; Sumner, 1995), structured development methods (Leonard-Barton, 1987; Goldstein, 1982), and more recently, object-oriented development (Fichman & Kemerer, 1993).

Research on the adoption of SPIs has shed light on the organizational requirements for implementing change and the processes through which implementation occurs. Although an SPI is adopted as a firm-level innovation, it may exert effects at the individual, group, and organizational levels. For example, one obvious individual-level change is the acquisition of new skill sets among IS employees. In addition, there are other, indirect consequences of SPI adoption, such as the creation of new specialist roles for IS professionals or users, new organizational structures, new coordination requirements, and possibly even a new profile of employee that is required to achieve proficiency in the new work environment.

Research on Software Process Innovations

Studies of SPI implementation have suggested frameworks to explain why some organizations adopt certain SPIs more readily, why their objectives may or may not be achieved, and how the implementation process can influence the degree of the innovation's acceptance. Two frameworks for analyzing SPI implementation at the organizational level have been suggested by Fichman (1995) and Orlikowski (1993). Fichman (1995) studied firm-level adoption of object-oriented development, investigating this SPI in terms of the *knowledge burden* it poses to IS departments. Building on diffusion of innovation theory (Rogers, 1983; Kwon & Zmud, 1987) and organizational learning theory (Attewell, 1992), he argues that successful assimilation of change requires a firm to possess sufficient prior knowledge or *absorptive capacity* (Cohen & Levinthal, 1990). Such related knowledge facilitates the adoption of the SPI by reducing the knowledge barriers inherent in the innovation. This framework helps to explain SPI adoption and assimilation at a *macro* level, by analyzing the aggregate knowledge and capabilities of a firm's IS department as a whole.

Another organization-level framework for understanding SPI implementation was suggested by Orlikowski (1993), who analyzed the implementation of CASE tools in two organizations. This framework emphasizes the processes and factors that shape the outcomes of technology adoption. Field studies revealed that important determinants of these outcomes were the context in which the adoption occurs, managerial intentions for the innovation, and actions

of key stakeholders during implementation. Certain innovations are adopted by firms with the expectation of *radical* shifts in the work processes and the products delivered by IS departments. In cases of radical change, the consequences are less predictable in terms of the new skills required or the balance of power between IS and business areas (or within the IS department itself). Conversely, when implementing a SPI where managers' intentions represent only *incremental* shifts in technical skills and work processes, the outcomes are more predictable and pose less risk to the organization. Although the outcomes are less predictable when the nature of change is radical, these changes are perceived differently by different employees and potential disruptions can be managed through foresight which, under certain conditions, will benefit from a gradual implementation pace even when the nature of change is radical (Gallivan, Hofman & Orlikowski, 1994).

Each of these frameworks was developed to explain the process or outcomes of SPI implementation at the organizational level. This chapter reviews the research on whether individual attributes of IS professionals and the changes that occur in work processes and skills can explain differences in individual attitudes to, as well as their adaptation to, the innovation. Is it possible at the *individual* level to identify attributes and learning processes of IS professionals that can explain successful assimilation of the SPI?

Although neither were developed specifically to address differences between individuals, in terms of their reactions to the SPI, the frameworks offered both by Fichman (1995) and Orlikowski (1993) highlight the importance of new technical knowledge to the IS professionals who will use the innovation in their day-to-day work. Both of these frameworks are consistent with other research that has been conducted on the adoption of technological innovations. Fichman's research emphasizes that the firm's ability to acquire the necessary knowledge to deploy the technology depends on its past stock of knowledge (absorptive capacity). Orlikowski's research shows that, in addition to technical skills, the nature of the work process may be changed by the innovation, partly in response to the features and

limitations of the innovation, and partly in response to the managerial intentions and the implementation strategy pursued within the firm.

These frameworks both support and build upon prior research conducted on effects of IT implementation more broadly. Research conducted by Barley (1986, 1990) Markus (1983), and Zuboff (1988) has shown the *emergent* or unexpected changes that can occur when technology is implemented into work environments. Any technological innovation will have specific effects which depend on the local context into which it is introduced (Barley, 1986), and may often trigger different changes within the same organization, depending on factors at the group/department level, such as the work orientation of the department manager (Kaplan & Duchon, 1988), or individual differences in the types of employees who adopt the technology. Orlikowski (1989) identified different user expectations toward the technology and how it would influence their jobs, drawing a contrast between employees who perceived themselves as technologists (whom she labelled *process-oriented*) and employees who perceived themselves as business consultants (labelled *results-oriented*). While the differential outcomes among these different employees may not have been anticipated by management, such differences are understandable, viewed through the lens of motivation and need-based theories. Such theories described differences in employees' needs and values in the job, and hence, should be able to explain — or even to anticipate — differential reactions from employees. It is, thus, critical to understand both the individual-level factors (employee needs and values) and also the organizational context as shaping the outcomes of technology implementation.

Longitudinal and multi-level research designs (Markus & Robey, 1988) are valuable in combining an understanding of the context, managerial intentions, implementation processes, and individual responses to technology innovations. Markus & Robey argue that:

We believe that mixing levels of analysis may be useful in research and theory on IT and organizational change. [Such] technologies are neither strictly micro nor macro in

character [and] should abound in an interdisciplinary field where mixed-level phenomena are the inevitable subject of study.

— Markus & Robey, 1988: 594.

Differences between Individual and Organizational-Level Innovations

The section below reviews the literature from the micro-level studies conducted in the fields of psychology, organization studies, and IS. Before introducing such micro-level theory, it is critical to acknowledge that this dissertation focuses on the process and outcomes of SPIs as a class of innovations adopted at the *organizational* level. While it is indeed possible for an SPI to be adopted at the individual level — through voluntary individual adoption (Brancheau & Wetherbe, 1990) — this research considers instead situations where such innovations are adopted and implemented at the company level — meaning the decisions and intentions are set by senior management — and then management determines which departments and individuals should use it. Adoption in this sense is not voluntary, but rather subject to organizational mandates. Other technology researchers avoid the political assumptions inherent in the term "mandate" — instead using euphemisms such as *managerial influence* (Leonard-Barton & Deschamps, 1988), *social influence* (Ajzen & Fishbein, 1980), *social norm* (Taylor & Todd, 1995), or *authority innovation decisions* (Zaltman, Duncan & Holbeck, 1973).

Thus, there is a tradition of acknowledging that technological innovations may be introduced in organizations without any latitude for the individual to voluntarily choose whether to adopt (Agarwal, Tanniru & Wilemon, 1996; Fichman, 1992). This also justifies why conceptual frameworks based on the assumption of individual adoption are *not* used here — such as classical diffusion theory (Rogers, 1983), the Technology Acceptance Model (TAM)(Davis, 1989), or the theory of trying (Bagozzi, Davis & Warshaw, 1992). Although some of these theories have been widely used for understanding technology adoption and usage, they are

inappropriate when users are mandated to use the innovation. Both classical diffusion theory and the TAM implicitly assume adopter voluntariness, assumptions that are inconsistent with the actual political dynamics and strategies that are followed when implementing SPIs in organizations (Fichman, 1992; Agarwal, Tanniru & Wilemon, 1996; Gallivan, 1996).

Conceptual frameworks have not yet been developed for understanding individual user responses to such innovation mandates in the workplace. Whereas the macro-level SPI literature (reviewed above), has described the emergent consequences of adopting an SPI and the potential knowledge barriers that may prevent organizations from using it successfully, this literature has also suggested some differences among individuals, which may explain subsequent attitudes and behavior. Orlikowski suggested one possible individual factor — which she labelled a *process orientation versus results-orientation* (1989: 202-205), a distinction that was also critical in Kaplan & Duchon (1988).¹ Zuboff (1988) argued that individual capabilities — the ability to develop complex "mental maps" of the technology's influence on work processes and controls — are an important determinant of users' reactions to technological innovation. In her work, Zuboff (1988) showed that IT has the power to change work, "informating" it by endowing it with potentially complex information. Some employees have the necessary cognitive (or "intellective") capabilities and motivation to work in this new environment; others may not. Through studying the changes in work processes due to technological innovations, both Orlikowski and Zuboff have identified possible elements for developing such a theory of individual-based outcomes. My objective in the remainder of this chapter is to merge their insights with related research at the individual

¹ Kaplan & Duchon (1988) reported this distinction as a group- or department-level variable. They interpreted an individuals' work orientation as consistent within a workgroup, but not across departments, resulting from the department manager's priorities.

level of analysis to identify all the components required for such a theory of individual response to technological change.

Frameworks for Explaining Individual Job Attitudes and Fit

The following sections identify individual level frameworks that have been developed to explain individual reactions to the work environment. A progression of frameworks is summarized below, starting from the most rudimentary and proceeding to the increasingly sophisticated. One common feature of all these frameworks is that they are static, they do not attempt to model individual change processes over time, nor do they explicitly represent technological innovation or other exogenous forces which may trigger changes in individuals' jobs. Since most of these theories have used job satisfaction and turnover intentions as outcome variables, this section identifies the independent variables (work environment, attitudes, and personality traits) that are associated with these outcomes (job satisfaction and turnover intentions).² These frameworks have progressed over time from very generic, coarse-grained models to more fine-grained, specific predictors of individual fit to the work environment. As researchers have built upon prior theories, their frameworks have become both more specific and more complete in describing job characteristics, employee attributes, and the degree of correspondence (or mismatch) between them.

During the 1960s and 1970s, managers and researchers were concerned with questions of how to create a satisfied workforce — and by extension — a productive one. They turned their attention to explaining the determinants of job satisfaction. Four major classes of theories evolved during this period, and each continues to be widely used today. These theories are:

² There has been less emphasis on developing individual level theories of job performance. Most research acknowledges that the precursors to job satisfaction and performance are independent (Brayfield & Crockett, 1957; Herzberg, Mausner & Snyderman, 1959), and therefore models explaining job satisfaction cannot be assumed to predict performance.

1) individual personality traits; 2) structural job features (attributes inherent in a job); 3) employees' career orientations; and lastly, 4) job characteristics. While each of these theories is historically important and has its proponents today, none of these frameworks provides a complete understanding of individual fit to the job. As will be shown below, each single theory has provided a taxonomy for characterizing jobs, employee needs, and other personality traits, but none has acknowledged and developed a framework to integrate all three simultaneously. It is only in recent years that organizational researchers have developed more complete frameworks for understanding the correspondence among all three variables (Edwards, 1994, 1995; Dawis & Lofquist, 1994).

Research on Individual Personality Traits

Kahn et al. (1962) studied a range of personality traits to determine their effect on job satisfaction. Using broad-based personality scales,³ results collected across dozens of job categories showed that specific personality traits had consistent relationship with job satisfaction. For example, Kahn et al. (1962) showed that extraversion was associated with higher job satisfaction than was introversion. Other personality traits such as cognitive flexibility were similarly associated with higher satisfaction. While not proving the causal linkage among traits and job adaptation, this research was a first step toward understanding how individual differences — assumed to be stable over time — can influence outcomes such as job satisfaction and performance turnover intentions. Similar research continues today, arguing that stable personality traits may lead to relatively consistent outcomes — both for satisfaction (Staw, Bell, & Clausen, 1986; Staw & Ross, 1985) and job performance (Tett, Jackson & Rothstein, 1991). One assumption of this research is that it is not necessary to examine the relationship between personality traits with certain types of jobs. This research

³ Including the *Minnesota Multi-phasic Personality Inventory* (MMPI) and *California Personality Inventory* (CPI).

does not examine other factors, such as individual job preferences, or their fulfillment in a particular work environment. This is one potential limitation of such dispositional or trait theories — since they do not attempt a correspondence between individual traits and specific jobs. Finally, other researchers disagree with the trait theorists — instead arguing that individual skills and cognitive attributes depend on the situation in which they are exercised (Lave, 1988; Suchman, 1987).

Structural Job Features

Some initial research in this area investigated the effects of different structural features of jobs, such as differences in management levels (Miles, 1976), different job types (Igarria & Greenhaus, 1992), and features of the job — such as those with boundary-spanning responsibility. Miles showed that senior managers enjoyed greater job satisfaction compared to either first-line managers or non-managerial employees. Other research studied the influence of role stress on job satisfaction (Kahn et al., 1962; Katz & Kahn, 1978).

Another structural job attribute that has been shown to contribute to role conflict is *boundary-spanning*. Boundary-spanning is defined as serving at the interface between an organization and its external environment (e.g., customers), or between two or more sub-units within the organization. IS employees who work directly with users, line managers, or vendors are, by definition, boundary-spanners. High levels of boundary-spanning activity have been shown to be negatively associated with job satisfaction (Keller et al., 1976), although the relationship is somewhat complex. A job with boundary-spanning activity is associated, in general, with lower job satisfaction, due to greater role conflict that results from requirements to interface across boundaries — in effect, from serving two sets of masters. Since jobs with a boundary-spanning features usually have more role conflict (which is itself directly linked to job dissatisfaction), it is noteworthy that such jobs, at times, have shown a paradoxical effect:

despite the greater role conflict, such boundary-spanning positions often lead to more challenge, and hence greater task variety and job commitment. The same features that make the job more stressful (due to role conflict) also make it more interesting and challenging.⁴ While this paradoxical result could arise from differences between individuals who occupy boundary-spanning roles — since some like the added challenge and others do not — such differences have not been explicitly addressed by the research (Miles, 1976; Igarria & Greenhaus, 1992). Baroudi (1985: 352) concluded that the traditional assumption of boundary spanning as creating stress and frustration for workers:

... does not accurately reflect the true relationship between [boundary-spanning, role conflict and job satisfaction] ... While boundary spanning does have a negative effect via role conflict, it ... is possible that the model should be expanded to explicitly include job characteristics such as job interest and job autonomy which boundary-spanning may enhance, thus increasing job satisfaction.

Beyond the research on boundary-spanning activity, other research has been conducted on the impacts of role conflict and ambiguity. There has been considerable research on employees' perceptions of *role stress* — specifically role conflict and role ambiguity.⁵ Both constructs have been widely studied among IS employees and consistently shown to be strong predictors of jobs dissatisfaction and turnover intentions (Baroudi, 1985; Guimaraes & Igarria, 1992). Of the two constructs derived from role theory (Kahn et al., 1962), role ambiguity has been shown to have more deleterious effects (Baroudi, 1985), while role conflict has weaker, but also harmful effects. This research stream has demonstrated that structural job features are predictors of job outcomes (such as job satisfaction and turnover intentions), although

⁴ This paradoxical result could only be determined through path analysis, where the unexplained residual variance between boundary-spanning and satisfaction (Baroudi, 1985) suggests a positive feature of such jobs. Path analysis shows that boundary-spanning activity has both a direct effect on role conflict, which reduces job satisfaction and commitment, but it also has a direct positive effect on commitment.

⁵ Role stress is the generic label employed by Kahn et al., (1962) and subsequent researchers to include both role ambiguity (perceived unclear role expectations) and role conflict (perceived contradictory expectations).

admittedly these studies have not made allowances for individual differences among employees.

Understanding Individual Job Needs through Career Anchors

A related framework that recognizes differences in individual needs and values is Schein's career anchors theory. Schein (1978, 1990) proposed that employees have a variety of needs that they seek to satisfy in their jobs — proposing a typology of eight different career *anchors*.⁶ IS researchers applied Schein's theory to the motivations of IS professionals (although renaming the framework as the career *orientation* framework). For example, IS researchers (Baroudi & Igbaria, 1992; Delone, 1987) documented six different career orientations for IS professionals (similar to Schein's categories but combining some categories and adding geographic stability). In both the organizational and IS literatures, there has been substantial support for the career anchor framework: for employees whose career anchors corresponds to their present jobs, their job satisfaction level is higher than that of employees who lack such a fit between their needs and the characteristics of the current job (Baroudi & Igbaria, 1992).

The application of the career anchors framework to the IS literature has been limited by the fact that it did not measure the actual characteristics of IS jobs, but rather assumed that employees with similar titles have the same jobs (i.e., they perform the same tasks). For example, employees with the title of "systems analyst" at different firms are assumed to have identical jobs, although this may not actually be the case.

Describing Job Attributes (The Job Characteristics Model)

Specific job characteristics have been shown to determine employee job satisfaction. Hackman (Hackman & Oldham, 1976; 1980) developed the Job Characteristics Model (JCM)

⁶ These eight career anchors are: technical/functional competence, general managerial competence, autonomy/independence, security/stability, entrepreneurial creativity, service/dedication to a cause, pure challenge, and lifestyle.

which identifies employee satisfaction based on the degree of challenge in a specific job. Hackman labels a job's inherent degree of challenge as its *motivating potential score* (MPS), based on a calculation involving five factors: autonomy, inherent feedback from the job, skill variety, task significance, and task identity (having a *whole* job to complete). Hackman's theory rests on two assumptions, namely that these job characteristics can be objectively measured, and that all employees want jobs with high MPS. The theory predicts that employees are more satisfied in jobs that contain these five features. Such jobs have, by definition, a higher MPS, and lead to higher job satisfaction. Over two decades, Hackman has applied his theory to show that higher MPS is, in general, associated with higher levels of job satisfaction (Hackman & Oldham, 1980; Hackman & Walton, 1990). Hackman's *job characteristics model* has been widely adopted by researchers in both organizational and IS literatures. The theory's assumption that all employees want jobs with a high MPS is problematic, however, since some employees may value job security (or another of Schein's career anchors) over challenging work.

Job characteristics theory was, arguably, the first example of a "correspondence theory" (Chatman, 1989; O'Reilly, 1977), that is, a theory which predicts outcomes resulting from a fit between the individual and the job. The correspondence in Hackman's framework, however, is between the characteristics of the current job and employees' need for challenging work. The latter construct was assumed to be high for all employees (they all desire challenging work), a doubtful assumption. Subsequent research, building on Hackman's framework, re-examined this assumption by directly measuring employees' need for challenge, borrowing the concept of *growth need strength* (GNS) from McClelland's motivation theory (1967). In the IS field, Couger and his colleagues (Couger & Zawacki, 1980) have elaborated upon job characteristics theory. Couger studied the importance of a job's MPS in predicting job satisfaction, while explicitly measuring individual's GNS and other preferences — such as need for social interaction (social need strength or SNS). Couger's findings showed that IS employees' GNS must correspond with the job's actual MPS in order to produce job satisfaction. Subsequent studies have validated Couger's

predictions among different classes of employees, such as IS programmer/analysts (Couger, 1980), data processing operations (Couger & Zawacki, 1979a), maintenance programmers (Couger & Colter, 1985) and programming managers (Couger & Zawacki, 1979b).

Within the IS literature, Couger's framework was the first correspondence framework, demonstrating that satisfaction results from the fit between the individual's need for challenge (GNS) and the job's characteristics (MPS). Like Schein's career anchors theory, Couger's framework is a correspondence theory between individual needs and job characteristics. Given the requirements for correspondence, a mismatch can occur when the job's MPS is either too high or too low for the employee, leading to dissatisfaction. A case in point is the work of maintenance programmers, whose job dissatisfaction often results when this low MPS job is occupied by individuals with high GNS. Because their GNS (need for challenge) is *too* high for the job, such individuals are poorly matched to the job (Couger & Colter, 1985). The resolution to this problem is either to use the principles of Hackman's job characteristics model to redesign these jobs so they are more challenging (Hackman & Oldham, 1980), or to screen potential job candidates, in order to select employees with an appropriate level of GNS for these positions.

Couger's contribution beyond Hackman's initial framework is to suggest a more fine-grained model, one that allows for and measures the diversity of employees along two dimensions of low to high GNS and SNS. Couger's framework measures employees' needs along these two primary dimensions, and then identifies the degree of fit between the employee and job.⁷

Summary of Individual Level Frameworks

As these frameworks have progressed from initially rudimentary, coarse-grained to more elaborate frameworks, they have become more specific in identifying different types of

⁷ It was notable that Couger (1981) showed that IS employees have the highest growth need strength (GNS) of any occupation but the lowest social need strength (SNS, or need for social interaction) compared to dozens of other occupations. The only profession with lower average SNS was forest rangers, based on comparative data.

employees, based on their level or type of jobs (Miles, 1976; Guimaraes & Igarria, 1992), their specific need for challenge and social interaction (Couger, 1980), based on other individual values, such as career anchors (Schein, 1978; 1990).

This chapter has summarized both organizational-level and individual-level research. The organizational-level theories reviewed above examined the influence of SPI adoption, and other technology implementation — on employees' skill requirements, their orientation to work, and their work processes. While these frameworks did not explicitly test the importance of individual differences in explaining outcomes, they nevertheless suggested certain areas for investigation. In building theory about the importance of individual attributes, the studies identified employees' perceived work orientation (Orlikowski, 1989; Kaplan & Duchon, 1988), ability to develop complex "mental maps" (Zuboff, 1988), and absorptive capacity based on prior knowledge and skills (Cohen & Levinthal, 1990; Fichman, 1995) as influencing employees' adjustment to new technologies.⁸

The individual-level frameworks reviewed also identified a variety of explanatory variables for understanding employees' job outcomes. These frameworks suggested the importance of structural aspects of jobs (such as boundary-spanning or managerial level), and the additional job characteristics and the employees' need for challenge (growth need strength) and need for social interaction (social need strength). Other frameworks considered differences in needs and values among employees, in terms of employees' career orientations (Schein, 1975). As argued at the beginning of this chapter, each of these individual level frameworks contributed an additional component to understanding correspondence between individuals and their jobs, although no single framework incorporated a comprehensive understanding of job characteristics, employee needs, and other personality attributes. Finally, none of these frameworks explicitly modeled the influence of technological innovations on employees and

⁸ Although absorptive capacity was initially defined as a firm-level construct (Cohen & Levinthal, 1990), it may be extended to the individual level of analysis.

their job requirements, nor did they attempt to explain the variables that affect job performance.

Chapter 3 focuses on assembling these disparate components into a comprehensive framework of individual response to technological change, drawing on the *Theory of Work Adjustment* (Dawis & Lofquist, 1984) as the source for such a theory. Chapter 3 includes many of the constructs presented in this chapter (employee, task, and job environment attributes) to suggest an integrated framework of the determinants of employees' job satisfaction, performance, and turnover potential.

Chapter 3

Theoretical Framework

The prior chapter reviewed the existing IS and management literatures, classifying all prior theories into organizational-level and individual-level theories. This chapter articulates a conceptual framework that explains individual adaptation to the changes required by new software process innovations (SPI), such as client/server development. Although it may be possible to translate one of the macro-level theories to explain micro-level processes, by modifying constructs such as *absorptive capacity* (Cohen & Levinthal, 1990) or *knowledge barriers* (Fichman, 1995) to fit the individual level of analysis, the approach in this research is to begin with a *micro-level* theory that describes an individual's fit to the work environment. Then, by modifying the framework to incorporate technology as a trigger for changes to the skill requirements and associated work processes, the framework will provide an explanation of individual adaptation following SPI implementation.

Differences between Individual and Organizational-Level Adoption of Innovations

It is important to emphasize that the phenomenon under investigation — SPI adoption within IS departments — occurs at the level of the IS department or group level, not at the individual level. For this reason, the desired framework must consider the organizational context as important, and the resulting framework will differ from diffusion of innovation theory (Rogers, 1983) or other theories of individual technology adoption and usage (Brancheau & Wetherbe, 1990; Davis, 1989; Bagozzi, Davis & Warshaw, 1992). Such theories are inappropriate because they assume *voluntary* individual adoption of the innovation, but an SPI is a strategic shift that occurs at the organizational level. Following organizational adoption, individual training and use of the innovation are often mandatory. Thus, the focus of this research is on the individual adjustment to and assimilation of an SPI which is adopted by the IS department.

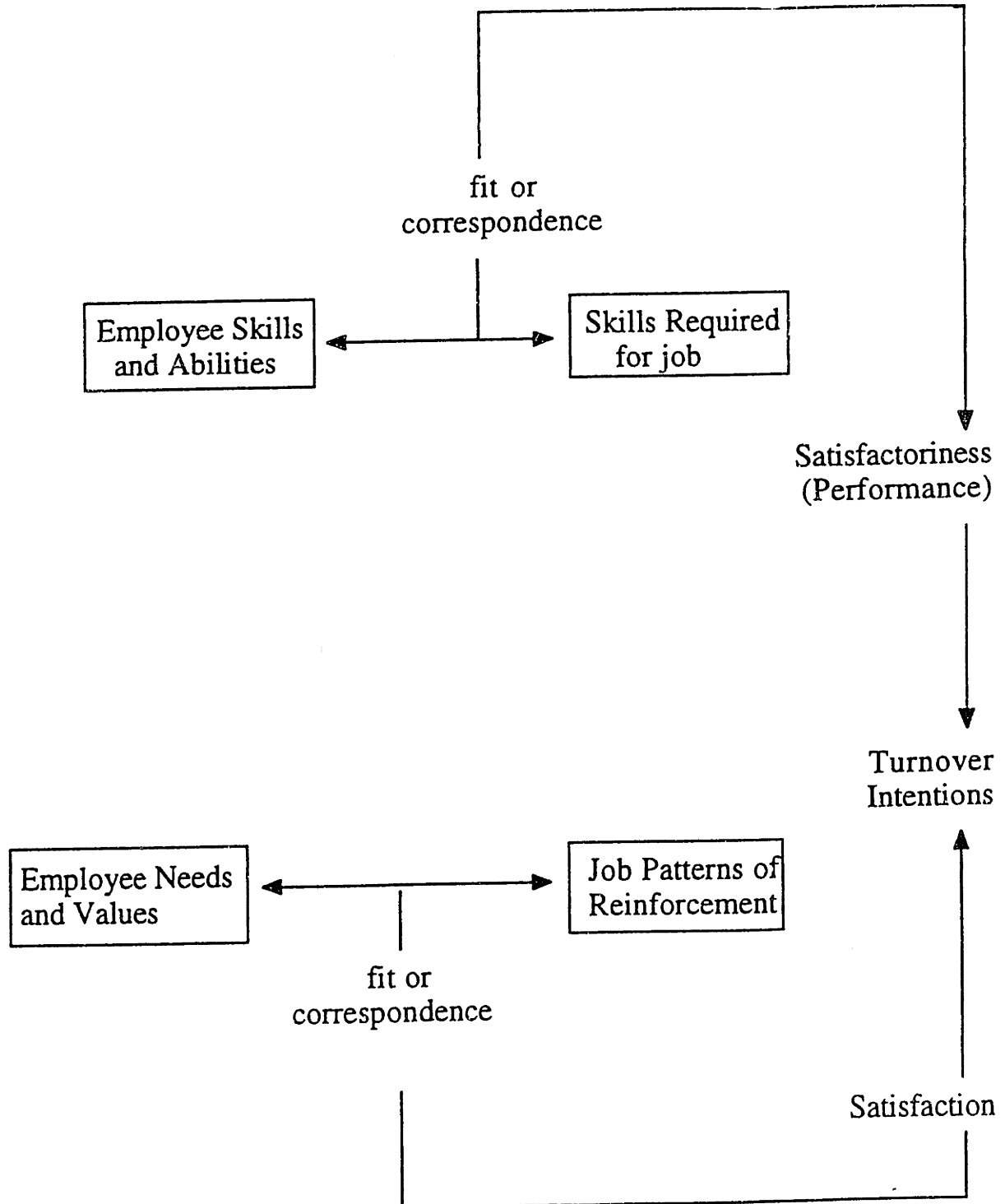
The Theory of Work Adjustment

The *Theory of Work Adjustment* or *TWA* (Dawis & Lofquist, 1984; 1994) proposes a model of person — environment fit that explains individual job satisfaction and performance as resulting from the fit between the person, the task, and the work environment. Based on the degree of fit, the TWA predicts three outcome variables: employee satisfaction, job performance, and job tenure (or turnover). The TWA was developed at the University of Minnesota to explain employees' fit to prospective or current jobs. The TWA is an example of a class of theories called *correspondence* theories, which have been widely used in the organizational literature (Caldwell & O'Reilly, 1990; Chatman, 1989) to predict certain outcomes as resulting from the fit between the person and the environment. Several studies have used the TWA to evaluate their employees' adaptation either retrospectively or prospectively. Although the TWA has not been formally tested in the IS literature it has been applied to other technical professionals (Seiler & Lacey, 1973). In addition, certain constructs from the framework have been adapted and used in the IS careers literature (McLean, Tanner & Smits, 1991; Smits, McLean & Tanner, 1993) and in IS research examining task-technology fit (Goodhue, 1994, Goodhue & Thompson 1995).

The TWA was originally developed by Dawis & Lofquist (1971) as a static model to assess the fit between a prospective employee and a specific job at a certain point in time. The theory has since been expanded, however, to serve as a process theory explaining individual adjustment and job search behavior over time. Researchers have conducted longitudinal studies using the framework (Bizot & Goldman, 1993; Breeden, 1993) to complement the many studies that have used it as a static framework (Pervin, 1993; Hackman & Kulik, 1993).

The relationships among constructs in the TWA are illustrated in Figure 3.1. The TWA assumes that two dependent variables (employee satisfaction and performance) are each determined by the fit between a pair of independent variables: employee satisfaction is determined by the fit between an employee's needs and values and the *reinforcer pattern* provided by the job and the work environment. Job performance (or *satisfactoriness*)

Figure 3.1
The Theory of Work Adjustment



is determined by the fit between the employee's skills/abilities and the job requirements. The TWA does not posit a direct link between job satisfaction and performance, although both satisfaction and performance determine job tenure or the converse, turnover intentions.¹

Applying the Theory of Work Adjustment to Implementing Software Process Innovations

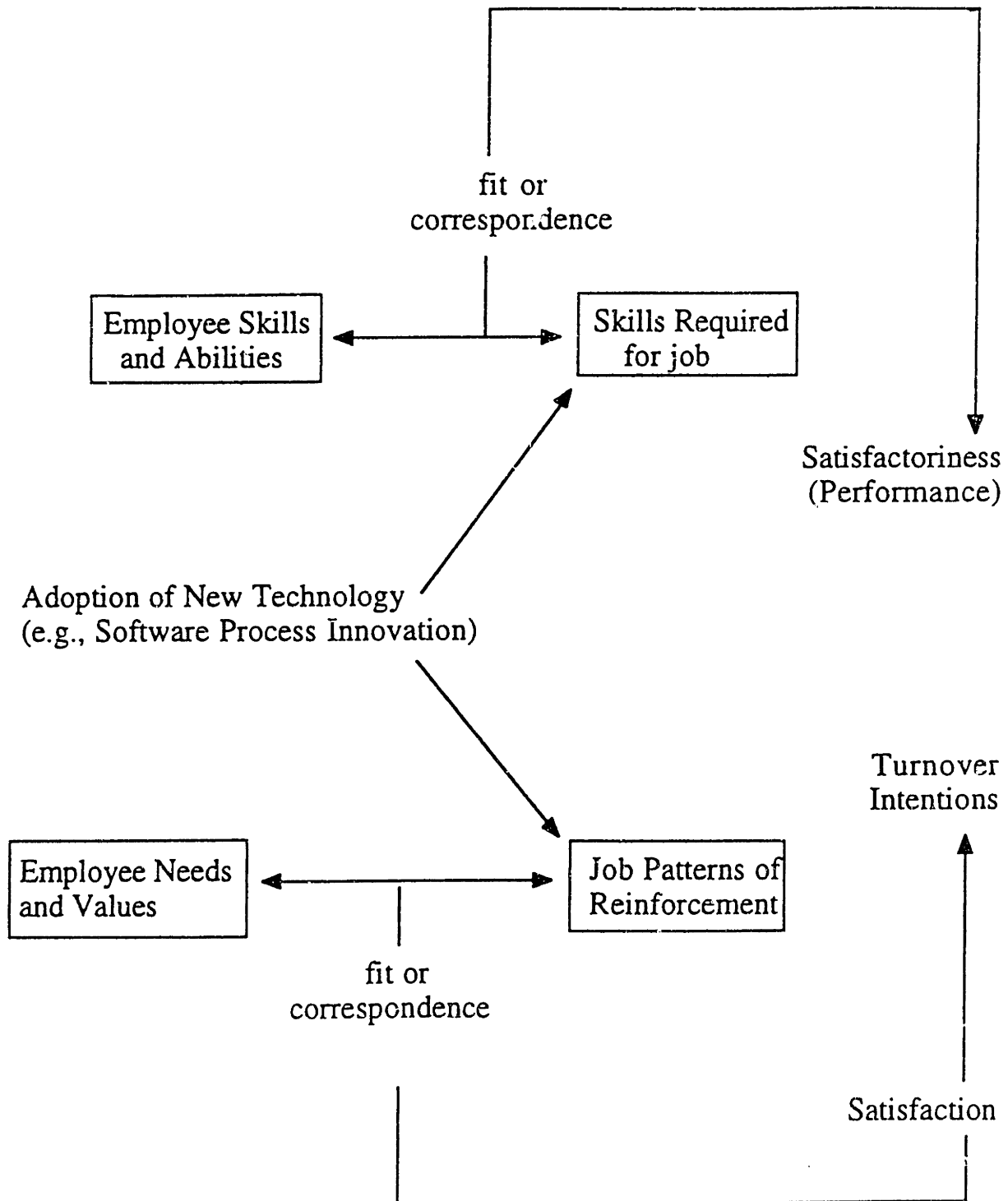
The scenario below demonstrates how the TWA can be used to explain individual adjustment to an SPI, such as client/server development. Because the TWA was developed as a theory of individual fit to the work environment rather than as a theory of innovation, technological change is not *explicitly* represented in the framework, however it is *implicitly* represented since many of the independent variables may be influenced by technology adoption (e.g., job requirements and employees' skills and abilities). Figure 3.2 presents these relationships explicitly.

Several variables may be influenced by technology adoption, through the technology's impact on changes in the work processes (reinforcer patterns). The TWA is an equilibrium model that explains individual job satisfaction and performance. As an equilibrium model, this framework assumes that balance is desirable and should be maintained. Balance does not imply stasis, but rather a dynamic correspondence among components. Equilibrium can be disturbed, in the short term, by adoption of new technology. Such technology adoption is an exogenous event that occurs outside of the framework and can potentially alter the equilibrium among the framework's components. For example, once a technological innovation (such as client/server development) is adopted, skill requirements change leading to a potential mismatch between an employee's existing skills and those skills required to learn and employ the SPI in their day-to-day work.

¹ The relationship between satisfaction and performance in the TWA is complex. According to Dawis & Lofquist (1984:227), satisfaction moderates the relationship between performance and turnover, while performance moderates the relationships between satisfaction and job tenure. Specifically, this means that where employee satisfaction is high, the size of the correlation between performance and job tenure will be larger than the correlation where satisfaction is low. In an analogous manner, job performance moderates the relationship between satisfaction and job tenure: that is, for high performers, the size of the correlation between satisfaction and tenure will be greater than for low-performers.

Figure 3.2

The Theory of Work Adjustment
as Applied to Software Process Innovations



Unless the employee has prior experience with the SPI, it is likely that *some* skills mismatch will exist at the time of adoption. The degree of skills match or mismatch at the time of SPI adoption depends on several factors, including the employee's job duties, management's intentions for using the SPI,² and the employee's prior related knowledge. If no action is taken to remedy such gaps, this discrepancy between skills required and skills available may lead to a deterioration in employee performance.

When introducing a new technology, management will often take steps to remedy the gap during implementation of the SPI — for example, offering training classes for employees or hiring new developers with prior experience using the SPI. These actions may serve to reconcile the skill gap. Training may reduce the skill gap for existing employees; hiring new employees already experienced with the innovation may also serve to remedy the gaps — but only if the new hires work directly with existing employees, *mentoring* them to facilitate their learning of the innovation.³ It is only for those employees who are unable or unwilling to learn the SPI that the initial skill gap (at the time of SPI adoption) will lead to a deterioration in performance. The likelihood of job turnover will increase for such employees. Similarly, their likely job tenure will be reduced, since they may voluntarily choose to move to a new position more compatible with their skills; they may also be asked to leave involuntarily.

The scenario above traced the effects of SPI adoption on job requirements and employees' skills and abilities, showing how the fit between them can influence job performance and job

² Skill requirements for employees may change depending on management's intentions for using the SPI — that is, management's intentions for which employees will use the SPI and how they will use it. The skills required to use the SPI may differ for various job categories. For example, in adopting client/server development, the new skill requirements may vary across job categories (e.g., application developers, maintenance programmers, project managers, and database administrators).

³ The use of the term *mentor* differs from the traditional concept of a mentor as a senior colleague who serves as a role model to guide a younger employee's career path. As used here, the mentor refers to a person experienced in using a particular SPI, who assumes a role of guiding others, offering advice and informally leading the project. The use of the term mentor has become widely used in this context, especially in the training literature and in research on implementing another SPI (object-oriented development). For example, articles appearing in the trade press by Ballou (1994), Engler (1994) and Asbrand (1994) discuss the benefits of mentors.

tenure. There is an analogous correspondence relationship between employees' needs and values and fulfillment of them through the *reinforcer patterns* of the job. When a technological innovation is implemented there can be many associated changes in work processes which may satisfy or conflict with employees' needs and values. Such changes in work processes, power dynamics, and social relationships resulting from new technologies have been demonstrated in field studies by Barley (1986, 1990), Markus (1983), Orlikowski (1993), and Zuboff (1988). Such changes are labelled changes in *job reinforcers* in the terminology of the TWA, and may be positively or negatively perceived by different employees. Depending on how the fit between employees' needs and values and job reinforcers changes, this may alter employee job satisfaction either for the better or worse. This, in turn, may lead to changes in turnover intentions and job tenure.

Advantages of the Theory of Work Adjustment

The TWA has several attributes which make it useful for analyzing individual responses to organizational adoption of a SPI. First, the TWA does not assume that all employees are identical, but allows for individual differences in skills, abilities, needs, and values. Second, the TWA includes outcome measures that are meaningful to both IS employees and to managers (satisfaction, performance, and job tenure). The TWA can represent the dynamic shifts that occur from a particular firm's implementation of a SPI, leading to changes in job requirements, employees skills, job reinforcer patterns, and possibly over time to changes in employees' needs and values.⁴ The TWA is careful to distinguish between the determinants of employee satisfaction and performance. Unlike other theories that have attempted (and failed) to prove a more complex causal linkage between satisfaction and performance (Lawler & Porter, 1967), the TWA recognizes the absence of a direct relationships between them, while reflecting their mutual importance in predicting turnover intentions and job tenure. The relationship between employee satisfaction and performance has been studied for over 40

⁴ This is to illustrate that potentially all of the variables in the TWA may be altered by introduction of a SPI. The last construct, employee needs and values is considered to be semi-permanent, that is changes in such needs and values are relatively stable (Dawis, 1988).

years in the organizational literature (Brayfield & Crockett, 1955; Pervin, 1968), and these constructs have been repeatedly shown to be unrelated, or at best, very weakly correlated.⁵ In addition, the organizational interventions that seek to influence satisfaction and performance have often been shown to impact job satisfaction but not performance, or vice-versa (Kelly, 1992).

Given that the TWA distinguishes between the determinants of job satisfaction and performance, it acknowledges the differences between one employee whose performance suffers as a result of being unable to learn the new skills required by the SPI, and another employee who successfully acquires the necessary skills but who is dissatisfied with the other changes associated with the SPI. In the first case (where the employee cannot learn the SPI), the TWA predicts that the employee's performance will deteriorate due to inadequate skills, and the employee may be asked to leave voluntarily or transferred to another job. In the second case, it predicts that the employee will become dissatisfied with the job and will be more likely to quit. This is because changes in the job reinforcer patterns may conflict with how the employee likes to — or is accustomed to — working, thereby creating a mismatch with the employee's needs and values. Although both types of job fit may be captured by collecting longitudinal data on employees' job tenure, cross-sectional measures of employees' attitudes (turnover intentions) will only capture the second relationship. Thus, poor performers will not be expected to show greater turnover intentions at any single point in time, although their likelihood of remaining in the job over time may be reduced.⁶

⁵ In these studies, the average correlation coefficient between individual satisfaction and performance was about +0.10 to +0.15 (Robinson, Athanasiou & Head, 1969).

⁶ This distinction between the causes of voluntary turnover versus involuntary turnover is admittedly, oversimplified. First of all, it assumes that a dissatisfied worker can still continue to perform at previously high levels of performance (since satisfaction and performance are not directly related). Second, it assumes that dissatisfied workers are more likely to voluntarily leave the job, while low performers are likely to involuntarily leave. This, of course, ignores the possibility that in some organizations, high performers may have shorter job tenure, due to their being promoted to positions of more responsibility or being hired into competitors' firms, due to their outstanding performance. The theory also neglects the possibility that a dissatisfied workers may be more vulnerable to termination, despite their high skill levels, if their negative attitude are perceived by the supervisor undermining performance or morale.

Relationships among the Theory of Work Adjustment Constructs

Based on the TWA a set of relationships implicit in the framework are stated below. The goal of the proposed research is to apply the TWA to study IS professionals in organizations that are in the process of implementing an SPI. After stating these relationships, the general relevance of the framework is evaluated in Chapter 4, which describes a set of field studies of organizations that were implementing client/server development. Following this analysis in Chapter 4, formal propositions derived from these relationships are stated in Chapter 5, then measures for each construct are introduced in Chapter 6 and tested in Chapter 8.

The relationships from the Theory of Work Adjustment are stated in Table 3.1. These relationships are stated generically — in terms of changes that are triggered by "adoption of a SPI." Although these relationships should exist during the adoption of any SPI, this research applies these relationships to the adoption of client/server development, as a new technology and new set of methodologies and processes associated with system development. The rationale underlying the last relationship is described below.

Although traditional TWA would predict both a positive relationship between *job performance* and *tenure*, as well as an inverse relationship between *job performance* and *turnover intentions*, no such direct relationships are predicted here. This is because employees may leave — or hope to leave — their present jobs for reasons that have nothing to do with poor performance. In fact, given the high demand for system developers experienced in using client/server development, it may be that it is the most highly skilled developers who are most likely to leave — either because they are sought by executive search firms, or because they desire more challenge elsewhere. Of course, there may be some low performers, too, who hope to leave their present job, in order to find a more suitable job for their talents. Given these more complex relationships between performance and both turnover intentions and tenure, no simple, direct relationship is expected. This statement of the relationship acknowledges these various possibility, and thus no overall relationship is expected between job performance and turnover intentions. It is examined for exploratory purposes only.

TABLE 3.1

Relationships Among Constructs in the Theory of Work Adjustment

(Measurement constructs appear in italics)

1. Organizational adoption of a software process innovation will change the *skill requirements* for the job of system developers, by creating the need for new skills and by reducing the need for traditional skill sets.
2. Organizational adoption of a software process innovation will lead to changes in the *reinforcer patterns* of system developers' jobs.
3. The degree of fit between *employee needs and values* and *job reinforcer patterns* will be positively related to *satisfaction*.
4. The degree of fit between *job requirements* and *employees' skills and abilities* will be positively related to *job performance*.
5. *Employee satisfaction* will be inversely related to *turnover intentions*.
6. *Job Performance* will have no direct relationship to *turnover intentions*.

Chapter 4

Field Studies: Methodology and Results

Overview of Field Study Methodology

In order to provide a preliminary validation of the Theory of Work Adjustment and also to collect contextual information about firms implementing client/server development, 52 interviews were conducted in four organizations. Results from two of these field studies are presented in this chapter.¹ Fifteen interviews were conducted at each of the two firms — Chemco and Insureco. Interviews each lasted from one to two hours, and most followed a semi-structured format (described below). Approximately one-third of the interviews were tape-recorded and transcribed. For the remaining two-thirds of the interviews, detailed handwritten notes were recorded during the interviews, and immediately transcribed afterwards.²

Hierarchical Level of Respondents. Since the objective of the field studies was to capture the insights of various respondents, each firm was asked to provide respondents from a combination of IS, business unit, and training/human resources departments. Each company was also asked to provide a mix of respondents from managerial and non-managerial ranks. While the single largest category of interviews were conducted with IS managers (60% of total interviews), an approximately equal proportion of respondents was selected from the other categories.

¹ Although data from two other firms (Investco and Telco) were valuable in assessing the suitability of the Theory of Work Adjustment for this research, these two field studies are omitted from this chapter because each was pursuing a primary strategy for implementing client/server development which did *not* involve reskilling *existing* IS staff. Instead, InvestCo and Telco sought to "graft" (Huber, 1991) new talents onto the IS departments, whether through hiring new employees, independent contractors, or management consultants to handle the responsibilities of implementing client/server systems. Overviews of strategies for implementing client/server at InvestCo and Telco appear in Appendix 4.1.

² The interviews that were not tape recorded were those conducted during summer, 1994. Because over 25 interviews were scheduled during a 4-month period, and because funds for tape transcription were not available, data from the Phase 2 interviews were based on detailed handwritten notes.

Detailed field study results for Chemco and Insureco are presented below. A total of 15 interviews were conducted in each firm, beginning in summer, 1993. Four phases of interviews were conducted in each firm, spanning 27 months from July 1993 to November 1995.

Phase	Time Period	Number of Interviews at Chemco	Number of Interviews at Insureco	Total Interviews
1	Summer 1993	4	4	8
2	Summer 1994	9	7	16
3	Spring 1995	1	3	4
4	Fall 1995	1	1	2
All Phases	1993 - 1995	15	15	30

Each interview phase served a distinct purpose. Phase 1 (summer, 1993) was designed to identify broad changes in IS management practices and the business and technology drivers underlying these changes.³ Although this initial phase did not specifically focus on implementation of client/server development, this topic arose as a principal theme at both firms. This phase captured information about the history and culture of each firm's IS organization and the firm as a whole. A copy of the interview protocol for Phase 1 is included in Appendix 4.2.

Phase 2 (summer, 1994) was designed to chronicle the history of each firm's implementation of client/server development and IS reskilling, including training, use of consultants, and other related practices. This phase also sought to identify individual attributes of IS employees that were perceived by respondents to differentiate between developers who were

³ In addition to the eight interviews at Chemco and Insureco, Phase 1 included interviews with an additional 15 IS and business managers from five other firms. The results from these 23 interviews were used to identify general trends and challenges related to IS management. The broader results from Phase 1 are summarized in Gallivan (1994).

capable of making the transition from mainframe-based development to client/server development. A copy of the interview protocol for Phase 2 is contained in Appendix 4.3.

Following Phase 2, a preliminary analysis of the data collected from each site was prepared and submitted to the primary contact person at Chemco and Insureco. This report described the results of the field site at the target firm, and compared the client/server implementation approach to the other three firms (using pseudonyms for the other firms).

Phase 3 interviews (spring 1995) were designed as a follow-up to the preliminary report. In addition to verifying data with each firm's primary contact person, the goal of these interviews was to identify ongoing progress with the implementation of client/server development and to secure the firm's cooperation in the subsequent survey phase of the research. A single interview was conducted with the primary contact person at Chemco,⁴ however at Insureco, several manager interviews were necessary to secure the cooperation of a sufficient number of respondents to participate in the survey. At Insureco, the primary contact person was the Director of IS Training, and since he was part of Human Resources, rather than IS, he could not ensure the cooperation of IS department managers. Also, due to the fact that Insureco's IS application development activities were decentralized to each business unit, several interviews with managers of these various IS units were conducted in order to determine their suitability for the study (that they had adopted client/server development), and to secure their permission to participate in the survey. The Phase 3 interviews were unstructured, since the purpose was to validate information in the preliminary field study analysis and to secure cooperation for the survey phase.

⁴ At Chemco, the primary contact person was the IS Director for one of the firm's business units. Only one interview was required at Chemco to gain the cooperation of *all* Chemco's IS application development groups. This was due, in part, to Chemco's prior research relationship with MIT's Center for Information Systems research. Both this primary contact manager and the firm's CIO were enthusiastic about participation in the research. Their cooperation considerably streamlined the research process for both the field study and survey phases.

Phase 4 (fall, 1995) was designed as a follow-up to identify further progress in each firm's implementation strategy. One interview was conducted in each firm with the primary contact person. At Chemco, I also presented preliminary survey results to two committees: the senior IS management team and a newly-established committee, the Methodology Deployment Task Force.

Data Analysis and Presentation of Results

Inductive methods (Miles & Huberman, 1994; Strauss & Corbin, 1993) were used to identify constructs and factors that were important to the process of implementing client/server development at each site. The interview data were not collected or analyzed with any particular theoretical framework in mind. Detailed transcripts of each interview were prepared immediately following each interview and key themes were identified.⁵ As interview results accumulated, similarities and contradictions were identified between respondents within each field site, as well as across field sites. These key themes were:

- organizational culture of the firm and IS department
- relationships between IS and the business units
- degree of centralization of the implementation of client/server development
- changes in technology and system development processes associated with client/server development
- changes in organizational culture associated with new work process
- activities employed to reskill IS employees (including training, use of mentors, hands-on learning, hiring consultants)

⁵ The basis for preparing key summaries of interviews differed somewhat depending on whether the interview had been tape recorded or documented with handwritten notes. For the handwritten notes, I carefully differentiated between respondents' direct quotes and my paraphrasing of their comments at the time of the interviews. Developing a summary of these notes very shortly after the interviews was a critical step in improving the accuracy and completeness of the data, since additional, paraphrased information was added to each interview, based on my recollections of respondents' comments. For tape recorded interviews, the opposite challenge was to reduce the interview transcript to a manageable level of detail. This required identifying sections of the taped interview which required detailed transcription, and other sections that could be briefly summarized or omitted. For all interviews, the objective was to identify information relevant to the themes listed below.

- locus of responsibility for reskilling (individual employee versus the company)
- individual attributes perceived as important to successful adaptation to the new technical skills and work processes

These themes emerged from analysis of the field study data and appear as key themes in the presentation of results, described below. Many of these themes emerged from an analysis of organizational context and culture and did not appear in the conceptual framework presented in chapter 3, which focused exclusively on individual-level variables.

The results from each field study are presented in the following sequence. For each case study, background information about the company and its IS department are presented, followed by a summary of its approach to implementing client/server development and specific examples of the reskilling approaches used to augment the skills of existing IS staff, or to "graft" (Huber, 1990) new skills to the department. Each field study summarizes changes to the system development process and work patterns associated with client/server development. Each field study concludes by identifying constructs representing individual attributes perceived by IS managers and employees as necessary for developers to adapt to client/server development.

Results from Field Study of Chemco

Company Overview

Chemco is a diversified manufacturing firm that operates in three distinct business units: sales of industrial gases, chemicals, and construction of production plants. Chemco is based in a mid-sized city in the northeastern U.S., with sales offices and factories in a half-dozen countries world-wide. Total 1994 revenues exceeded \$3 billion, with approximately 25% of its revenues derived from overseas operations. Global headcount is approximately 13,000 world-wide.

In Chemco's largest business unit (industrial gases), the firm is a market share leader, however, price competition is intense. Selling prices have remained constant for more than seven years, leading to erosion of profit margins. Recent market research conducted by the firm showed that customers perceive the firm's products (gases) as commodities, and therefore Chemco must use information technology to reduce costs while simultaneously incorporating value-added services into its products. One senior manager explained the increased competition:

The business environment is different now for three reasons: there is a low-growth economy, business users want to focus on customer service with low price, and there are other strong competitors who are also cutting costs.... The environment is really unstable.

There is strong pressure to reengineer business processes, in order to cut costs. When this study began in 1993, a 7% across-the-board headcount reduction had just been announced, affecting all business units, as well as every area of MIS.⁶

Chemco had developed a strong reputation for its accomplishments in using information technology. Its IS department was consistently featured as one of *Computerworld's* Top 100 MIS firms, and several business teaching cases highlighted its accomplishments.⁷

IS functions at Chemco were organized as a *hybrid* structure, consisting of both centralized and distributed IS functions. Application development staff were physically co-located with the respective business units, and the IS managers leading these groups reported directly to the business units, and on a dotted-line basis to the CIO. Given cost pressures on the business, certain MIS activities needed to be managed in a centralized, cost-conscious manner, and these *core MIS* functions were centralized and reported directly to the CIO. At the same time, many emerging technologies (including client/server technology) needed to be managed with the objective of identifying their potential to streamline business processes and to reduce cycle time. The CIO elaborated on this duality required for managing both

⁶ Headcount was reduced from 14,500 in 1992 to 13,300 in 1994 — more than an 8% reduction.

⁷ These Harvard teaching cases explained the reorganization of IS application development functions to have system development report to its decentralized business units (in 1989) and the consolidation of multiple data centers (in 1992).

conventional technologies (mainframe data centers) and emerging technologies (client/server technology and local area networks):

In terms of the management requirements there is a dichotomy between the two types of technology: we are managing both the *mechanistic* [conventional] and the *organic* [emerging] technologies. In the past, we could manage these core functions using a cost minimization strategy, but now with all this emerging technology, we are putting a lot of [new] infrastructure into place, and it's affecting our costs. So there will be growth in the core group's costs to accommodate these emerging technologies... The business divisions need to recognize that they need to pay for this investment in infrastructure [to facilitate] the *organic* side.

Historically, IS costs had been closely managed by the firm and treated as a business expense. Given the rapid changes occurring in its business environment, Chemco's managers recognized that they needed to treat IS as an asset — it was necessary to spend money in order to achieve the benefits of these new technologies.

We are reengineering the business processes in the Gases division, and we believe it's establishing some fundamentally different competitive advantage for us.

IS Organizational Culture

As a chemical engineering firm, Chemco shares some characteristics with other engineering firms, including a tradition of working with an eye for precision and detail. Due to this historical focus on precision and the fact that Chemco traditionally developed all its own systems in-house, this has led to long application development cycle times. Given the speed of change in the industry, such multi-year system development cycles were no longer acceptable, and application development cycle time is one critical area that IS management has sought to transform with client/server technology. In short, there is a need to develop applications quickly, whether they are purchased, developed in-house, or implemented with the help of a system integration firm. Chemco was even looking ahead to the next generation of system development techniques by evaluating the feasibility of using object-oriented development and object repositories.

In terms of MIS hiring, Chemco has a tradition of hiring college graduates with the relevant functional background in chemical engineering. Members of Chemco's IS division have a

very high level of education,⁸ with a majority holding degrees in engineering or chemical engineering, rather than business MIS or computer science. One IS project leader said:

Chemco is heavily engineering-oriented, so having an engineering degree, even in my job today helps. A lot of the [IS] managers are engineers by training.

Many employees have long tenure at Chemco, and employee turnover is low. Average tenure of non-management employees is 12 years, while average tenure of senior IS management is over 18 years.⁹ Chemco created a dual career ladder to reward the technical achievements of its IS employees, allowing IS employees to advance without entering into management. The work culture of IS emphasized the need for employees to be ambitious and self-motivated. Several comments from respondents revealed the high level of expectation. One IS project leader said:

We hire good people, throw them in a slot, and get the work done. We see which ones bubble up [rise to the top].

IS employees themselves praised the high quality of their peers:

One of the best parts of working here is the people: I feel that Chemco hires and retains very interesting and technically skilled people. My interaction with these people challenges me to increase my skills.

Another IS project manager said that Chemco encourages its IS staff to take initiative:

you just need to show what you are interested in doing, and the firm will give you the opportunity.

In addition to providing a challenging work environment, internal transfers were encouraged. One manager explained that IS staff were encouraged to seek new opportunities, through transfers to other IS positions:

The mentality here is that you stay with your job for around two-to-three years, and then if you feel like moving onto something else, then you do.

⁸ The educational level of Chemco respondents was extremely high: 71% hold a bachelor's degree (or higher), 62% hold a master's degree (or higher) and 14% hold a Ph.D.

⁹ Most senior IS managers had been at ChemCo for 15-25 years (based on data from a 1995 Harvard Business School teaching case).

The combination of intense business cost pressures and the high level of expectations of its IS staff led to pressures on employees to excel. These pressures, in turn, led to some conflicting perceptions regarding job security. Some employees were highly optimistic and energized under these working conditions, as they recognized that Chemco provided strong technical skills that were sought by other local employers. One IS employee said:

I generally feel that my position is secure, however, I am aware of the changes taking place here and in the marketplace worldwide that may change that. I, along with many others, find this disconcerting, but believe we must face these new realities and make the most of it. I think that Chemco is a very good place to be and believe that if I *did* lose my position or decided to leave, that I have highly marketable skills that would allow me to get another job fairly easily.

There was also a downside to such high levels of challenge and expectation on employees, creating uncertainty about their future job security. Another IS employee elaborated:

No one is looking out for my career except me. I think the company has made it clear that no one is guaranteed a job — regardless of their current and previous successes. It has made the work environment very competitive and, at times, vicious!

Relationship between IS and Business Units

As mentioned above, IS application development functions were distributed to the three major business units in 1990 (gases, chemicals, and process systems), creating a *hybrid* organizational structure with both *centralized* and *distributed* features. Each of the three distributed IS application development divisions was overseen by a senior IS manager who reported directly to the respective business unit manager and indirectly to the CIO. Each of the three major IS divisions had approximately 40 full-time IS staff. There were a few smaller application development groups which were still retained as part of core MIS, however, this study focused on the large, distributed IS divisions.¹⁰

¹⁰ The three application development groups retained in core MIS were: Corporate applications, Research & Development IS, and European systems IS. None of the interviews were conducted with the managers or staff of the smaller, *core* IS application groups (corporate applications, R&D, or European IS), although some respondents from the latter groups were included in the subsequent survey.

There was a fair amount of job mobility between IS and the business units. Approximately 10% of the total IS staff transferred from IS to a job in the business units, or vice-versa. Despite this movement of staff between jobs in IS and the business units, IS staff rarely transferred between *different* business units (i.e., from gases to chemicals IS).

Given the close working relationships between each IS division and its respective business unit, many respondents commented that the IS staff generally understood the business processes even *better* than line employees. This was a surprising comment, given the contrary tendency in many other companies.¹¹ This unusual result was attributed to several factors: First, IS development had been distributed to the business units for many years. Second, there was close alignment between IS planning and the distinct objectives of each business unit. Third, the current system applications automated the existing business processes, thereby concealing from users the details of how these processes worked. This lack of familiarity with the current processes on the part of business users became a critical issue as the business divisions sought to reengineer in the 1990s. When reengineering design teams were assembled, business unit management realized that IS employees were the ones who actually knew best how the business worked:

The business people realized that the IS department knew the business better than they did. They only knew the gloss-and-veneer; they did not know what was going on under the covers [of the old systems].

This also created a challenge when reengineering teams were formed, since the IS staff were expected to wear many hats on such teams — as experts on technology, system development methodology, and current business processes. One IS project leader explained:

We ask the business unit to provide someone who knows the business processes on the reengineering team, and they point at us and say "that's you." We try to explain to them, "no, we want to use these IS employees for their technology expertise now. You will have to provide someone else who actually knows the business."

¹¹ In many other firms reported in the literature, as well as at Insureco, IS employees are criticized for not getting close enough to the business — meaning that they do not understand the business functions that they seek to automate, support, or reengineer with IT.

Introducing Client/Server Technology to Chemco

Starting in 1993, Chemco's various IS divisions began to explore client/server technology as a potential substitute for older, mainframe-based technologies. Until 1993, each IS group had performed mainframe-based development using traditional, third-generation languages such as COBOL and PL/1 on *Tandem* mainframe hardware, using technologies such as the CICS on-line monitor and mainframe database management systems (IDMS and DB-2). Most application software had historically been developed in-house, with a disdain for using packaged software that one IS manager called the "not-invented-here syndrome." The only exception to this bias toward in-house development was the use of packaged financial software — such as a corporate general ledger system implemented with the help of systems integrator Andersen Consulting.

When the three major IS divisions began to explore the potential adoption of client/server technology, each IS division conducted its own investigation in a decentralized manner. There was no formal "client/server initiative" or "IS reskilling project" to speak of. Instead, there were a set of loosely-coupled efforts to explore the new technologies available in the marketplace, with no central oversight by the CIO or any member of his core IS staff. The loosely-coupled character of such initial forays into client/server technology can be traced to several features of the corporate context: first, it was due to the existing distributed IS organizational structure; second, each business unit had distinct application needs and business objectives; third, centralized technology standards had always been avoided at Chemco. Instead, each IS division was permitted to choose its own, local technology standards. Given this context, client/server technology was introduced in a decentralized manner, without any top-down technology standards. By 1993, some *de facto* client/server standards had begun to emerge in the marketplace, and most Chemco divisions chose to follow them. One IS manager said:

Like it or not, the [division name] IS group operates very much independently, very much as do the other IS divisions. But we have come to our senses within MIS as a whole, realizing

there are certain *somewhat* standard technologies that we all need to center around in the future, such as the SQL database platform.¹²

Aside from using SQL (structured query language) as the database management system platform, there were few common standards across Chemco's three IS divisions. Some IS divisions chose IBM-compatible 486 computers for the *client* workstations, while others chose UNIX workstations. In terms of the client software used by each IS employee to develop client/server systems, different tools were adopted in different IS divisions. Two of the divisions chose *Visual Basic* as their application development tool, while *PowerBuilder* was selected by another.¹³

Although there were some differences in the client and server hardware and software chosen by the three application development groups, there were many similarities in the changes to the system development processes within each division. The following section identifies these common changes that occurred, despite the various toolsets deployed. The final section of this study identifies some individual attributes that were perceived as necessary for IS employees to adapt to these changes. Specific differences between the three divisions existed, but are beyond the scope of this chapter.

Adoption of Client/server Technology

By definition, the adoption of client/server technologies involves specific changes in hardware: rather than using "dumb terminals" connected to a centralized processor (mainframe computer), client/server denotes using PCs or workstations with a graphical user interface (GUI) capability — such as Microsoft Windows - with their own powerful

¹² Structured query language (SQL) is a common standard for the database management systems (DBMS) running on the *server* side of client/server. The latter part of this manager's statement may appear to be contradictory, however, he argues that any standards that have been commonly adopted at ChemCo are due to de facto marketplace standards, rather than due to standards enforced top-down by ChemCo's CIO.

¹³ The various *client* and *server* technologies adopted by each IS division were influenced, in part, by the fact that some US divisions chose to work closely with external *partners* to develop client/server applications quickly. These external consultants often influenced the choice of technologies within a IS division (for example, UNIX instead of IBM-compatible hardware).

processing capability, linked to each other over a local area network (LAN), and to a high-speed *server*. When software applications are processed in a client/server environment, the processing is divided between the client and server machines. This division-of-labor maximizes the strengths of both client and server machines, ensuring rapid response time and integrity of the system data.

Given this narrow definition of client/server technology, there were few steps required to adopt and implement the technology — purchasing and installing new *client* workstations for IS employees, and using powerful *server* machines, running a DBMS, such as SQL. Each of Chemco's IS divisions purchased new IBM-compatible 486 or UNIX workstations for its developers, as well as the appropriate *server* hardware, LAN operating systems (Novell Netware), and DBMS software (Sybase SQL). This one-time expense for deploying new equipment represented a reversal of Chemco's traditional cost-minimization focus, as described by one manager:

We decided to open up the purse strings ... we wanted the MIS staff to feel that they were moving into the 21st century, and that they would be expected to become world-class developers. We bought each developer a workstation and told them to expect an era of change.

In addition, while not part of the strict definition of client/server *technology*, however, there is a web of associated changes in the toolsets and the methodologies used to develop client/server applications which are implicit in the phrase client/server *development* (Vaskevitch, 1993). At Chemco, the specific changes denoted by client/server *technology* are first identified, followed by the associated changes that are included in the definition of client/server *development*. These latter changes include the adoption of graphical user interface (GUI) based application development tools, a prototyping approach to system development, greater involvement of users in the system development process, the adoption of a business process reengineering approach, and the increased involvement of external third parties in the reengineering and software development processes. Since these changes were associated with implementation of client/server development, and because they affected the skill requirements and work processes of IS employees, they are described below.

New application development tools. Each division began to use a GUI (graphical user interface) application development tool to facilitate developing GUI-type applications. The application tools selected — *PowerBuilder* and *Visual Basic* — enabled IS staff to create GUI applications for business users. These application development tools facilitated a new style of programming known as event-driven programming, which differs from traditional, sequential systems code. Such GUI applications permit a user to select icons, drop-down menus, or buttons to initiate specific processing. These new application development tools required some initial training, which was conducted by external training vendors. The timing of the tool training varied for different IS divisions (in terms of whether training was conducted prior to having the users adopt the toolset, or after using the tool for a period of time).

Prototyping approach. The system development approach changed to an iterative prototyping approach in order to exploit the capabilities of the GUI-based application development tools. The terms rapid application development (RAD), and prototyping were used interchangeably. Both these terms implied replacing the traditional, structured system development life cycle where each phase of the process is conducted sequentially (requirements analysis, detailed design, coding, testing, conversion), with a faster, more iterative process. The new GUI-based tools enabled working system prototypes to be developed quickly, in conjunction with users and then refined until a successful system design was achieved. By streamlining the time to develop a system prototype, and by allowing more iterative testing and refinement of the system, the overall application cycle time became much shorter, and the resulting system more closely approximated users' needs.

Reengineering philosophy. Given the competitive pressures on the business, most new systems were being developed not simply to automate an existing manual process, but rather to reengineer some business process. The terminology of business process reengineering (BPR) was adopted by Chemco concurrently with the move to client/server technology, although some business units were more ambitious than others in terms of the scope of

change they were undertaking. The contrast between the opportunity to conduct business process reengineering and the historically low level of user involvement in systems development projects posed a challenge to the business units.

Greater User Involvement. Given the reengineering objectives, the system projects required considerable inputs of user time, responsibility, and leadership. Given the history of inadequate user involvement in prior systems projects, this represented a significant challenge. As described earlier, the business units relied on IS employees to know their business processes, leading to some inherent tension with the objectives of BPR, which required users to provide leadership and ownership of such projects (Hammer & Champy, 1993). Respondents suggested that, in general, the business units successfully rose to this challenge of leading reengineering projects. Moreover, numerous respondents stated that the single greatest change associated with the adoption of client/server development was increased user involvement. For example, one IS manager, who had just successfully implemented a client/server system for the Financial Controller's office, said that establishing this user ownership was the greatest change and one critical to the project's success.

At the outset, we said, "This is not an IS project; this is a Controllership project which has MIS as a sub-contractor. And Controllership will control this project and decide the scope of this project." It think that's the primary difference that allowed this [first client/server project] to run smoothly. Now Controllership is responsible for making sure that resources are available and that the right people are included on the team, instead of IS being responsible.

This greater user involvement meant closer interaction between IS employees and users, who were involved throughout the entire project. Instead of having users participate only in the system's requirements analysis phase for users, the new GUI-based application tools and the prototyping approach created an opportunity to contribute throughout the entire project. One IS manager commented that:

Before, users were part of the project team more-or-less in name only. They were involved early on, up-front, but later their involvement in the project was minimal. Now, we have learned to keep some user who has been on that design team right there through the entire process. Now, they sit there right next to the IT team... It's an entirely different level of involvement, and we have also put a lot of the ownership squarely in their laps. . . . It has

helped with developing their level of understanding of what it takes to get an IT system in place.

Co-location users and MIS staff. Not only were users much more involved on system project teams, but they were usually *co-located* with IS developers. *Co-location* provided the opportunity for users to communicate readily with IS staff and any external consultants hired for the project; this also had the advantage of physically removing them from the distraction of their normal job duties, allowing them to focus on the system project. This principle of co-location is best illustrated by the use of the *RAD Room* or *RAD House* methodology, employed by the process systems IS division.¹⁴

The "Win Ugly" Approach to System Development. One additional change in the system development was related to the prototyping methodology, and it revealed a paradigm shift in the philosophy of system design and implementation: a focus on achieving *fast* system solutions, rather than *perfect* ones. This was a radical change from the traditional software development mindset, which ensured that systems would be precisely designed and developed, albeit very slowly. This new, quick-and-dirty approach to developing systems was influenced three factors: the availability of GUI-based application development tools, the adoption of a prototyping methodology, and the drive to reengineer the business quickly. Given these competitive conditions, respondents described this new paradigm of system development through a variety of metaphors: *time-boxing*,¹⁵ *the 80% solution*, or the slogan of *win ugly*. *Time-boxing* implies developing systems with the assumption that the deadline is immovable, but the system functionality is flexible, to allow as much development as possible, under the deadline. This was a radical change in assumptions underlying system development. For

¹⁴ Chemco created a set of large rooms where all the participants in a given project could work collaboratively for the duration of 16-week projects. These rooms were called *RAD Rooms* (Rapid Application Development rooms), and collectively these rooms were labelled the RAD House concept.

¹⁵ The concept of timeboxing is credited to DuPont's IS department. Using a firm deadline, as much functionality as possible is designed and developed in a specific period of time. The philosophy behind timeboxing is that systems should be developed with specific portions of functionality, in short time frames of 90-120 days. Over time, the capabilities of a specific system will be elaborated. For further details on *timeboxing*, see James Martin's book *Rapid Application Development*, Prentice-Hall, 1991.

example, one IS manager, who had just completed a review of his department's first client/server system said:

One of the critical success factors of the project was *heresy* as far as what had been done in the past — namely that 80% of the functional requirements would be met by this effort, instead of 100%. Some people could not accept it at first, but they walked into it with their eyes open, with the understanding that "this is a new technology — we are not going to be able to do everything with it that users want, as we have tried to do in the past. So let's get 100% of the *bare minimum* requirements met, and then the rest of it can wait."

Some managers described the scenario where some system's functions were being programmed before the rest was fully designed. One manager coined the phrase "win ugly," to acknowledge that they could not afford the time to completely design a system prior to coding. To emphasize the time pressures they faced, he explained that "we were building systems before we knew what the hell they were doing."

General Magnitude of Change in Work Process

The overall bundle of changes that IS developers were expected to undertake touched upon nearly every aspect of system development work. In the eyes of some respondents, these were radical changes indeed. One respondent argued that it was difficult to:

... really understand the magnitude and intensity of the change that IS management is requiring people to accept. Developing *apps* in the client/server world is radically different than that of legacy systems and presents a plethora of additional tools, methodologies and challenges that did not exist when most of today's IS managers cut their teeth as developers. I readily enjoy new and challenging things, but the scope and pace of the changes that we (developers) are being asked to absorb is rapid, dramatic, and stressful. In search of the *holy benefits grail*, IT management is rushing to port mission critical applications to client/server at breakneck pace.

This respondent's comment underscores that the changes prompted by adoption of client/server technology transcend a specific set of skills associated with the new hardware platform itself.

One IS project team leader, who had herself undergone an intensive learning experience in using the new technologies, reinforced the same point of how difficult it was to adapt to the many changes associated with client/server development under the pressure of deadlines:

Everything was foreign to us — there was nothing that stayed the same. It was totally brand new, and we really didn't have much formal education in it before we got on site.

Individual Attributes Associated with Successful Adaptation to Change

Given these widespread changes in the nature of the developers' jobs, respondents were asked to identify any individual attributes which might facilitate or constrain an employee's ability to adapt to the new environment. In describing the profile of a successful adaptor, respondents cited personality attributes far more often than they cited specific technical skills. The following section summarizes the personal attributes that respondents identified as necessary to adapt to the new working environment: past efforts at reskilling, creativity, ability to tolerate ambiguity, and resilience to stress.

Evidence of Past Efforts at Reskilling. When respondents *did* mention the challenge of learning new technical skills, it was often framed in terms of developers having the flexibility to apply what they knew to the new situation. Respondents suggested that the best indicator of this flexibility is evidence of an employee's prior efforts to adjust to new technologies:

I would look at some of the things they have done in the past: how many times have they been willing to try different things? I think that's a real key as to whether or not someone is going to make it in a *reskilling* environment. If they stayed *status quo* with the same thing all the time, it is going to be very difficult for someone to move out of that. But if you look at someone who has at least *attempted* some different things, who hasn't stayed with the exact same thing all the time — then once they have made one transition, I think you have some confidence that they can go forward.

Creativity. In addition to past evidence of willingness to learn new technologies, respondents also suggested that success in the position required a certain cognitive flexibility to adapt their skills to the demands of the new environment. Specifically, Chemco respondents mentioned the need for the IS developer to be creative in terms of applying their prior knowledge to the new technical environment and to the new system development paradigm. Such creativity was not solely in terms of learning new technical features, but rather in applying new toolsets under the constraints of the prototyping and time-boxing development environment. In selecting developers to make the transition, the same manager explained:

I would also look at that person's creativity: there's a lot of importance in [recognizing that] "I can't think the way I used to think. I might not have the perfect solution, but what can I get by with?" So there's some of that thought process [required] in this reskilling.

Ability to Tolerate Ambiguity. Third, many respondents underscored the need to be tolerant of ambiguity - both at the level of specific system features, but also in terms of total work environment. The importance of being able to tolerate ambiguity represents a sharp contrast to the highly structured work environment in which many developers received their initial experience. The ability to tolerate ambiguity was described as inconsistent with the high need for structure that traditionally characterized the IS profession. One division IS manager said that:

IS people are very used to structure. We tried to break that paradigm ... We told the staff that they should expect frequent reorganizations — on a quarterly basis. We have conditioned people to expect that frequent changes will occur. We told them: "expect an era of change — in the future, the work environment will be unstable.... We won't just conduct business as usual."

At Chemco the career path for IS professionals is no longer straightforward. Job assignments are now short-lived, with staff continually assigned and reassigned to new project teams. One IS manager said that:

Now, I say to my staff, "We're not going to use the word *permanent* anymore. Permanent means the next two minutes. Don't ask me to plan any farther out than that." We projected that there are probably going to be significant changes among some teams every three months, and it has turned out to be just about that. When I first talked to my staff about moving from one team to another, the first question was "How long is this for? Am I going to do this for the next two years or the next five years?" I tell them, "I don't know — I think you're going to do it for the next six months, unless something else comes up. I don't know what's going to happen." And they had trouble with that. They weren't used to that. They wanted to know what they were doing, where they were going, looking for that sameness, that stability.

There is one other area in which developers are required to tolerate ambiguity — which is the specific systems development methodology. Tolerance of ambiguity was perceived as critical to working with the rapid prototyping methodology.

What was new was the whole methodology — the Rapid Application Development (RAD), prototyping, the idea of starting development when your design is not yet solid, getting something out fast. Those were hurdles. We have some people with 15 years of application development experience who are used to some fairly well-defined project that was really cast in stone before they would go in to develop it. Such people had a really tough time adapting to the fact that things were changing. They'd code something one day, and then the next day, they'd be told, "sorry, that's not the way the system is going to work; go back and re-code."

And developers got frustrated when that happened a number of times. But throughout the course of the project, they were able to understand that this is the way we need to be able to move. We can't do the RAD if we're really going to wait to solidify everything along the way. This [ambiguity] is part of the iterative design. Maybe you end up re-working things — that's just part of it, that's the way it happens.

Resilience to stress. Given the multitude of skill changes required and the tight project deadlines, several respondents articulated the stressful nature of these projects. Some respondents identified a distinctive personality profile required for those developers who successfully reskill — high levels of drive and ambition, combined with an ability to withstand stress. One project team leader, who had completed one year on a very intensive engineering project expressed this point:

What kind of person can survive it? I'm not sure how many people can really survive what we went through. I can't tell you how many times I thought 'I can't do this anymore — I can't work 20 hour days and keep coming back in here.'... But I did. It was just a constant [reminder that] you gotta get by, you gotta be one of those people that *wants* to get by. It's going to be those Type A people that are going to move on [succeed].... You had to take initiative, to make it known that you wanted to [succeed]. You are still learning your [new] skills every day, even though it's been a year [since the project started]... At the pace that we're going, it's difficult — not everyone can do it. There's a lot of burn-out.

One IS manager emphasized the stressful nature of working under tight deadlines, while adapting to the new work approaches:

There is a lot of stress on projects. There are times when tempers get short and people have to learn to work through that as well.

Summary of Personality Attributes Identified

In summary, many attributes were perceived as necessary for developers to adapt to the changes related to client/server development. Technical skills were rarely cited, and even then only in the context of evaluating whether a developer had shown prior initiative to learn new technical skills in the past. It is noteworthy that none of the respondents emphasized the need for brilliant programming skills, or the need for prior knowledge of specific technology (such as UNIX or network operating systems), as prerequisites to successful adaptation. Rather than interpreting this to mean that technical knowledge skills are unimportant, this probably suggests that Chemco respondents believe that their peers who already know how

to program in the traditional mainframe environment have sufficient technical skills and the necessary intellectual capability to learn new technologies. Their claim was that what does differentiate those IS employees who can successfully adapt to the client/server environment, however, are personality factors, such as willingness to learn, tolerance for ambiguity, creativity, and resilience to stress.

Finally, it is important to underscore that age or years of job tenure were not cited as determinants of employees' ability to reskill. Thus, in contrast to the conventional wisdom offered by the computer trade press, Chemco respondents did not report age to be a handicap to reskilling (nor as an enabler). In fact, one manager provided evidence that older employees could adapt:

At the management level — people had some of the IS staff pegged as: "they'll never change — they know these old systems; that's what they're used to doing." And these IS staff members surprised everybody. I've seen people working through [the changes]. In our group, I can honestly say that there's not one person who is just not making the transition or is having too much difficulty.

Perhaps in view of the high levels of performance that were expected of Chemco's IS staff, their ability to meet this newest set of challenges should not come as a surprise. Managers said that they expected good results from their IS staff but, as one pointed out "we did not realize how much people could do and take on until we unfettered them."

Summary of Chemco Study

In summary, Chemco is a firm that adopted client/server technology as well as a "plethora of additional tools, methodologies and challenges" associated with system development. Despite the many changes associated with client/server development, Chemco's IS department implemented them without undertaking any centralized or corporative initiative. In fact, identifying the range of changes associated with client/server development at Chemco made for a challenging field study, specifically due to the decentralized nature of the changes. There was no IS manager or staff group in charge of implementing client/server development, and no manager responsible for the training or staffing of IS employees across these divisions. Of Chemco's three distributed IS divisions, each followed a different set of

standards, and each used a different set of reskilling approaches to ensure that the staff assigned to its client/server project teams had the necessary skill sets and the capabilities to deliver systems in the new environment.

This case study has underscored that Chemco has a very well-managed IS function — one which has had its share of recognition in the computer trade press in teaching case studies. Although Chemco has had its share of challenges to overcome — notably a prior IS cost-minimization philosophy on the part of corporate management and many business users with insufficient understanding of their own business processes, Chemco has set itself on a path toward implementing a wide array of innovations through bottom-up changes in work processes.

This case study has sought to identify the commonalities across the three primary Chemco application development groups, in terms of the changes made and attributes perceived as necessary for successful adaptation. There are two limitations of the data presented here. First, the field interviews focused exclusively on the three major, distributed IS application development groups, rather than the smaller, centralized groups reporting to the CEO as part of "core MIS." Second, the differences in implementation approach between the three major application development groups have been minimized here. This is an acceptable limitation however, since these differences between divisions were primarily in terms of specific technology standards and the differential use of third parties during the introduction of client/server development. A more detailed description of these differences would merely reinforce the argument that Chemco pursued a decentralized strategy for implementing the system development processes associated with client/server development, while expecting IS staff to take initiative and to excel.

Follow-up note: At the time that preliminary results of this study were presented to Chemco's IS management team (in late 1995), some changes in terms of greater degree of centralization were being discussed. First, there was a new enthusiasm for identifying

common standards for the distributed application groups to follow (although specific standards had not yet been identified). Second, there was a new initiative to develop a common application development methodology firm-wide. Third, the two largest IS application development groups (gases and process systems) were merged, following the merger between their business units. The different variations on client/server development that had evolved within these two (previously separate) IS departments were being evaluated and consolidated to determine which practices would continue in the future. All of these changes illustrates the fact that the practices associated with client/server development are responses to business and technology needs, and that such decisions will continue to evolve, as necessary.

Field Study of Insureco

Company Overview

Insureco is the ninth largest U.S. life insurance firm, with over \$73 billion in assets under management. The firm has more than 14,000 total employees nationwide, of whom nearly one-third are located in its headquarters. Total IS headcount was over 900 employees. Insureco operates in three business segments: group life insurance, individual (retail) insurance, and pension fund management. IS functions are divided into six divisions: this includes four application development groups, which are decentralized to the business units plus two corporate-level IS groups (see Table 4.1). One of these corporate groups (Corporate Information Services) — manages the systems and telecommunications infrastructure while the other implements corporate-level applications (Corporate Sector Systems).

The current organizational structure with application development decentralized to various business units is labelled a "hybrid structure" (Von Simson, 1993). This structure was created in 1988 to enable better alignment between the IS divisions and the business units, while retaining some centralization of authority. The corporate division (CIS) is still very large, and beyond managing the infrastructure, it has authority for setting technology standards for the other IS divisions.

History of Information Technology at Insureco

Like other insurance firms, Insureco was conservative in its use of IT and more a follower than a technology leader. IS applications had historically been developed to support actuarial calculations and other financial transaction processing. Until 1994, most corporate systems were mainframe-based, using mainframe operating systems (such as MVS), and written in procedural third generation languages (COBOL or PL/1) or even older, second-generation languages (Assembly language).

Table 4.1
Overview of IS Divisions at Insureco

Division Name	IS Staff Headcount	Centralized or Decentralized ¹⁶
Corporate Information Services	360	centralized
Retail Information Systems	270	decentralized
Group Systems	140	decentralized
Investments & Pensions	70	decentralized
Financial Information Systems	45	decentralized
Corporate Sector Systems	35	centralized

Historically, Insureco was one of the largest IS employers in its region, hiring nearly 100 new college graduates each year. Insureco was recognized as the programmer training ground for many other local firms, and turnover was moderately high, as IS employees joined other firms. Those employees who remained at Insureco stayed in IS throughout their careers, with little transfer of staff between the IS and positions in the line business units. Promotions were made internally, with very little external hiring of IS talent. Most new IS

¹⁶ The term *decentralized* indicates that the senior IS manager responsible for the department reports to business unit management, whereas *centralized* indicates that the senior IS manager reports directly to the CIO.

employees were hired with a liberal arts background — and then immersed in a standard eight-week programmer training course. Such employees then worked as entry-level programmers, eventually completing more technical training over the years and rising through the ranks. Few IS employees were hired with technical degrees. Instead, it was more important for new hires to be capable of learning to program, rather than having prior knowledge of computer systems. The entry-level programmer training program was discontinued in 1991, when hiring was curtailed due to the economic recession. Despite the 1991 recession, and the significant reduction in one business unit (retail insurance), overall IS headcount has remained stable over the past years. Also, despite terminating the entry-level programmer training program, Insureco still maintains a very large IS training department and facility.

The IS training department — known as Technical Training — plays a critical role in terms of IS employees' skills. Technical Training employs over a dozen full-time staff and operates from a spacious conference/training center, featuring six PC-equipped training classrooms. Beginning in 1994, Technical Training gained responsibility for providing technical skills to business unit employees, supplementing its prior focus on IS employees alone. In 1994, the IS training department delivered over 8,000 person-days of training, including more than 700 annual course offerings. Half of these classes were taught by Insureco's own training staff and half were taught by external IS training vendors at Insureco's facility. This significant investment in formal training played a critical role in the introduction of client/server computing, as described below. Three trends, however, have recently begun to moderate the traditional emphasis on classroom training. First, there is an increasing emphasis on using technology itself to replace the traditional trainer role — including interactive CD-ROM and video-based training, which employees can complete at their own pace. Second, there is increased recognition of the need for hands-on learning and coaching to learn technical skills, rather than classes. Third, the trainers' role is increasingly one of a broker who outsources courses to a vendor. Despite these changes, classroom training still plays a prominent role at Insureco.

Organizational Culture

Insureco appears to be an organization whose culture is more aptly described as stodgy and bureaucratic, rather than entrepreneurial. Competition in the life insurance industry has increased in the 1990s, and respondents frequently cited the need for Insureco to change. Several senior managers were hired externally — some from even outside the insurance industry — in order to invigorate the organization. The business units experienced a "hugely dramatic" re-organization and downsizing in 1991, labelled by one manager as the "purge of people." Since 1991, however, employment has been stable, and employees perceive good job security — perhaps so good that one manager described a "sense of entitlement," arguing that many employees are complacent in their jobs.

Culture of the IS Workgroup

Respondents suggested that Insureco's IS culture is best recognized as a blend of Insureco and IS traits. One IS manager said that:

The IS department here has some characteristics that are common to IS departments across the insurance industry, but we also have the cultural characteristics of the rest of the company.

This manager described Insureco as traditional in its use of IT for primarily batch financial transaction processing. She also described the culture of the IS function as focused on computer technology, rather than with the business itself or the potential of using IT to transform the business. Another manager described the IS staff as "very insular," because they were not interested in networking with other employees in the firm.¹⁷ It was partly in response to the perceived gap between IS and the business units that the application development groups were decentralized in 1988. Other subsequent steps were taken in the early 1990s to better align IS with the business, including the creation of a quality assurance program which surveyed user attitudes toward the IS department and toward the systems they developed.

¹⁷ This conformed to the stereotype of the IS professionals uninterested in business issues or social interaction with users (Couger, 1981; Couger & Zawacki, 1980).

Relations between IS and the business units had historically not been very close, because the IS division was not seen as being very "customer-oriented." IS professionals expected business users to identify system requirements and then "throw them over a wall" to IS for development. Even worse, the systems analyst function was historically located in the business units, with distinct lines of reporting separate from the IS. As a result, the gap between IS and the business units was even worse at Insureco, compared to other IS departments:

From an application development standpoint there were three parties involved in building a system: there was the end customer, the business [systems] analyst, and the developer. If you talk about "throwing things over the wall," there were two walls instead of one.

There were separate career paths for programmers and business systems analysts until 1988, when application development was decentralized to the business units. In 1988, these distinct roles were merged, and both former programmers and analysts were obliged to adopt the other skill sets, through a process of formal training.¹⁸

IS professionals worked exclusively in the mainframe environment until the early 1990s, when PCs started to appear in the business units. When this study began in 1993, nearly all corporate and business unit systems were mainframe systems, although retail IS had previously begun to support PC hardware and applications within its insurance agents' offices in the early 1990s. Like other traditional IS departments, Insureco was reactive, rather than proactive in adopting PC technology. In fact, PCs were introduced to Insureco by the end users — "smart mavericks in the business groups," and IS had little choice but to follow. One manager said that:

There was an explosion of interest in the PC technology and IS panicked! There was a sense that 'we gotta get our hands on it and manage it, or it will get the best of us.' That was the wake-up call.

¹⁸ For example, the programmers were required to learn about the business units, and how to manage user expectations and relationships during the system development process. Conversely, business systems analysts had to learn programming and technology concepts (COBOL, JCL, MVS, hierarchical data structures, etc.).

With the increased availability of PC technology, business users began to develop their own standalone applications (using *Paradox* database software), thus forcing IS employees to learn about PCs. These PC systems were not actual client/server systems, however, and the few true client/server systems that existed by 1993 had been implemented by outside systems consultants, with minimal involvement from Insureco's in-house IS staff.

Centralization of Technology Standards

One function retained at the corporate level, despite the decentralization of application development activities, was technology standards. There was both a specific department called Technology Standards & Direction (part of Corporate IS) and a committee consisting of members of the various IS divisions called the Technology Standards Committee. Both were charged with infrastructure planning and standards-setting for *all* the IS departments.

The CIO explained:

We facilitate and coordinate the standards process. We have a Technology Standards Committee that consists of representatives from each of the business sectors. We play a very aggressive coordinative, collaborative, facilitative, and driving role. Most of the time, we propose standards but we don't mandate standards.... We manage the overall standards process from start-to-finish, including communication of what the standards are.

Two levels of standards exist — *standard* and *supported* — for all IT components: hardware, software, operating systems, communication protocols, etc. An 8-page brochure specifying the list of approved products for every component of IT architecture was published quarterly. The CIO needed to approve any purchase that fell outside these corporate standards, and the IS divisions were strongly discouraged from adopting non-standard technologies.

Introducing Client/Server Technology

When Insureco decided that it was ready to evaluate the client/server platform, Corporate Information Services created two new committees: the Client/Server Environment Committee and the Reskilling Task Force. Whereas the Client/Server Environment Committee sought to identify new technology standards, the Reskilling Task Force sought to identify the range of skill sets required for IS professionals to operate in the new environment. The latter

committee evolved into the *Reskilling for '95* program — a high-visibility initiative with significant financial support (over \$2 million) from both the CIO's office and the Human Resources division.¹⁹ *Reskilling for '95* was conceived as a centralized initiative to plan the deployment of client/server technology and the transition of IS staff to the required skill sets.

Although Insureco's approach to reskilling was the most centralized of all case study sites, the implementation process had both centralized and decentralized components, reflecting the hybrid structure of the IS function. *Reskilling for '95* was centralized in terms of certain planning activities that were undertaken with the entire IS function in mind. New infrastructure was also created within Technical Training to oversee the training process. The initiative was also partly decentralized in the sense that most other planning activities and all implementation occurred separately for each project team or IS group. All senior IS executives and IS managers participated in the initiative program in one of three ways: First, some managers served on the Reskilling Task Force committee, which selected a management consultant (Ernst & Young) to lead the initiative. Second, the consulting firm involved 38 additional managers in focus groups to incorporate their input. Third, IS managers developed "Sector Transition Plans" to identify the necessary changes in skill sets and work processes for their staff.²⁰

There were several objectives of the *Reskilling for '95* initiative: identifying the required skill set for IS professionals in the client/server environment, documenting existing skill gaps, and coordinating a plan to remedy any identified gaps. A specific meeting labelled a "skills assessment workshop" was conducted whenever a project team started a new client/server project. In 1995, the IS training department decided to formalize the "skills assessment"

¹⁹ Charge-back to the IS departments for the cost of training was discontinued in 1993, when the Technical training department was merged into the Human Resources division. The \$2 million figure cited here therefore includes the cost of client/server development training, as well as other classes.

²⁰ There were actually two levels of planning for reskilling: one at the project team level and another at the business unit level. The sequence of these two levels of planning differed across different business units, depending on whether a specific client/server development project preceded the "Sector Transition Plan." The planning and implementation activities described below refer to both types of reskilling.

process, and they purchased a skills inventory database, *Skills Management System*, from a vendor named Interpersonal Technologies Group. The system allowed the IS department or project manager to identify, for each team member (including users), the target level of each skill required for the project, participants' current skill levels, and a plan to remedy any gaps. Several critical assumptions about the goals of the *Reskilling for '95* initiative were intentionally embedded into the system and, for this reason, specific details about the deployment of the *Skills Management System* are described below.

Four major categories of skills were defined by Technical Training: technical, business, interpersonal, and management.²¹ A total of 110 possible skills were defined and four skill levels were identified (Levels 1-4), with a customized definition of each skill level for each skill. When each skills assessment workshop was conducted, the project manager first identified the important skills (from among the 110 possible skills), and the desired skill level for each member of the department or project team. Project team members then rated their own current level of expertise on each skill, and various "training activities"²² were identified to remedy any potential skill gaps. In addition to classroom training, other reskilling activities included (list these from the project list).

Use of Management Consultants as Coaches

In addition to training classes, the other major reskilling activity was to involve consultants to serve as a mentors or coaches on the client/server project teams.²³ In several IS divisions, the development of the first client/server system was perceived as too risky to leave

²¹ The number of skills in each category was as follows: technical skills (72), business skills (10), interpersonal skills (12), and project management skills (16).

²² This term "training activities" is a misnomer, since several of these activities relied on events other than training. For example, some non-training activities included "have lunch with a business unit associate," "solicit advice from others," or "sit in on data/process modeling session."

²³ Insureco respondents used the term "subject matter experts" to describe individuals who could mentor other employees. Since the term *mentor* was used at other field study sites and has entered popular usage in the computer trade press, the latter term is used below, rather than the unwieldy phrase "subject matter experts."

to novices; hence, additional consultants from Ernst & Young were hired to provide leadership and technical expertise on the project teams (although the importance of the consultants varied across different projects). Consultants were not hired merely to develop systems, but also to transfer their expertise to the in-house staff. For example, some projects first hired trainers to teach a one-week class on a new application development tool, (i.e., *PowerBuilder*), and then contracted with the trainer to serve as a coach for the project team. Several respondents commended the value of this hands-on learning, guided by coaches or "subject matter experts." In fact, the Director of Technical Training was often quoted for his statement that "90% of learning goes on outside the classroom," and he advocated conducting more reskilling using the two-phased strategy of classroom training, followed by hands-on mentoring, despite the extra cost.

Regardless of the specific activities that were used to impart the necessary skills for client/server development, there was a general assumption that management ought to provide the direction and specific activities for skill-transfer to employees, rather than having employees take this initiative to figure it out on their own. This was formalized in the Sector Transition Plans, whereby each manager developed a structured plan for the skill changes that would occur, including specific reskilling activities.

Content of Reskilling

In 1994, a structured "client/server curriculum" was developed by Technical Training, comprised of more than 20 courses. Separate curriculum tracks were established for application developers, network support personnel, and managers who sought a broad overview of client/server (both user and IS managers). While the new client/server curriculum focused on the technical and system development process skills, there was widespread discussion of the need to update both the business knowledge and interpersonal skills of IS employees. The CIO articulated this need:

IS historically has attracted a fairly analytic, heads-down, focused kind of person. We're in a different business now. We're really in a consultative business to a large measure, so a lot of the ... [changes] over the last couple of years have focused on the behavioral side of how

we do what we do, and trying to change the behavioral focus from being inward and technologically-focused to being externally- and customer-focused. [We need] to try to help people transition from the more heads-down introspective roles and behaviors that were successful and appropriate in the past when IS was a large, centralized function in a much more simplistic technology world ... to the behaviors that we believe are the success factors of the future: focusing on customers, people-orientation, quality, teamwork, those kinds of things.

In general, the interviews revealed frequent references to the *need* to change the culture of the IS workforce and its relationship with the business units, but considerably less discussion of the *actual* changes that were occurring in these areas. This disparity may be explained in one of two ways: either respondents believed that the IS culture could be altered through sending respondents to training classes (e.g., to learn about business issues, interpersonal skills, and customer relationship management), or they believed that culture change would be difficult to achieve. Evidence exists to support both explanations. The perception that formal training would succeed in triggering the required changes was stated by one IS manager:

It's a culture change for this company to change it from a stodgy insurance company to a vibrant financial services company that can change and be agile, flexible, strong. A big, big, big change. There's a whole education process [such] that all the managers in the company are required to take so many courses ... and all that is on change, transformation, and leadership... We are breaking down the barriers ... in terms of the internal workings of the company in terms of our people. That's what they're trying to do is change the direction of this company. And people look at [Insureco] as a major, stodgy institution. It's changing. It *is* changing.

Despite explaining the training and development activities they were required to complete, some managers admitted their skepticism that such changes would be occur. Some evidence was provided by IS managers who suggested that inertia comes from middle managers, who seek to protect their own interests.

It's like trying to turn around the Queen Mary in Boston Harbor. And it isn't going to be easy.... People are saying, "how do you get the bottleneck — which is sometimes the manager — to do that?" Sometimes the answer is that you remove the manager to get rid of the bottleneck.

One mid-level IS manager herself conceded the resistance that many middle managers feel in reaction to this rapid culture change.

They [senior management] tell us to "go out of your bounds, don't put blinders on, go outside the status quo!" Well that's easy to say, but awfully hard to do. They are saying, "we want the company to change; we want it to go in this direction," but we are not sure. We are testing the waters all the time to see if it's changing in the direction that's good [for us] — that we want it to [change].

The CIO blamed the resistance not just on Insureco's organizational culture, but also on the type of personality profile that is pervasive across the IS profession:

In spite of the fact that IS has been a change agent, IS people do not like change, and do not adapt well to change. There is a real dichotomy between what they do to others, and what they can deal with in their own sphere. [They are] very left-brained, very structured, very analytical.... The systems people resist change more than anyone else. It's rather ironic that we're in this incredibly dynamic field, and we're the biggest change resisters. Especially at a company like this, where we have people that have stayed around in the systems areas longer than at other companies.

Individual Attributes Associated with Success in Reskilling

Given the set of changes that Insureco defined as necessary and the obstacles posed by organizational inertia, one case study objective was to document the attributes perceived as required or useful for IS employees to successfully adapt to the required changes. Four of these attributes, identified by respondents, are described below: tolerance for ambiguity, willingness to adapt to change, a creative cognitive style, and openness to accept a broader role set in the system development function. Age was also identified as a factor, since several managers perceived that it was inversely correlated with employees' willingness and ability to accept these changes. This section describes the four attributes identified by respondents, and then concludes with respondents' perceptions of the link between these attributes and age. Before describing these attributes, it is important to underscore that the notion of individual differences in ability to adapt was first raised in the initial interview with Insureco's CIO. Without prompting, the CIO suggested the importance of individual differences:

I think the IS community, in general — or at least in this company — is divided into 3 segments. There is a segment that will not and cannot adapt to that [set of changes]. To the extent that there are still viable jobs on the mainframe ... where you come in and do the same thing day in and day out ... those people better be the ones in those jobs, because they are not going to adapt. Then there's a group in the middle that still thinks that maybe the world of 1978 is going to come back again ... but they are moldable, they're trainable, that's the

challenge group.... They are longing for the good old days, but they still have a lot of opportunity to change. And then there is the group that's just clearly energized ... So the trick is to get the right people in the right places, and to concentrate energies on that middle group, and help people learn new skills, learn new behaviors and be successful.

Tolerance of ambiguity. Several respondents described the need for IS employees to work in an environment with more ambiguity — where procedures were less straightforward. Developers cannot expect the same structure and precision that they were accustomed to in developing mainframe systems. One manager who led Insureco's first client/server project described a paradox of working in the client/server environment. On the one hand, there is a great deal of technological uncertainty, because many of the technical issues are new. This requires that the employee be comfortable in accepting ambiguity. This project manager said:

A person who is able to work and proceed with so many unknowns is the type of person who can do this. Here, we work with so many unknowns — if we wait until we are certain to make a decision, we won't get this done; it will be a roadblock.

On the other hand, the steps that might appear logical for employees to reduce this ambiguity — by drawing on their prior technical knowledge — is a misleading solution, because old technical skills do not necessarily transfer to the new environment:

It is important to be willing to admit that you don't know everything — particularly to yourself. If you don't admit this, then you fall back on relying on your experience — which can give a false sense of security of knowing what to do... The fact that you have worked in systems before is not a contributing factor [because] you don't know which of your skills are directly transferrable to this [client/server] project.

Capacity to Adapt to Change. Willingness to change — to learn new skills and roles — was the attribute most frequently cited at Insureco as necessary for adaptation. Many respondents suggested that adaptability to change is critical in determining a person's potential for reskilling. For example, one respondent said that successful adaptation requires "people that can embrace change and get excited about change." One IS manager mentioned the construct of *resilience*, citing a current book, *Managing at the Speed of Change* (Conner, 1992), which she had recently read. She defined resilience and emphasized its role in helping staff to adjust to change.

Resilience is the capacity to change — the ability to bounce back, to come back to fight a battle another day.

Resilience — or capacity to change — transcends a specific skill set (e.g., client/server development) and can prepare employees for any future technologies that may come along:

Change is a way of life, and the quicker you can react and respond, the more successful the company and IS organization will be. And my hope is [that] someday more people within my department — and the IS function in general — will look at change as an energizer and a good thing, and really be excited about the *organicness* and the amount of change, rather than overwhelmed by it ... the way it's looked at today.

Creative Cognitive Style. A similar, but distinct, attribute was the need to have a certain cognitive style which allows employees to be more innovative when dealing with new technology. This attribute was described in the context of allowing employees to work with new technologies. One manager cited an in-house management development seminar that focused on four types of cognitive styles, arguing that dealing with complex, distributed technology requires employees to be both intuitive (right-brained) and global, rather than procedural-oriented.²⁴

Visual Basic is more complex ... and there are some people that aren't going to get it ... There are not procedures to follow — as there are in doing mainframe work — procedures to [diagnose and] fix something. Troubleshooting PCs and LANs is not procedural — it's an intuition.

This manager explained that IS employees who are accustomed to a very procedural, left-brained style of thinking would have great difficulty adapting to the skill set required for client/server development.

Acceptance of Broader Role Sets. Several respondents emphasized how much the set of roles for IS employees had changed with the adoption of client/server systems. Several managers suggested that IS developers working in a traditional mainframe environment had a narrow concept of their role — one focused solely on coding application software. This was

²⁴ These terms derive from the Hermann Brain Dominance profile, which identifies two dimensions of cognitive style: right- versus left-brained (also called intuitive versus procedural), and global versus detailed. Four quadrants of cognitive function are identified, based on combinations of these dimensions. The manager cited above claimed that working in a client/server environment primarily requires a right-brained, global style.

acceptable in the traditional mainframe environment, where application software was distinct from both the hardware and operating system (and where technical specialists were designated for the latter components). One manager said:

In banking and insurance, a job in IS previously meant understanding COBOL. Now there is so much more to learn.

In the client/server environment, however, there is much more integration and overlap between the various components of the client/server architecture, and developers must understand the complex interactions between these components (workstations, servers, printers, application software, and network operating systems). Today, software developers must assume broader responsibilities. In particular, when something fails, the cause of the problem is often ambiguous, and the developer must accept broad responsibility for diagnosing and resolving problems:

The problem is the entrenched people — they are hung up on what their roles should be. They think, 'we are *application programmers*.' I contradict them and say, 'no we're not; we're *technologists*'. Some of these people won't make the transition." Their attitude is "I don't know, I don't *want* to know, I don't *have* to know."

Age as a Constraining Factor

For all four of the traits described above, respondents suggested that age was at least partially an explanation for why some employees lacked the willingness or capability to change. While no respondent suggested that age was the *only* explanation for employees' inability to change, nevertheless, it was perceived by many respondents to be correlated with the various other attributes necessary to change. One manager explained:

Age is one of the factors that does influence employees' ability to adapt to change. Seven or eight people in this division would drop dead if they had to do [client/server development]. They can't compare it to anything in their background. Some people are in their forties and fifties, and age has something to do with it.

A second manager characterized the different attitudes she perceived from older versus younger employees:

Many of the older employees are just waiting, looking toward retirement. They expect that the company should train them on company time, rather than showing initiative themselves. They have the 'send me to a class' mentality... But the young people, they are going out and buying their own PCs, eating them up.

Obstacles to Change

Beyond individual demographic variables (age), there were other attributes that were perceived as preventing the necessary changes, such as a "sense of entitlement" and the belief that the firm should bear responsibility for leading them through the required changes. Such common beliefs among "entrenched people" were perceived as obstacles to change — regardless of much resources were dedicated to training. It was ironic that the tremendous resources represented by Insureco's Technical Training facility and staff were identified as part of the problem, or at least one factor which reinforced the "sense of entitlement." Such a strong emphasis on the company's responsibility for leading the reskilling initiative suggests a paternalistic relationship between Insureco and its employees. Such a relationship implicitly devalued the importance of individual initiative and fostered a dependence, alternately described by respondents as the "send me to a class" or the "do it to me" outlook on training.

Despite Insureco's structured, ambitious, and generously-funded efforts to reskill the IS staff, some respondents were critical of the approach. Some managers believed that Technical Training was too strongly focused on providing technical skills "training" rather than "educating" IS professionals more broadly for the future. One manager, in particular, believed that the fundamental changes in roles and mindset of IS professionals required more than sending employees to classes.

We need to rely more on mentoring, coaching, and .. on our own people's ability to take the initiative, to do the reading on their own. That's the other issue — the culture here. People will not do things on their own. They are sitting there and asking [management] "what are you doing for me?"... Reskilling here has been very dependent upon the company doing things. We are trying to change that mindset, to help people to see "you need to take the initiative too." No one reads trade journals here. No one attends Boston Computer Society, or any other networking [opportunities] here. If you talked to people here, they wouldn't know what the internet is. So, there is not that self-education taking place that needs to take place.... I'm not blaming people. I'm saying that is the culture at [Insureco], and change management is the toughest thing. Trying to get people to change: that's our biggest hurdle right now. It's not getting people to learn C++, but trying to figure out how we can get them to understand how they can do things — all the time — differently.

A second IS manager agreed that the emphasis on class training as the primary mechanism for changing the skills sets was at best inadequate, and potentially even wasteful, because employees may not utilize the skills in a timely manner.

What's the use of taking a class if you're never going to use it or if you don't understand the context?

A third manager said that formal training could not prepare Insureco's IS staff to function in new ways and, for this reason, his project teams relied on consultants to play a key role. He believed that Insureco's IS staff could assume new roles sometime later, but only if the scope of change and the timeframe were long enough:

We can't [just] look out one year from now, and try to reskill for that. There is a client/server technology world right now, but what's beyond that? Or is client/server going to be around here for the next five years? Now is the time we ought to be looking three to five years out, so we're not in this predicament again, next year. Let's start focusing for the future world. It's too late to reskill people for current projects, is my feeling. All the classes in the world will not allow us to put people on projects to hold the types of roles that we need for these client/server projects... So we've closed out the opportunity to reskill — to just "boot camp" — to put them on the project.

Summary of Insureco's Culture and Implementation Strategy

In general, Insureco is a firm that has been traditional in its use of IT. Furthermore, both the culture of the overall organization and that of the IS function are described as bureaucratic, insular, and slow to change. The company assumed a paternalistic role toward employees in the past, with good job security, and plentiful training on company time. Such factors are perceived as having contributed to a conservative culture among Insureco's IS department, where a "sense of entitlement" prevailed. IS employees were not pushed to focus on the business and many of them, in turn, appear to have become complacent in their jobs or, in the words of various respondents, insular, introspective, heads-down, and technologically-focused.

In terms of managing innovation in IT, Insureco's IS function still follows a hierarchical approach, despite having its application development groups decentralized to the business units. The large and authoritative Corporate Information Services division plays a "driving role" in the technology standards-setting process for all business units, strongly discouraging the use of non-standard technologies. The implementation of client/server technology has been managed in a centralized fashion as well, funded through both the CIO's office and Human Resources departments, coordinated by the Technical Training department, and led by external management consultants. Individual attributes perceived as necessary for individual adaptation include tolerance for ambiguity, adaptability to change, willingness to assume broader role sets, and a cognitive style which facilitates learning complex new technologies. Age was also identified by several respondents as a factor that undermines employees' capacity or willingness to adapt, since they perceived it as negatively correlated with the above traits that enable change to occur.

Summary of Key Contrasts between Chemco and Insureco

There were many points of contrast between Chemco and Insureco. The two firms competed in different industries — chemical manufacturing versus insurance. Chemco was very innovative in its use of IT (and has received strong recognition for many of its accomplishments), while Insureco was very traditional both in terms of the technologies employed and in terms of the barriers that existed between its IS function and business departments. There was more emphasis on challenge and autonomy for individual IS employees at Chemco, whereas at Insureco, there was more discussion of an overall implementation plan and structured training curriculum. At Insureco, most respondents spoke about the *need* for IS employees and managers to change their mindset and workstyle, but it was unclear whether such changes were taking place or whether they would occur over the long-term.

Insureco had a highly visible Technical Training function with significant financial and physical resources at its disposal, while Chemco had no department charged with training for IS employees. Insureco's implementation of client/server development was much more centralized, both in terms of having corporate standards to follow, as well as a committee composed of senior IS managers and management consultants overseeing the implementation of client/server and reskilling of IS personnel. While Insureco revised and published its detailed corporate technology standards on a quarterly basis, Chemco had no centralized technology standards at the time of this study. Rather than adhering to a standard approach within each IS division, IS managers in the three decentralized IS divisions were free to tailor their choice of technology standards, reskilling approaches, and decisions about using external *partners* to the needs of their respective business units.

Although many similar individual attributes were mentioned in both firms as necessary for employees to adapt to the client/server environment (tolerance of ambiguity, capacity for change, prior experience in reskilling), several Insureco respondents mentioned a concern that age, seniority, and a "sense of entitlement," among IS employees could pose obstacles to change. At Chemco, no respondent mentioned age or seniority as important considerations — either as potential enablers or constraints to change. Instead, Chemco respondents emphasized the high performance standards that IS employees had been expected to meet in the past, and that all IS employees with a positive attitude to change and perseverance were likely to be successful in adapting to client/serve development.

Chapter 5

Elaborations to Theoretical Framework and Statement of Propositions

This chapter translates the insights from the field studies of Chemco and Insureco into modifications to the theoretical framework presented in Chapter 3. Specifically, the insights regarding specific needs/values and specific skills are used both to add to existing constructs in Chapter 3, and to create new constructs, representing those individual attributes that were shown to be important for individual adaptation to client/server development. The structure of this chapter is first to summarize the findings from Chapter 4 that have implications for the theoretical framework, next to review the literature and identify suitable scales to measure each construct, and third, to state formal propositions for each construct in the framework.

Importance of Individual Adaptability to Change

One important insight from the field studies is that the assumption of a static correspondence framework (such as the Theory of Work Adjustment), which assumes a "fit" between the person and the environment may be too simplistic for predicting either job satisfaction or performance in a rapidly-changing job environment. Although there must be some relationship between the independent variables in the TWA¹ and the outcome variables (satisfaction, performance, turnover intentions), the relationship implied by the fit is not static, but dynamic. This means that, beyond individual characteristics — such as need and skills — other attributes describing their capacity for change may be needed to explain their likelihood of accepting and adapting to technological changes. Such attributes may, in turn, influence employees' job satisfaction, performance, and turnover intentions. The existing constructs from the TWA describe only employees' static fit to the job requirements and work environment *at a single point in time*, but not their willingness or ability to adapt to changes *over time*.

¹ This includes employees' needs and values, job reinforcer patterns, employees' skills and abilities, and the skills required in the job.

Researchers have noted that IS professionals are "change agents" who are good at imposing change on other employees in the firm, but they do not welcome or deal well with changes to their own routines (Orlikowski, 1989, 1993). Vitalari (1991:17) argued that:

The systems development profession is undergoing a social, managerial and technological transformation ... [but] ironically ... the function that implements change and innovation for other departments is cautious about changing itself.

This may explain why IS departments are so concerned today with identifying those IS employees that have the right mix of skills, enthusiasm, and initiative to adapt to rapid change (*Datamation*, 1994, *Computerworld*, 1995).

In contrast to the assumption of the TWA that employees are *fit* for particular jobs by virtue of their needs or skill sets, the field studies showed that it is critical for employees to be adaptable. The next sections describe three individual attributes that were cited by IS managers and employees, and reviews literature on each. These attributes are conceptualized not as *replacements* for the existing constructs in the TWA, but rather as *elaborations* to the framework. These attributes were identified as important for IS professionals to adjust to the client/server environment: *tolerance of ambiguity*, being *creative* or *innovative* in applying old knowledge to the new work environment, and being *resilient* enough to withstand the stresses associated with rapid change.

These three attributes differ considerably from those personality traits that have traditionally characterized IS employees: a high need for challenge, structure, and clarity, a low need for social interaction and a technical orientation (Couger & Zawacki, 1980). Having a high need for challenge is still important for IS employees who must confront the changes associated with client/server development, but they must now be motivated by more than just *technical* challenge. In addition, IS professionals must be motivated by the challenges of working

closely in teams with business users, of learning more about the business, and developing their abilities to manage projects and relationships with users and third-party contractors.

These attributes required for IS employees to adapt — tolerance of ambiguity, innovativeness in adapting to new work practices, and resilience in the facing of stress induced by rapid change — are directly contrary to the need for structure and clarity that have traditionally been emphasized in IS work. This suggests that some traditional or veteran IS professional may be mismatched to the demands of the IS profession today (Stokes, 1995; Ziff, 1993).

In summary, the field studies of Chemco and Insureco suggest that explanations of individual adaptation to a changing work environment should include individual attributes beyond those already represented in the TWA framework. The framework must be expanded to include individual attributes such as tolerance of ambiguity, innovativeness, and resilience stress.

Summary of Literature Related to Individual Attributes

The following section briefly reviews the relevant literature for each of these attributes (tolerance of ambiguity, innovative style of creativity, and resilience to stress) and identifies propositions related to each.

The academic IS literature has downplayed the potential role of individual attributes (other than demographic variables) that may influence job satisfaction and performance. Recently the IS trade press has begun to focus attention on this issue (*Datamation*, 1994; *Computerworld*, 1995). Such articles have revealed the lengths to which IS departments have gone to pre-screen individual job applicants for hiring or to screen existing employees in deciding whom to train on new technologies.² Thus, a broader review of the organizational

² The IS trade journals have mentioned several proprietary personality instruments that have been used by IS departments, including the Myers-Briggs Type Indicator, ODR's Personal Resilience Profile, and the Cambridge Assessment Centre's Cambridge Assessment Method, and the Kolbe Conative Index (which measures "instinct.")

literature on individual differences for other types of employees was conducted to identify research related to the attributes suggested by the field studies.

Individual cognitive style has received much attention in the recent IS research literature, but the focus has been on users' rather than system developers' cognitive style. When cognitive style was first proposed as a factor explaining system users' reactions to and usage of computers (Keen & Bronsema, 1981; Robey & Taggart, 1981; White & Leifer, 1986), it was subject to much criticism. One researcher (Huber, 1983), even labeled the focus on cognitive style as "much ado about nothing," thus fueling a debate with researchers who believe that understanding individual cognitive style was critical to explaining computer acceptance and usage (Robey, 1983; Taggart & Robey, 1982). Recent research on cognitive style has shown its importance in shaping user attitudes toward computers, as well as determining the most suitable approaches for user training (Olfman & Mandviwalla, 1995; Santhanam & Sein, 1994; Sein & Robey, 1991; Bostrom, Olfman & Sein, 1990). Cognitive style has been widely studied in the psychology literature, with several different variables investigated. One cognitive style construct — tolerance of ambiguity — has been studied in terms of its relationship as a moderator between role stress and job satisfaction (Kahn et al., 1962; Katz & Kahn, 1978).

Tolerance of ambiguity.

Tolerance of ambiguity is an aspect of employees' cognitive style which helps them to function in situations that lack clear structure, guidelines, or black-and-white solutions. Tolerance of ambiguity has been widely studied, in response to research showing role ambiguity to be the strongest predictor of job satisfaction. Role ambiguity, defined as unclear job expectations, has been the focus of considerable study — both in the IS literature (Baroudi, 1985; Goldstein & Rockart, 1984; Igbaria & Guimaraes, 1993; Igbaria & Greehnaus, 1992) and in the management literature (Katz & Kahn, 1978). Furthermore, role ambiguity has been shown to diminish job satisfaction among several different types of IS professionals, including programmer/analysts (Baroudi, 1985; Goldstein & Rockart, 1986),

information center and end-user support personnel (Igbaria & Guimaraes, 1993) and even operations support (Igbaria & Greehnaus, 1992) .

Since role ambiguity itself is so deleterious to employee job satisfaction, researchers have studied tolerance of ambiguity as a capability that should, in principle, buffer employees from experiencing the negative consequences of role ambiguity. The converse of tolerance of ambiguity — intolerance of ambiguity — was originally defined by Budner (1962:29) as "the tendency to perceive ambiguous situations as sources of threat." Individuals with low tolerance of ambiguity, are uncomfortable when faced with ambiguous problems or social situations, and they become tense, dissatisfied, and often seek to withdraw from the situation (or avoid the assignment or problem). Individuals who are tolerance of ambiguity, however, perceive these situations as opportunities to excel, rather than as threats (Budner, 1962).

The fact that tolerance of ambiguity was proposed as a moderator variable between role ambiguity and job dissatisfaction means that the correlation between role ambiguity and job dissatisfaction should be weaker for employees who are tolerant of ambiguity, compared to employees who are intolerant of ambiguity. Research has demonstrated support for *some* connection between tolerance of ambiguity and job satisfaction, although without demonstrating conclusively whether tolerance of ambiguity serves as a moderator variable, or whether it is *directly* related to job satisfaction (Frone, 1993; Lysonski & Andrews, 1992; Keenan & McBain, 1979).³ Research on other professions has also shown tolerance of ambiguity to be positively related to job satisfaction (Glisson & Durick, 1988).

Innovative Creative Style

³ By definition, a true moderator variable has no direct relationship with either the independent or dependent variable, however it "moderates" the strength of the relationship between the independent (role ambiguity) and dependent variables (job satisfaction). Thus, the magnitude of the correlation coefficient between role ambiguity and job satisfaction should be much higher for individuals with low tolerance of ambiguity, compared to the coefficient for individuals who are highly tolerant. If role ambiguity were to also have a direct influence on job satisfaction (in addition to its moderating role) then technically it would not be a true moderator variable, but rather a *quasi-moderator* (Sharma, Durand & Gur-Arie, 1981; Baron & Kenny, 1986).

A second attribute closely related to tolerance of ambiguity is individuals' style of creativity. Respondents from the field studies mentioned the need for IS employees to be innovative, in terms of being agile in applying what they already know to novel problems and situations. There are two popular theories in the management literature, each of which proposes a typology describing different types of individual behavior related to creativity and learning: Kirton's *Adaption-Innovation Theory* (Kirton 1976; 1994) and Kolb's *Experiential Learning Theory* (Kolb, 1982). Both theories explain and create typologies to describe different types of cognitive preferences for creativity and learning, respectively.

Kirton (1976, 1994) classifies individuals into two styles of creativity — innovators and adaptors. Innovators are people who enjoy change, preferring it over stability. Innovators prefer changes that are both more frequent and more radical in nature; in contrast, adaptors prefer the status quo, but they can accept changes if they occur incrementally and less frequently. According to the Kirton's theory, Adaption-Innovation Theory does not measure the individual's *amount* of creativity, but rather their *style* of creativity. Some individuals are more open and accepting of change; they welcome opportunities to deviate from the routine, testing themselves in new circumstances.

Kolb's Experiential Learning Theory identifies four phases of learning, and classifies people into four learning styles, depending on which phases of learning they prefer. Kolb's categories are: convergers, divergers, assimilators, and accommodators. Although Kolb's theory has a different focus than Kirton's theory (since it identifies individual preferences for styles of *learning*, rather than styles of *creativity*), there are many similarities. Both theories classify individuals into different types, and both avoid making value judgments about whether one type is better than another.⁴

⁴ Kirton's Adaption-Innovation Theory was chosen for this research because the scale has been strongly supported in various studies. In contrast, studies have questioned the construct validity and factor stability of Kolb's instrument for measuring learning style.

Kirton's Adaption-Innovation Theory has been shown to be a stable predictor of managers' behavior when they were confronted with changes in their corporate environment (Clapp & DeCiantis, 1994). Adaption-Innovation Theory has also been shown to be useful in predicting computer usage of end users. For example, Foxall & Bhate (1991) have shown that employees who score higher on Kirton's scale (the Kirton Adaption-Innovation Inventory) are more likely have positive attitudes toward computers and to use them more frequently. Other studies have validated these findings by examining the influence of cognitive style on the variety of different software applications used and the frequency of computer use by senior managers and MBA students (Foxall & Hackett, 1992; Foxall & Bhate, 1991). Sein & Robey (1991) showed that when training novices to use computers, the training method must correspond to users' creative styles. Where such congruence exists (between users' creative style and the training method), the training outcomes are better, as demonstrated by users' retention and task performance.

The importance of understanding the relationship between a person's creative style and use of computer technology has also been studied for IS professionals. In particular, Couger (1992, 1994) has applied Kirton's Adaption-Innovation Inventory to explaining IS professionals' skills and performance. In one study, Miller, Couger & Higgins (1993) compared the creative styles of IS professionals with other professional workers, showing that IS professionals did had a less innovative style, compared to other types of professional employees.⁵ The link between individual and group creativity was demonstrated by Couger and colleagues, who suggested techniques for increasing IS departments' overall levels of creativity. This research examined the impacts of creativity-improvement training on the quality of system development products (Couger, Higgins & McIntyre, 1993), and on the quality of business process reengineering outcomes (Couger, Flynn & Hellyer, 1994).

⁵ By definition, if an employee is not innovative (scores low on innovativeness), then he or she is adaptive (Kirton, 1976). This terminology is somewhat misleading, because innovative employees are those who can best accommodate — or adapt to — rapid change. Due to reasons of complexity, I will use the expression "low on innovativeness" to describe employees who score low on Kirton's scale, rather than "high on adaptiveness."

Kirton's original scale (the Adaption-Innovation Inventory) has been shown to consist of three factors — originality, efficiency, and rule-conformity (Foxall & Hackett, 1992b; Taylor, 1989b). By definition, *innovators* score highly on originality, but low on the other two factors (efficiency and rule-conformity). In contrast, *adaptors* score in the opposite direction (low on originality and high on efficiency and rule-conformity). Several recent studies which validated Kirton's scale using large sample sizes has also identified a fourth factor — adaptability to change — that was previously merged with the originality factor (Taylor, 1989a,b). Innovators score high on this fourth factor (adaptability to change), since it is a sub-factor of originality. The KAI has been shown to have high validity and internal reliability (Bagozzi & Foxall, 1995; Taylor, 1989a), and stability over time, based on longitudinal studies of adults and children (Taylor, 1994; Clapp & DeCiantis, 1994).

Individual Resilience

Respondents mentioned a third attribute that is important for IS employees: having a positive attitude toward change or "embracing change." Such a positive attitude to change was described as critical to buffer the potentially stressful effects of rapid change. The psychological and organizational literature has identified several attributes to explain describing individual attitudes toward confronting and enduring the potentially stressful consequences of change: hardiness (Kobasa et al., 1982), and resilience (Rutter, 1974; Conner, 1992), learned optimism (Seligman, 1991) — or its converse, learned helplessness (Seligman, 1977). Some of these constructs have been used more to explain the physical health consequences of different personality traits (hardiness), while others have been shown to influence both physical and mental health outcomes (resilience and learned optimism). All three of these traits (resilience, hardiness, and learned optimism) have been shown to serve as buffers to stress (and learned helplessness is a mindset associated with stressful outcomes).

None of these psychological attributes has been studied in the IS literature, although the resilience has been examined in both the management and psychological literature, As early as 1974, the groundwork was laid for understanding the components that are associated

with a resilient personality (Rutter, 1974; Lazarus & Folkman, 1981), and recently, Conner (1992) has used resilience to describe how managers confront and manage rapid change (Conner, 1992). With his consulting firm, ODR,⁶ Conner has examined the detailed factors and processes that underlie a person's ability to cope with change and developed a 75-item scale, the *Personal Resilience Profile* (ODR, 1992; 1994). The assumptions underlying the theory and scale are that resilience is comprised of seven interdependent factors:

- having positive beliefs about oneself
- having positive beliefs about the world
- having flexible thoughts
- being flexible socially
- being focused
- being organized
- being pro-active

Given the many factors it encompasses, resilience is a broad construct related to individual attitudes to and readiness for change. It incorporates certain assumptions about users' attitudes toward novel situations (similar to both tolerance of ambiguity and Kirton's innovativeness, but it is a broader construct because it is concerned with individual behavior rather than just attitudes.⁷

The IS trade press (Datamation, 1994; Computerworld, 1995) have described the ODR's instrument (the Personal Resilience Profile) and claimed that IS departments are among the most frequent users. The instrument's internal reliability and validity (ODR, 1994, 1996) have been documented, and some recent dissertations have studied the outcomes between resilience and its relationship to exercise behavior (Colgate, 1996) and to individual "cause

⁶ ODR (Organizational Dynamics Resources) is located in Atlanta, Georgia.

⁷ In fact, the subconstruct called "having flexible thoughts," is similar to tolerance of ambiguity, and several of the items on this sub-scale derive from the tolerance of ambiguity construct.

maps" generated during organizational change processes (Weber, 1995). According to descriptions of its use in IS departments, (Datamation, 1994; Computerworld, 1995), the PRP has been used to evaluate job candidates or to select existing employees for re-training. The Personal Resilience Profile was selected over other measures (hardiness, learned optimism) for this study, because there is a lack of research criticizing the scale's construct validity and factor stability.⁸

Propositions to be Tested

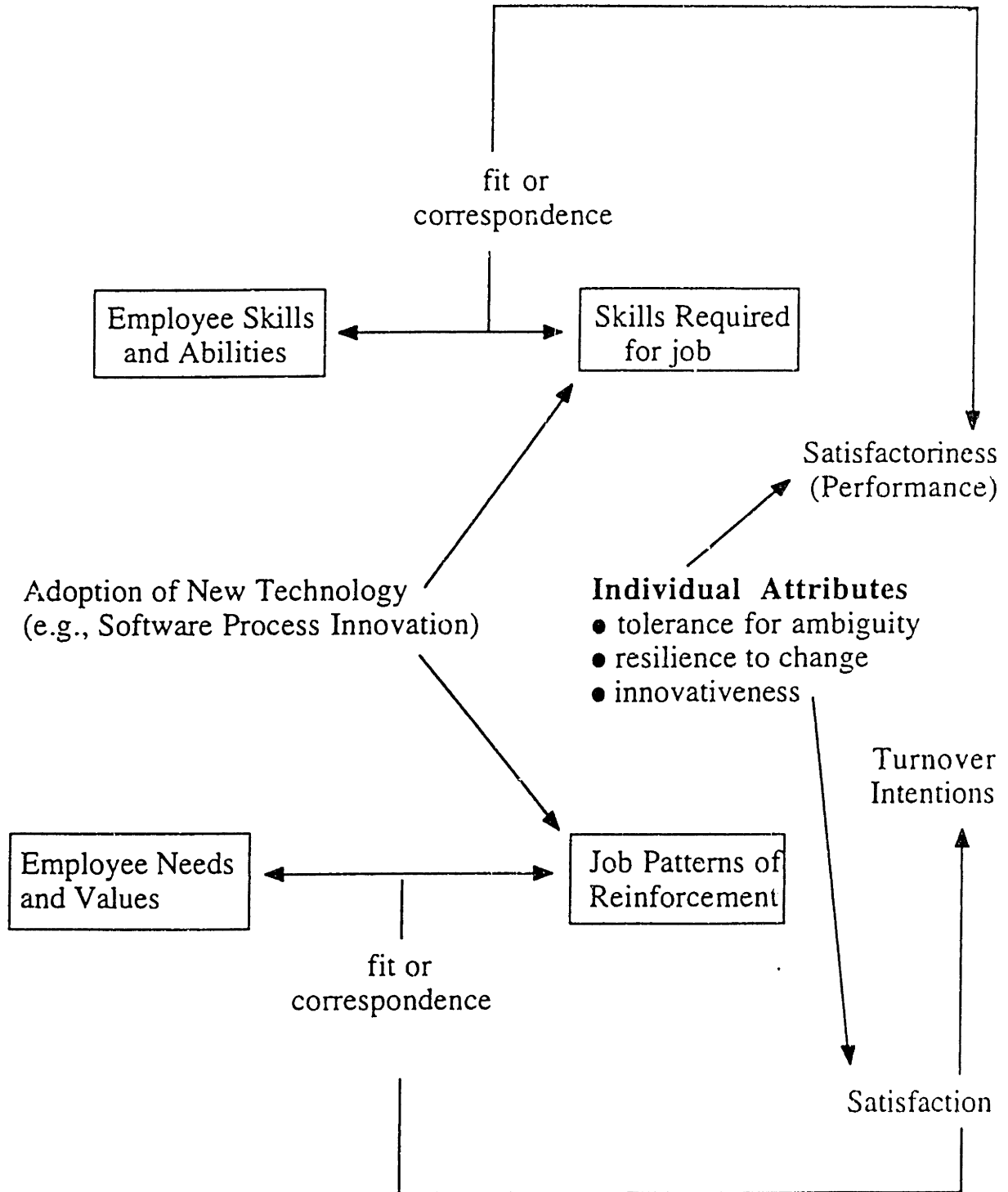
Based on the literature review, the relationships in Figure 5.1 are presented as propositions to be tested. In addition, due to fact that the "conventional wisdom" that older (or more experienced) will have greater difficulty adapting to client/server development, propositions representing these assumptions are stated in null form (Propositions 1, 2, 11, and 12).

- Prop. 1: Employees' *age* will be unrelated to job satisfaction.
- Prop. 2: Employees' *job tenure* will be unrelated to job satisfaction.
- Prop. 3: The fit between *employees' need/values* and the *patterns of reinforcement* provided in their current job will be related to job satisfaction.
- Prop. 4: Employees' *tolerance of ambiguity* will be positively related to *job satisfaction*.
- Prop. 5: Employees' *personal resilience* will be positively related to *job satisfaction*.
- Prop. 6: Employees' *innovativeness* (style of creativity) will be positively related to *job satisfaction*. Since each of the cognitive style variables is proposed as a predictor variable explaining job satisfaction in addition to the job fit factors specified by the Theory of Work Adjustment, each of the propositions 4-6 is restated in a stronger form:
 - Prop. 7: Employees' *tolerance of ambiguity* will be positively related to *job satisfaction*.
 - Prop. 8: Employees' *personal resilience* will be positively related to *job satisfaction*.

⁸ In contrast, although both hardiness (Kobasa et al., 1982) and learned optimism (Seligman, 1991) have corresponding instruments that have been around longer, there is more research that criticizes their measurement properties, showing that the empirical results do not support the theoretical formulations. It is possible that the Personal Resilience Profile has simply not been in existence long enough for such studies to accumulate.

- Prop. 9: Employees' *innovativeness* (style of creativity) will be positively related to *job satisfaction*.
- Prop. 10: Employees' *job satisfaction* will be positively related to their *turnover intentions*
- Prop. 11: Employees' *age* will be unrelated to their *job performance*.
- Prop. 12: Employees' *job tenure* will be unrelated to their *job performance*.
- Prop. 13: The fit between employees' skills/abilities the skill requirements of the job will be related to their job performance.
- Prop. 14: Employees' *tolerance of ambiguity* will be positively related to *job performance*.
- Prop. 15: Employees' *personal resilience* will be positively related to *job performance*.
- Prop. 16: Employees' *innovativeness* (style of creativity) will be positively related to *job performance*.
- Prop. 17: Employees' *job performance* will be unrelated to their *turnover intentions*

Figure 5.1
The Theory of Work Adjustment
As Applied to Software Process Innovations
Includes Cognitive Style Attributes



Willingness to Learn

One additional insight provided by field study respondents was the belief that individual initiative and willingness to learn are necessary conditions for IS employees to learn and adapt to client/server development. Several respondents emphasized that learning to develop systems in the client/server environment is not merely a question of learning new technical skills, but of knowing when to draw upon prior knowledge, and how to adapt it to fit the technology and system development processes. Thus, initiative and willingness to learn were frequently emphasized by respondents at Chemco and Insureco, rather than intellectual ability or technical wizardry. This emphasis on individual initiative and willingness to learn was reinforced by another study on implementing client/server development. Based on an analysis of six firms that had implemented client/server development Beath, Ross & Goodhue (1993) concluded that:

Client/server changes the skill requirements for IS professionals ... [and] demands that IS professionals rely more on learning and less on what they [already] know. They need to engage more aggressively in continuous education and self-teaching than has traditionally been the case... IS professionals often learn these new technologies by experimenting with them.

— Beath, Ross & Goodhue, 1993: 17

A related insight from the field studies was that making the transition from mainframe to client/server development requires not just a one-time, step-function change in IS employees' skills, but rather an ongoing process of learning and adaptation. The relevant question for assessing an employee's potential for succeeding is not simply "can employees learn a specific skill set necessary to perform client/server development?" but instead "do employees have the necessary curiosity, ambition, and perseverance to acquire new skill sets necessary for succeeding in the client/server environment?"

If employees' willingness or capacity to acquire new skills is more important than their current skills set (at a particular point), this suggests the need for some changes or additions to the TWA framework: employees' need for learning and challenge should be incorporated as one measure of their needs and values. This will be included in the Job Preference

Inventory (JPI). This does not add a new construct to the framework, but merely suggests new items to include within an existing construct (employees' needs and values). In prior research on the JPI, Sein & Bostrom (1991) suggested one new item to capture IS employees' desire for learning.⁹ The field studies show that it is important to capture each IS employees' desire not only for technical learning, but also their desire to learn more about the business itself and about managing projects and relationships. Thus the following items are suggested for the JPI scale, and these can be evaluated within existing Proposition 3.¹⁰

Within the existing proposition:

The fit between IS employees' desire for learning and the opportunities for learning provided in their current job will be related to job satisfaction. This need for learning can be measured in three areas:

- the opportunity to learn new technical skills
- the opportunity to learn about the business itself
- the opportunity to learn project management skills

⁹ Sein & Bostrom (1991) proposed adding a single item to the JPI: "How important is it for you to have a job that provides the opportunity for learning?"

¹⁰ Proposition 3 states that: The fit between *employees' need/values* and the *patterns of reinforcement* provided in their current job will be related to job satisfaction.

Chapter 6

Data Collection Methodology for Survey Research

This chapter describes the procedures by which the employee and manager versions of the survey were developed and administered. Items to measure the constructs from the conceptual framework described in chapters 3 and 5 were either derived from prior research or created. In developing the survey instrument, three objectives were pursued: 1) to locate common scales that have been frequently employed in IS or management research; 2) to employ scales that are reasonably short, in view of the many constructs in the conceptual framework, and 3) to achieve high internal reliability of each construct. Decisions regarding which scales to employ were made in order to optimize all three objectives. Where multiple scales existed to measure a certain construct, I selected the scale most frequently used in published research. If multiple scales were common, and assuming that other attributes of these scales were similar (reliability, validity), then the scale containing fewer items was chosen.¹

After selecting existing scales to measure each construct, items were deleted from the scale prior to administering the survey if prior research had identified certain items as problematic, or if published internal reliability statistics showed some items to load poorly on the construct (specifically if item-to-scale correlations were less than 0.50). Given the many constructs in the conceptual framework, the objective was to minimize total survey length, while justifying deleted items on the basis of prior research. Although internal reliability analyses were planned for all constructs based on the completed data, I specifically deleted questionable items prior to administering the survey — again, in keeping with the objective of minimizing the overall survey length.

¹ For example, there were two job satisfaction scales that were both frequently used (Smith, Kendall & Hulin, 1969 and Weiss, Dawis, England & Lofquist, 1967). Since the goal was to find a set of items focused on satisfaction with the job itself, the Smith, Kendall & Hulin's *Job Descriptive Index* (1969) was chosen because it featured an 18-item subset which was shorter than Weiss et al.'s 72-item *Minnesota Satisfaction Questionnaire* (1967).

Survey Version for IS Employees

The complete version of the survey for IS employees consisted of 176 items. A printed copy of the full employee version of the survey is contained in Appendix 6.1. Table 6.1 shows the number of items related to each construct in the employee survey. Despite the large number of survey items, only a small fraction (about 4%) were open-ended questions; the other 96% of the items were either 7-point Likert scale items or closed-ended questions. The open-ended questions are listed in Table 6.2.

In addition to choosing existing scales to operationalize most constructs in the conceptual framework, some constructs required new scale development. Original scales were developed for two constructs, as shown in Tables 6.3 and 6.4: *Technology and Work Process Changes related to Client/Server Development* and *Reskilling Approaches for Learning Client/Server Development*. For the first construct, *Technology and Work Process Changes related to Client/Server Development*, the objective was to identify specific changes associated with client/server development that had been implemented within the previous 18 months. Although survey respondents had been pre-screened to ensure that they were members of departments that had adopted *some* software process innovation,² the field studies demonstrated that the specific tools and other innovations varied across IS departments within the same firm. Furthermore, the field studies revealed that some IS departments were utilizing multiple innovations, each geared to a specific part of the system development cycle. For example, one department may have adopted *PowerBuilder* as their front-end application development tool, joint application development (JAD) as the methodology for specifying user requirements, and Sybase SQL as the back-end database management system.³

² This process of pre-screening potential respondents was accomplished by interviewing IS managers face-to-face or over the telephone.

³ The terms *front-end* and *back-end* are frequently used to describe components of the client/server architecture, and these terms are analogous to the terms *client* and *server*. *PowerBuilder* is a front-end innovation because it is used on the *client* workstation, whereas Sybase SQL is a back-end innovation, because it runs on the *server*.

Table 6.1
IS Employee Survey Version

# of Items	Construct Name	Question Prompt	Source of Scale
7	Technology and Work Process Changes related to Client/Server Development	"During the period from late 1993 until now, have you begun using a new ..."	<i>(original scale)</i>
1	Most Critical Change	"Please specify the change that has made the greatest difference to your work."	<i>(original item)</i>
18	Attitudes toward Software Process Innovation	"In my opinion, the [software process innovation] ..."	Moore & Benbasat (1991) Segars & Grover (1993)
5	Reskilling Approaches for Learning Client/Server Development	"Please reflect on how you learned to use the new tools and methods listed above."	<i>(original scale)</i>
21	Job Preference Inventory (JPI)	"How important is it for you to have a job that ..."	McLean, Tanner & Smits (1991)
21	Job Characteristics Inventory (JCI)	"My present job provides ..."	Sims, Szilagyi & Keller (1976)
21	Importance of Job Skills	"How important is the following skill or ability for performing your job?"	Goldstein (1988)
13	Job Descriptive Index (JDI)	"The work I perform is ..."	Smith, Kendall & Hulin (1969)
23	Kirton Adaption-Innovation Inventory	"I would describe myself as someone who ..."	Kirton (1976)
21	Personal Resilience Profile	(no general prompt)	Conner (1992); ODR (1993)
8	Tolerance for Ambiguity	(no general prompt)	MacDonald (1970)
12	Demographic Variables	(no general prompt)	Goldstein (1988)
4	Turnover Intentions	(no general prompt)	Baroudi (1985)
1	Miscellaneous Feedback	"Would you like to provide any feedback on survey?"	<i>(original item)</i>

Table 6.2 (a)
Open Ended Survey Items

Construct Name	Item Name	Item Wording of Open-Ended Question
Approaches to Learning Software Process Innovations	LEARN-02	"Are there any other approaches that you used for learning the software process innovations (listed above) that were not included on the previous list?"
Demographic Variables: Job Title	DEM-07	"What is your job title?"
Miscellaneous Feedback	FEEDBACK	"Is there any other feedback you would like to provide about the survey?"

Table 6.2 (b)
Closed Ended Survey Items
Which Include "Other" as a Response Option

Construct Name	Item Name	Open-Ended Question
Demographic Variables: General Job Category	DEM-09	"Which of the following job areas best describes the work that you perform?" (option 7 = "other")
Demographic Variables: Hardware Platform	DEM-PA1	"Please identify the primary hardware platform for which you develop systems." (option 7 = "other").
Demographic Variables: Specific Job Tasks	DEM-PA2	"Please select each of the items below which corresponds to the tasks you perform in your job." (option 7 = "other")

Table 6.3 (a)
Technology and Work Process Changes
Related to Client/Server Development

"During the period from 1993 until now, have you begun using a new ...?"

Item Name	Item Wording
SPI-01	... programming language
SPI-02	... application development tool
SPI-03	... hardware platform for development
SPI-04	... approach for defining system requirements
SPI-05	... methodology for system design
SPI-06	... approach for involving business users
SPI-07	"Have there been any other changes in system development work?"
SPI-08	"Please specify the one change that has made the greatest difference to your work process."

Table 6.3 (b)
Items Measuring Reskilling Approaches for
Learning Client/Server Development

Item Name	Item Wording
LEARN-01	Please rank order the following activities in terms of how important they have been for learning new skills. Select the <i>most</i> useful learning activity, followed by the <i>second</i> most useful activity, and then the <i>third</i> most useful activity.
LEARN-02	Are there any other learning processes that you used to learn and reinforce your new skills that were not included above?
LEARN-03	Did you take any training classes to learn to use the new tools and technologies that you listed above?
LEARN-3a	(If yes to Learn-03) How many total hours of day-time training classes did you take?
LEARN-3b	(If yes to Learn-03) How many total hours of evening training classes did you take?

Given the variety of possible combinations of innovations employed, respondents were asked to answer the questions appearing in Table 6.3 (a) with a "yes" or "no" response. If their response was "yes," they were also asked to name the innovation (whether a product name or a methodology), and also the old one replaced by it.⁴ The items used to operationalize the construct, *Reskilling Approaches for Learning Client/Server Development* (in Table 6.3b) were developed to identify the different mechanisms used to reskill existing IS employees.

Developing the Diskette-based Survey

The survey was developed using a dedicated software package for producing diskette-based surveys, *Ci-3* (Computer Interviewing 3, version 1.1). The vendor of *Ci-3*, Sawtooth Technologies, initially developed this product for creating surveys for market researchers to administer over the telephone. *Ci-3* was later modified to allow researchers to mail a diskette containing the survey to potential respondents, and ask them to complete it on their own. The latter approach has been called computer administered data collection, *CADAC* (Saris, 1995), disk-by-mail (Mitchell, 1994), and computer-assisted personal interviewing, *CAPI* (Saltzman, 1993). *Ci-3* supports the creation of diskettes that can be self-administered by research subjects on any IBM-compatible personal computer.⁵ The relative advantages of the *CADAC* approach are touted in Carr (1991), Saltzman (1993), Mitchell (1994), and Hoo & Downes (1994). A more balanced approach to assessing *CADAC* as a survey research innovation appears in Saris (1995), who argues that controlled research studies have not been conducted to prove many of these claimed advantages. The *CADAC* or disk-by-mail technique has recently begun to be used in academic research (Fichman, 1995; Saltzman, 1993).

⁴ For example, if in response to the first question: "Are you using a new programming language?", respondents said "yes," then they were asked to name the new programming language (i.e., C++) and also the language that it replaced (i.e., COBOL).

⁵ When I purchased *Ci-3*, version 1.1 in November, 1994, only IBM compatible computers were supported, and in a DOS, rather than Windows mode. Sawtooth Technologies recently introduced a new, Windows-95 version of *Ci-3* in mid-1996 (version 2.0). Although the version 1.1 used in this research runs in DOS mode, it allows respondents the option of using either the mouse or keyboard to select responses to closed-ended questions. Furthermore, Sawtooth Technologies was in the process of developing versions for Windows-NT, UNIX, and Apple Macintosh.

Although the use of *CADAC*, including disk-by-mail surveys, is still somewhat novel, several advantages have been noted. These included the fact that disk-by-mail surveys:

- reduce the time necessary for respondents to complete the survey
- eliminate the need for a separate data entry step to prepare survey data for statistical analysis (since subjects input their own data).
- eliminate the risk of data entry errors by the researcher.
- offer the researcher flexibility, in terms of the sequence of items to be presented to a specific respondent.
- allow data to be validated for reasonableness and consistency across items at the time respondent enters the data; any discrepancies can be detected in real-time, and subjects can be prompted to reconcile them.
- allow the researcher to randomize the order of questions within a section, and/or entire sections of the survey.
- allow the research to specify that, based on a particular response to a question, that the survey should continue, terminate, or branch to a new section.
- allow respondents the opportunity to return to a prior question, in order to review, and possibly change their previous answers. (The survey developer decides whether this feature is utilized, and for which specific items the answers can later be modified).
- have been rated by subjects as more "enjoyable" or "fun" than completing a pencil-and-paper survey (Mitchell, 1994; Saris, 1995).

All of these features were present in Sawtooth Technologies' Ci-3 product, and nearly all were incorporated into the survey created for this study (with the exception of randomizing the item sequence). One final advantage of disk-by-mail surveys that positively influences survey response rates is the fact that subjects cannot see the total length of the survey prior to beginning it. Subjects are less likely to refuse to answer the survey due to its *apparent* length, since they cannot make assumptions about the survey length (Saris, 1995). Instead they must trust the researcher's estimate of the time it takes to complete the survey (in this

case, 25-30 minutes). A related benefit is that subjects are unable to browse or scan ahead in the survey, which may bias their responses to previous questions.⁶

Administering the Employee Disk-by-Mail Survey

The employee version of the survey was pilot tested in three rounds: First, it was distributed to members of the dissertation committee and to several MIT Ph.D. students. Second, it was administered to three experienced software developers from Boston-area high-tech firms. Third, one manager at each firm (Chemco and Insureco) reviewed the survey and provided feedback.

At each stage of pilot testing, the pilot subjects were asked to provide oral and written feedback regarding their impressions (with written feedback keyed directly to the survey diskette). Pilot subjects were specifically asked to report on any questions that were difficult to understand, problems with the survey instructions, or problems with the mechanics of using the disk-by-mail format. No serious problems were identified through the pilot testing, although a few additional items were suggested, and minor changes in the wording of instructions or optional help screen instructions were suggested. All pilot subjects reported that they found the mechanics of the disk-by-mail format to work well and they found the content to be interesting. Pilot testing of the survey also suggested that respondents would need approximately 20-25 minutes to complete the survey.

The final employee version of the survey consisted of 176 actual items (although Ci-3 stored the compiled version of the survey program as 260 items, due to its counting of instruction screens, and other idiosyncracies in counting closed-ended items with multiple possible responses. Some additional details are described in Appendix 6.2. Since the license for the

⁶ This is a particular advantage, since there may be many survey questions that only specific respondents need to complete, yet which add to the total length of the survey, and which might otherwise deter a respondent from completing it. For example, a survey may have 300 different items, but a most likely "path" through the survey of 100 items. With a printed survey, the potential respondent would see that 300 items exist, however, with disk-by-mail surveys, the software program controls whether subjects are asked these questions. Thus, depending on subjects' responses to previous questions, they may never know that the additional 200 items exist.

version of the Ci-3 software program purchased for this study only permitted a maximum of 100 "items" in a single survey, the survey was subdivided into three parts -- each with approximately 60 questions. Each part of the survey was saved on the diskette as a *separate* file (and hence, each part was treated by the Ci-3 program as a separate survey). From the respondents' perspective, however, the survey appeared as one continuous survey with brief pauses between parts. This solution of sub-dividing the survey into three parts and linking them together was accomplished through a simple DOS batch file program. This DOS batch file permitted the three parts of the survey to be administered in a specified sequence, achieving a work-around to the 100-item limit.⁷ Each part of the survey required approximately 8-10 minutes to complete, and thus, total completion time was estimated to be 25-30 minutes. Respondents were permitted to take breaks between completing each part of the survey. They were also allowed to discontinue the survey part-way through, and to resume at a later time.

The entire survey was saved on a single diskette, which included a printed label describing the instructions for starting the survey. In addition to the survey items, each diskette included a unique identifier number for each respondent and the Ci-3 programs required for respondents to run the survey on their IBM-compatible PC. Each diskette was packaged in an envelope along with a cover letter explaining the purpose of the research and a postage-paid diskette mailer for returning the survey.⁸ In addition to explaining the purpose of the research, the cover letter enclosed with the diskette described how to start the survey, as well as what to do when it was completed. Specifically, subjects were asked to enclose the diskette in the pre-paid diskette mailer and return it directly to the researcher. In accordance with procedures specified by the MIT Committee on the Use of Humans as Experimental

⁷ This work-around to the 100-item limit was chosen rather than the opting to purchase a more expensive version of the Ci-3 program. I rejected the option of upgrading to the 250-item or the 500-item version, which would have cost \$1,500. or \$2,500., in addition to the \$500. for the 100-item version. Sawtooth's pricing structure suggests that it is not intended to be mass-market software.

⁸ The per unit costs for the diskette, diskette mailer, pre-paid postage totalled to \$2.00.

Subjects (COUHES), respondents' names did not appear on the diskettes. The cover letter promised respondents that their responses would be confidential — but not anonymous. This distinction meant that the respondents' identities would be known to the researcher, but their responses — as well as the fact of their participation — would not be disclosed to employees or managers in their company. In compliance with the MIT human subjects ethics committee (COUHES) procedures, managers were not to be informed about which subjects did or did not return the survey, however, a follow-up letter was sent directly to non-respondents six weeks later, requesting that they complete and return the survey.

Approval of the appropriate managers from the two research sites (Chemco and InsureCo) was requested for their IS employees to participate in the survey. At ChemCo, a central contact person, responsible for IS methodology deployment, agreed to handle the details involved in gaining approvals and ensuring cooperation from managers of the appropriate IS departments. This greatly simplified the details of securing approvals and administering the survey. ChemCo's participation in this study was also supported by the CIO and by several senior IS managers who had participated in the field study phase of research. In contrast, at Insureco, this research was not championed by any senior IS managers. My primary contact person at Insureco was the Director of Technical Training, who reports to Human Resources (and thus had no authority to encourage cooperation from IS managers). Without an IS manager as champion to secure interest from other Insureco IS managers, the necessary authorization to conduct this research was sought from over a dozen Insureco IS managers at four different levels of the hierarchy.⁹

⁹ This highlights the obstacles involved in conducting research where there is a decentralized organizational structure, and where there is no internal champion for the research. At Insureco, I began by requesting permission from the five *Sector* Information Officers (Insureco's divisional CIO's within each business unit), and proceeding down the IS management hierarchy from there. This process was time-consuming, since — at any given level — the manager could either refuse participation, or grant me permission to seek authorization from the managers at the next layer of the hierarchy. From the time I was first granted permission to ask managers to participate in the study, it took three months to contact the necessary managers, in order to request permission and to obtain a list of the names of appropriate candidates for the survey. As a result, the survey was distributed to Insureco employees two months later than at Chemco (July, 1995 at Insureco versus May, 1995 at Chemco).

Target Respondents and Response Rates

The employee version of the survey was sent to 215 respondents in the two firms (Chemco and InsureCo). All IS staff receiving the survey had been pre-screened to ensure that they met the following criteria:

- they were full-time IS professionals (rather than business unit employees)
- they were primarily programmer/analysts, rather than operations or technical support.
- they were currently members of a department or project group that had recently adopted the client/server tools, methodologies, or languages.
- their department manager had granted permission for them to receive a copy of the survey.

Response rates for the employee version of the survey were 59% for Chemco and 47% for InsureCo.¹⁰

Employee Response Rates

	ChemCo	InsureCo	Total
Surveys sent	125	90	215
Surveys completed	74	42	116
Response rate	59 %	47 %	54 %

Due to the lower response rate from Insureco employees, permission was requested from each Insureco IS manager to re-send the survey to non-respondents. (Again, Insureco managers were not informed about which employees were non-respondents). This additional round of mailing surveys netted another four completed surveys, bringing the final response rate at Insureco to 51%, and the total number of completed surveys to 120.

¹⁰ This difference between the response rates of the two firms may be attributed, in part, to the more highly centralized coordination of the survey administration at ChemCo. First, ChemCo's CIO distributed an e-mail message to all IS managers and staff scheduled to receive the survey, requesting their cooperation in the research. Chemco also assigned an IS manager to serve as a liaison for the study. She oversaw on-site distribution of the surveys and answered any questions from employees about the survey.

The completed survey diskettes were accumulated and descriptively analyzed for any serious problems. First, respondents who were in positions that were only tangentially related to system development (e.g., clerical/administrative employees or user analysts) were excluded from further analysis. Second, surveys that were only *partially* completed were accepted and saved for analysis, while they were simultaneously re-sent to the respondent, with a letter requesting that they complete the missing parts.¹¹ Third, responses to the few open-ended survey items were aggregated, printed, and content-analyzed — especially the final item — "miscellaneous feedback" — in order to identify any problems or questions noted by respondents. Where it was possible to modify the survey to incorporate their suggestions, such changes were made to the Insureco version of the survey (which was sent two months later), and also into the subsequent manager version of the survey (which was mailed to IS managers five months later).¹² Due to the identical format and similar content of the manager version of the survey, it was important to respond to any questions or issues raised by respondents, prior to distributing the manager version of the survey.¹³

¹¹ Due to the DOS batch file linking the three parts of the survey, respondents who chose to temporarily discontinue and later restart the survey had to follow a specific procedure which was printed on a sheet of paper attached to the cover letter. The many returned diskettes with one or more incomplete parts suggested that this procedure was difficult to follow. Any survey with at least one completed part was included in the data analysis, but also re-sent to the respondent to complete the missing parts.

¹² There was a two-month gap between the date that surveys were sent to ChemCo and InsureCo employees. During this time, some minor modifications were made to instruction screens and to optional help screens, to satisfy respondents' comments. Some concerns expressed by ChemCo respondents could not be addressed, given the restrictions of the Ci-3's program — for example, the optional help screens could not be tailored to each question to provide specific information about the answers sought. Ci-3 restricted its *Help* screens to be generic — that is, for explaining the mechanics of the keyboard and cursor movement, but not customizable to a specific item.

¹³ Respondents provided feedback regarding the *content* of the survey, as well as the *mechanics* of completing it. In some cases, they requested more detailed help screen information than that already provided. Furthermore, some respondents commented on purported "loops" in the program; these "loops" were the intentional result of a validation routine included in the survey, to discourage respondents from answering with the *neutral* response to several questions consecutively. On 7-point Likert scale items, the cursor was always initially positioned at the *neutral* response ("4"), and respondents could use either the mouse or arrow keys to select a response other than *neutral*. The validation routine was designed to prevent respondents from repeatedly pressing the *enter* key. This routine counted the number of *consecutive* times that a respondent selected the *neutral* response; if this counter reached three (indicating three consecutive *neutral* responses), then the respondent's screen displayed an error message, and required respondents to answer the last question with a response other than *neutral*. The counter then reset to zero. Respondents were, thus, permitted to press the *enter* key (recording a *neutral* response) for up to two consecutive questions, but not third. The purpose of this error validation was to guard against respondents entering meaningless data.

Developing the Manager Survey Version

The manager survey was developed for the immediate supervisors of each respondent who had already completed the employee survey. In addition to containing some different items (compared to the employee survey), the manager version was individually customized for the specific manager who would be completing it. Since the primary purpose of the manager survey version was to obtain employee job performance data from the managers, each manager's copy of the survey was customized with the actual names of the IS employees who had already completed their survey. Managers were asked to provide job performance data only for the employees whose names were encoded onto their diskette.¹⁴ This customization prompted the manager with each employee's name while the managers provided skills and performance evaluation data for the specific employee. With the exception of these performance evaluation items, all other questions in the manager survey were identical for all managers. There were a minimum of 95 questions on the manager survey version. Table 6.4 presents the constructs and items in the manager survey version. There was considerable overlap between the items in the manager and employee survey versions. A full copy of the manager survey version appears in Appendix 6.3.

The manager surveys were sent in September, 1995 and January, 1996, to Chemco and Insureco managers, respectively. A total of 30 manager surveys were sent to the appropriate IS managers in the two companies — those managers to whom any of the 120 employee respondents reported. The procedure for determining which managers were to receive the manager survey depended on which departments had *at least one* employee return their employee version of the survey.

¹⁴ This was a delicate issue in my protracted negotiations with the COUHES committee. I was not permitted to (explicitly) provide information to managers regarding *which* employees in their department had completed a survey, due to the COUHES committees' concerns regarding "managerial coercion" of employees to participate in the survey. Moreover, I was also not permitted to ask managers to provide job performance data for non-respondent employees, because I would then be collecting performance data on employees "without informed consent." This impasse was resolved by a compromise which violated neither of these restrictions. I proposed to request performance data from managers for only those employees who had completed their surveys; thus *implicitly* conveying information to the managers regarding which employees had completed their surveys — but not explicitly communicating why they were being asked to provide this information for some employees, but not others.

Table 6.4
Manager Version of Survey
Number of Items per Construct

# of Items	Construct Name	Question Prompt	Source of Scale
7	Technology and Work Process Changes Related to Client/Server Development	"During the period from late 1993 until now, have the members of your workgroup begun using a new ..."	<i>(original scale)</i>
1	Most Significant Change in Work Processes (related to client/server development)	"Please specify the one change that made the greatest difference to the work processes of your staff."	<i>original item</i>
18	Attitudes to Software Process Innovation	"In my opinion, [name of software process innovation] is ..."	Moore & Benbasat (1991) Segars & Grover (1993)
7	Reskilling Approaches for Learning Client/Server Development	"How did the members of your staff actually learn to use the new tools and methods listed above."	<i>(original scale)</i>
13	Demographic Variables	(no general prompt)	<i>(original scale)</i>
1	Miscellaneous Feedback	"Is there any additional feedback you would like to provide about the survey?"	<i>(original scale)</i>
21	Importance of Skills Used by IS Employees	"How important is the following skill or ability for your IS staff in performing their jobs?"	Goldstein (1988)
21	Employee Ratings on Job Skills	"How would you rate the following employee: [name] in terms of his or her skill on this dimension?"	Goldstein (1988)
6	Overall Employee Performance Ratings	"How would you rate the following employee: [name] in terms of ...?"	Goldstein (1988)

The number of responding employees per department varied widely from zero to ten.¹⁵ Completion times for the manager version of the survey thus ranged from 20 to 60 minutes, depending on how many employees the manager was asked to evaluate. The total length of the manager survey was *at least* 95 items. This is the minimum number of items that a manager would complete, if providing performance evaluation for *one* employee only. For each additional employee in a specific manager's department, there were 27 additional items to complete (corresponding to the last two rows of Table 6.4).

One assumption made in developing the manager version of the survey was that the construct called *Importance of Job Skills* applies uniformly to all the employees within the particular manager's workgroup. Managers were asked to rate the level of importance of 21 skills for their employees on a 7-point Likert scale. Although there may, in reality, be a different mix of skills required for employees within the same IS workgroup, the specific assumptions made here limited the number of additional items that needed to be completed per additional employee reporting to the manager.¹⁶ The manager survey took an average of 45 minutes *elapsed* time to complete, although this varied widely from 20 to 60 minutes elapsed time.

Similar to the follow-up letters sent to non-respondent employees, managers who did not respond were also sent a follow-up six weeks later. Overall, the manager response rate was 60% (as a ratio of the number of diskettes completed to the number sent).

¹⁵ In those cases where no employees in a particular department responded to the survey, then the manager survey was *not* sent to the manager. If at least one employee within a given workgroup responded, however, then the manager survey was sent. Some managers were asked to complete longer surveys, compared to other managers, depending on the numbers of actual employees respondents in their departments.

¹⁶ Given the assumption that the importance of each skill was the same for all IS employees in the same IS manager's workgroup, then only 27 additional items needed to be completed per additional employee (corresponding to the 21 skills plus six additional "job attitude" and "overall performance" items). The alternative approach, whereby managers would separately rate the importance of *each* job skill for *each* employee in their workgroup, prior to providing information about employees' level of skill and general job performance would have increased the survey length by 48 items per additional employee — a number that was considered excessive, since some managers would be completing this survey to provide skills and performance data for eight to ten employees.

Manager Response Rates
(As a Percentage of Diskettes Completed to Diskettes Sent)

	ChemCo	InsureCo	Total
Total surveys sent	19	11	30
Total surveys completed	12	6	18
Response rate	63 %	54 %	60 %

Although the above table provides *one* measure of response rate for managers, it is not the critical measure of response rate. Since the primary purpose of the manager version was to collect performance evaluation data from managers regarding their employees, a better measure of response rate for the manager survey version is the ratio of employee performance data returned to that requested.¹⁷ Based on this calculation, the relevant manager response rates were:

Manager Response Rates
(as a Ratio of Employee Performance Data Returned to Data Requested)

	ChemCo	InsureCo	Total
Employee performance data requested from managers	74	46	120
Employee performance data returned by managers	48	19	67
Response rate	65 %	41 %	56 %

Data Analysis Methods

All survey responses on diskette were aggregated into a comprehensive data file, and the seven open-ended questions were descriptively analyzed to provide results for the items listed in Tables 6.2 and 6.3. These items identified specific product names for client/server tools

¹⁷ An example will serve to illustrate the calculation: Assume that three managers were asked to complete the manager version of the survey: Manager A was asked to provide performance data for six employees and did; Manager B was asked to provide performance data for three employees and did; Manager C was asked to provide performance data for one employee, but failed to respond. The overall response rate would be 90%, rather than 67%.

and methodologies that had been adopted — as well as related changes in system development processes. The open-ended items also provided information about employees' titles, job duties, learning activities and miscellaneous feedback. Responses to open-ended items were analyzed and compared to the field study data to identify possible convergence or discrepancies.

The remaining 168 closed-ended items were transferred to a data file that was imported to SPSS-PC for analysis. All descriptive statistics and inferential statistics were evaluated with SPSS-PC. Because the statistical analysis methods were closely linked to the specific types of questions,¹⁸ these analyses are described in the following chapters, along with the results. There are two results chapters: Chapter 7 (Descriptive Survey Results) presents the results descriptively and evaluates differences between Chemco and Insureco responses using T-tests and Chi-Squared analyses. Chapter 8 (Hypothesis-Testing Results) provides information regarding scale validation for all multiple item constructs using Cronbach alpha and factor analysis. Chapter 8 also provides tests of the propositions presented in Chapters 3 and 5, using multiple regression analysis.

¹⁸ Different items required different statistical analyses, depending on whether they were 7-point Likert scale items, closed-ended categorical items, ordinal data (level of education) and interval-level data (age, years of experience, number of training hours, etc.)

Chapter 7

Descriptive Analysis of Survey Data

Introduction and Statement of Objectives

Prior to testing the propositions advanced in Chapter 5, the survey data was descriptively analyzed; there are four related objectives for this analysis:

- to develop a general "feel" for the data, prior to hypothesis-testing
- to identify any outlier or erroneous responses which should be culled from the data
- to detect general patterns in the data which may be meaningful to this research and to the organizations studied
- to identify differences between respondents at the two firms.

As demonstrated below, these results portray a general pattern of Chemco and Insureco as two firms undertaking a change in the technology used for software development, yet each with a distinct culture and approach to change. Although both Chemco and Insureco have IS departments that are innovating, the survey data, combined with prior field study data suggest that Chemco's IS department and its employees are more innovative or "non-traditional" (Myers, 1991), compared to Insureco. Although Insureco's IS department was in the process of undertaking technological innovation, it still displays an organizational culture and employee profile which are traditional in many ways. The survey data reinforces these conclusions which were drawn from the field study data.

Although identifying inter-firm differences is not the *primary* objective of this study, this chapter provides a descriptive overview of the data, including a comparison of respondent data from the two firms. The remainder of this chapter presents the descriptive analysis of the survey data and interprets these results in light of the field study results from Chemco and Insureco. Descriptive statistics for each firm are displayed for each variable in the study. Differences between firms are evaluated using T-tests for continuous variables and Chi-squared tests for discrete (categorical) variables. Differences are identified as statistically

significant where the p values < 0.05.¹ The *sign* of the values in the "mean difference" and "T-Test value" column is important in Table 7.1. A positive sign indicates that Chemco respondents scored higher on the particular construct, whereas a negative sign indicates that Insureco employees scored higher.²

Table 7.1
Comparison of Demographic Attributes
Between Chemco and Insureco Respondents

Variable Name	Chemco Mean	Insureco Mean	Overall Mean	Mean Difference	Test statistic	p Value
Age	36.0	38.6	37.0	-2.60	-1.82	.073 ⁺
Gender (% Women)	33.8%	43.5%	38.0%	-9.7%	-1.11	0.29 (n.s.)
Variable Name	Chemco Median	Insureco Median	Overall Median	Median Difference	Chi-square statistic	p Value
Level of Education	7 (Bachelor's degree plus study toward MS or MBA)	5 (bachelor's degree)	7 (Bachelor's degree plus study toward MS or MBA)	+2	+5.23	0.000 ^{**}

Legend: ^{**} p < 0.01 ^{*} p < 0.05 ⁺ p < 0.10

In addition to variables which were evaluated as statistically significant, differences which are close, but slightly above the standard "p < 0.05" threshold are labelled as *borderline*

¹ Since *Level of Education* is an ordinal variable, median values are reported instead of means, and the statistical test employed is the Chi-square test of significance, rather than a T-test.

² Since SPSS output provides two measures of T-statistics and p-values, based on *separate variance* and *pooled variance* estimates, the standard procedure for using the pooled variance estimate in calculating the T-test is used unless evidence exists that employees in the two firms have significantly different variances (p < 0.05, based on the F-test value which evaluates homogeneity of variance between the two samples). Only in those cases where the variance is significantly different (at p < 0.05) between the two groups is the *separate variance* estimate for the T-statistic employed.

significant. Finally, those differences where the p value is close to 0.10 are labelled as *trends*. For most variables in the study, no *a priori* predictions were made regarding differences between Chemco and Insureco respondents. In these cases, standard two-tailed T-tests were used, to allow for a difference in either direction (Chemco exceeding Insureco, and vice-versa). In some cases, *a priori* predictions were anticipated, and are elaborated below. In these cases only, one-tailed T-tests were used, restricting the difference to a specific direction.

Demographic Data

Few significant differences for demographic variables were noted in Table 7.1. These variables are summarized here.

Age. The mean age for all survey respondents was 37.0, with a range from 25 to 66 years. Chemco employees are slightly younger by 2.6 years, a difference that is borderline significant ($p = 0.07$).

Gender. Insureco has a higher proportion of female workers (43.5%), compared to Chemco (33.8%), however this difference was not statistically significant.³

Level of Education. Chemco employees are more highly educated than Insureco employees, on average, by 2 units on the ordinal scale used to measure education.⁴ The *median* level of education for Chemco is 7 on the 10-point scale (bachelor's degree plus some graduate school), whereas for Insureco, the median level of education is 5 on the scale (bachelor's degree). Since Level of Education is a categorical variable, an additional Chi-square analysis

³ Since gender is a categorical variable, a Chi-square analysis was used to analyze the difference between the proportion of women in the two firms. Neither the Chi-square analysis nor the T-test revealed a significant difference between the firms ($p = 0.291$).

⁴ The categories for level of education are: 1. high school graduate; 2. some college; 3. technical or trade school; 4. associate' degree (A.A.); 5. bachelor's degree; 6. bachelor's degree plus certificate; 7. bachelor's degree plus some graduate school; 8. received master's degree; 9. some work toward Ph.D.; 10. received Ph.D. degree.

was conducted, showing a statistically significant higher ($p < 0.01$) level of education among Chemco compared to Insureco employees. This significant difference was based on differences at the extreme ends of the education scale: Chemco has a much larger proportion of respondents with a master's degree or higher (levels 8, 9 10), whereas Insureco has a larger proportion of respondents at the low end of the scale (with less than a bachelor's degree).⁵

Job Tenure Measures

Consistent with prior research examining job tenure (Goldstein, 1988), this study used three different measures of tenure: career tenure (total years in the IS profession), company tenure (total years in the firm), and position tenure (years in the present job). These analyses reveal some interesting results, some of which appear contradictory. These results are analyzed below.

Table 7.2
Comparison of Job Tenure Measures
Between Chemco and Insureco Respondents

Variable Name	Chemco Mean	Insureco Mean	Overall Mean	Mean Difference	T-Test statistic	p Value
Career Tenure	12.0	11.0	11.6	+1.0	+0.92	0.36 (n.s.)
Company Tenure	10.6	11.6	11.0	-1.0	-0.80	0.42 (n.s.)
Position Tenure	3.0	2.9	2.96	+0.10	+0.35	0.73 (n.s.)

⁵ The Chi-squared analysis was conducted by collapsing the educational levels from 10 units down to four groups: a) levels 1-4; b) level 5; c) levels 6-7; d) levels 8-10). For the middle rungs of the scale levels 5, 6 and 7 (approximately 65% in each firm), there was little difference between the two firms.

Career Tenure. Career tenure ranged from 2 to 28 years, with an overall mean of 11.6 years. Chemco employees had an average of one more year of total work experience in the IS profession.⁶

Company Tenure. Company tenure ranged from one month to 28 years, with a mean of 11 years. Company tenure was exactly one year longer for Insureco employees compared to Chemco (although the difference was not statistically significant). This item provides an interesting contrast and apparent contradiction with the career tenure (the previous item). Average *career* tenure was one year longer for Chemco than Insure employees, while average *company* tenure was one year *less* Chemco (compared to Insureco). The likely explanation for this apparent discrepancy is that a larger proportion of Chemco respondents had previous IS experience in another firm (thus inflating their career tenure) compared to the proportion of Insureco respondents with prior experience.⁷

Position Tenure. The average position tenure (length of time that employees have been in their current jobs) ranged from one month to more than 14 years. The mean tenure (2.9 years) was nearly identical in the two firms.

Job Titles and Duties

Job Title. When asked to categorize their job description into one of the following categories, respondents from the two firms displayed the following results:

⁶ This difference between respondents' career tenure was not statistically significant. Furthermore, the distribution of scores for IS career tenure was not normally distributed; instead there are equal amounts of respondents with 5 - 10 years, 10 - 15 years, and 15 - 20 years of experience in the IS field. Approximately 30% of the total respondents sample was contained in *each* of these three groups (5-10 years, 10-15 years, and 15-20 years), with an additional 5% of the sample at each extreme (less than 5 or more than 20 years).

⁷ This is consistent with the field study data that showed Chemco sometimes hires experienced IS professionals, while Insureco rarely does so.

Results for Job Titles

Job Title	Total Sample		Chemco		Insureco	
	Number	%	Number	%	Number	%
Programmer/Analyst	60	51.3	32	45.1	28	60.9
Technical Lead	19	16.2	14	19.7	5	10.9
Project Team Leader	17	14.5	14	19.7	3	6.5
Other Categories	21	18.0	11	15.5	10	21.7
Total	117	100.0	71	100	46	100.0

These data suggest that the majority of respondents were programmer/analysts, or were senior programmer/analysts with some supervisory responsibility on their projects. There was a higher proportion of employees with some supervisory responsibility in the Chemco employee population (those labeled Project Team Leaders), compared to Insureco. Some additional respondents described themselves as either User Analysts or Technical Services Support. Based on other answers provided to open-ended questions by these employees, they were retained in the sample because their jobs related to developing systems in the client/server environment. Analysis of the differences based on a Chi-squared analysis showed a significant difference in the types of jobs held by respondents ($p < 0.05$), due to the larger proportion of employees who were Project Team Leaders and "Technical Leads" at Chemco, compared to Insureco.

Job Tasks Performed. In addition to classifying themselves according to one of the seven job categories above, respondents were asked to indicate whether they perform one or more of the following system development activities: system design, programming, testing, user training, user interface design, or supervising other IS employees. The difference between this question and the prior item is that here respondents are permitted to indicate that they perform multiple activities (from zero to six of these activities). Of the six system development activities, the only difference found was for user interface design (borderline significant; $p = 0.055$) — with 49% of Chemco respondents compared to 30% of Insureco

respondents indicating that they perform user interface design. The other functions had similar results for both firms.⁸

Table 7.3
Comparison of Dependent Variables
Between Chemco and Insureco Respondents

Construct Name	Chemco mean	Insureco mean	Overall mean	Difference in means	T-test value	p value
Job Satisfaction	5.00	4.67	4.86	+0.33	+2.05	0.043*
Turnover Intentions	3.50	4.01	3.70	-0.51	-2.09	0.039*
Overall Job Performance	5.82	5.67	5.76	+0.15	+0.69	0.49 (n.s.)
Technical Skills	4.14	3.52	3.89	+0.62	+3.06	0.003**
Business Knowledge	5.88	5.08	5.56	+0.80	+2.55	0.01**
General Work Habits	4.14	4.07	4.11	+0.07	+0.36	0.72 (n.s.)
Job Attitudes	5.94	5.21	5.65	+0.73	+3.50	0.001**

Dependent Variables

Job Satisfaction. Based on the 12-item scale used to measure job satisfaction (Smith, Kendall & Hulin, 1969), the average score for each respondent was calculated. Average job satisfaction scores for all respondents ranged from 1.8 to 6.6, with an overall mean score of

⁸ The percentage of respondents who performed each of these other five activities was nearly identical for the two firms: the overall ration of employee who perform each task were: system design (84%), programming (76%), testing (69%), training others (35%), supervising other employees (30%).

4.86.⁹ Chemco employees reported significantly higher job satisfaction scores than Insureco employees ($p < 0.05$).¹⁰

Job Turnover Intentions. The scale for job turnover intentions produced an average rating of 3.7 on the 7-point scale for all employees. Since this mean score was below the 4.0 midpoint on the scale, this shows that, on average, respondents reported low probability of quitting their jobs. Insureco reported higher turnover intentions (4.0), compared to Chemco employees (3.5), a significant difference ($p < 0.05$). In addition, responses from Insureco respondents to one specific item on the turnover intentions scale demonstrated some unusual results.

Job Performance Ratings. Data for ratings of IS employees' skill levels and overall performance ratings were collected from IS managers. Since managers provided skill and performance data for 72 IS employees, this represented 61% of the IS employees. Overall job performance ratings showed no differences. In addition, ratings of employees' skill levels identified four clusters of job skills and behaviors facets which influence job performance.¹¹ Since managers' ratings of employees' skills and behaviors on these four clusters are related to their overall job ratings, these clusters are labeled *facets* of job performance. Three of the four facets demonstrated significantly higher ratings for Chemco employees — technical skills, business knowledge, and job attitudes (all at $p < 0.01$). No differences were noted on the fourth facet — general work habits and communication skills.

⁹ On the job satisfaction scale, 7 = "extremely satisfied," 4 = "neutral" and 1 = "extremely dissatisfied."

¹⁰ Further evidence for higher job satisfaction at Chemco emerged from an analysis of outlier data. Outliers were those subjects who reported average job satisfaction either higher than 6.0 or below 3.0 on the 7-point scale. There were six outlier respondents in each direction. Five of the six high outliers (job satisfaction greater than 6.0) were from ChemCo; conversely, five of the six low outliers (less than 3.0) were from InsureCo.

¹¹ These four facets of overall performance were derived from factor analysis of managers' ratings of employees individual job skills. The details for the factor analyses are explained in Chapter 8.

Table 7.4
Comparison of Cognitive Style Measures
Between Chemco and Insureco Respondents

Construct Name	Chemco Mean	Insureco Mean	Overall Mean	Mean Difference	T-test value	p value
Tolerance of Ambiguity	4.54	4.25	4.42	+0.29	+2.19	0.03*
Personal Resilience	63.63	63.40	63.54	+0.22	+0.13	0.90 (n.s.)
Innovativeness	32.14	28.43	30.65	+3.70	+1.60	0.11 (n.s.)

Cognitive Style Attributes

Of the three cognitive style variables used in this research, only *Tolerance of Ambiguity* showed a significant differences between Chemco and Insureco employees.¹² Chemco employees had a higher average score than Insureco employees for *Tolerance of Ambiguity* ($p = 0.03$), but no differences were found either for *Personal Resilience* or for *Innovativeness* (on the Kirton Adaption-Innovation Inventory).

Strategies for Learning Client/Server Development

Several survey items focused on the learning activities for reskilling IS employees to conduct client/server development. Respondents were asked to identify the most useful learning activities from a list of eight alternatives (and to suggest others). They were also asked to

¹² The total scale score on the 7-item Tolerance of Ambiguity scale. One item on the 8-item scale had to be deleted because it correlated very poorly with the overall scale. This item, "Practically every problem has a solution," should correlate negatively with Tolerance of Ambiguity — suggesting an *intolerance* of ambiguity. The majority of respondents (80%) agreed with the item. In this study, it had a positive, but near-zero correlation with each of the other items and with the overall scale. Perhaps given the respondents' profession -- systems analysis, design, and development -- implementing solutions to business problems *is* the nature of their jobs. It is not surprising, that the overwhelming majority of respondents would agree with this item, without having it compromise their Tolerance of Ambiguity.

indicate whether they had taken *any* training classes, their total hours of training related to client/server development, whether the classes were taken during business hours or after hours.

Preference for Activities for Learning Client/server Development

Respondents identified the three *most useful* learning activities in which they engaged to learn client/server development. Although the most respondents selected classroom training as the most useful learning activity, the activity that placed second was trial-and-error hands-on learning. Due to concerns with order bias, two other approaches for analyzing these most useful learning activities¹³ suggested that hands-on learning was as important as classroom training in learning to perform client/server development. Working informally with a mentor one-on-one was reported to be the third most useful activity, regardless of the type of analysis.

Proportion of Respondents Attending Training Classes

Respondents were also asked to indicate whether they had taken *any* training classes, total training hours, and whether the classes were conducted during or after work hours. Results showed that a significantly larger greater proportion of Insureco employees took *some* training classes (compared to Chemco employees) and that the vast majority of these respondents took classes during business hours (97%), rather than after hours (only 3%). Of those who completed some training, two-thirds attended between 20-80 hours of training. Chemco employees attended more hours of training, on average, than Insureco respondents (48 hours versus 42 hours; not statistically significant).

¹³ The concern with order bias was due to the fact the "formal classroom training" was the first of the eight learning activities on the list. Since it was likely that respondents might simply read down the list, selecting their "most useful" activities in the listed order, this would influence their choices of "most useful" learning activities. To minimize this potential order bias, two other methods were used for analyzing the data. Results for this item are included in Appendix 7.1, which also lists all three methods for analyzing the data.

There is an apparent discrepancy between the fact that Chemco employees attended more hours of training, on average, than Insureco employees, versus the result that a larger proportion of Insureco employees attended *some* training classes. This apparent contradiction can be reconciled by recalling that field studies showed that Insureco used a *blanket training strategy*, sending nearly all their IS employees (81%) to client/server training. Chemco, in contrast, used formal training on an as-needed basis. As a result of its more selective, *just-in-time* training strategy, a smaller proportion of Chemco employees (62%) attended some training, but they attended more training hours, on average, than Insureco employees.

The Job Preference Inventory (JPI)

Raw Scores for Job Preferences

This section lists the overall results on the 21-item Job Preference Inventory (JPI). The 21 items on this scale allow respondents to state their preferences for various needs/values. Embedding such items within prior IS theory will provide a context for understanding these data. To briefly summarize prior research findings that were presented in Chapter 2, IS professionals have traditionally been found to be very high in their need for challenging work (or *growth need strength*, [Hackman & Oldham, 1980]) while low in their need for interaction or affiliation with others. In general, the overall results are expected to support this prior research — namely that items related to desire for challenge will be rated high in importance, but that items related to *social need strength* and hygiene factors will be rated as low in importance. Other items concerned with task characteristics identified as contributing to positive working conditions (Hackman, 1980) should also be moderately high in importance.

Highest and Lowest Employee Preferences on the JPI

This section presents the raw mean scores on the JPI for all employees and then compares results for Chemco and Insureco employees. The subsequent chapter (Chapter 8) explains the more complex statistical analyses conducted to show how these JPI items cluster together (using factor analysis), and also how they predict job satisfaction, performance, and turnover (using multiple regression analysis). As shown in Table 7.5, the expectation that Insureco

employees will rate more highly those needs/values that characterize motivation patterns of "traditional" IS employees was only partially realized. First, some comments are offered regarding on the overall rankings of employee preferences, then the next section will identify differences between the mean scores for Chemco and Insureco employees. Not surprisingly, several items related to challenging work and focusing on technology were rated very highly by all respondents.¹⁴ These results support the notion that having challenging work is valued by IS employees. What was surprising was that several items related to traditional "hygiene" factors were rated highly by most respondents.¹⁵ These items were not expected to be important motivators for IS employees (McLean et al., 1995). This appears to challenge the accumulated evidence regarding motivators for IS professionals, since these items, which were expected to be low importance, were all identified as important needs.

Those items related to a business/user orientation and a desire for social interaction were rated as low in importance, relative to other items. Consistent with Couger & Zawacki's (1980) research, these items were scored below the overall scale average of 5.6,¹⁶ but above the midpoint (4.0) on the 7-point scale. These results suggest that respondents, in general, conformed to the "traditional" stereotype of the IS professional.

¹⁴ In descending order of overall JPI score, items 9, 7, 19, 3 and 5 had average ratings above 5.9 on the 7-point scale. These items identified respondents' needs for a sense of accomplishment, creative/challenging work, opportunity to learn new technical skills, promotional opportunities within IS, and opportunity to state-of-the-art technology.

¹⁵ Items 1, 3 and 4 were all rated above 5.80 on the 7-point scale, specifying employees' needs for a strong benefits package, job security, and above-average income, respectively.

¹⁶ These items related to business/user orientation and a desire for social interaction (items 12, 13, 14, 15) had average scores between 5.0 - 5.4. These were all below the 5.6 average of all items on the JPI.

Table 7.5
Comparison Between Chemco and Insureco
Respondents' Scores on the Job Preference Inventory (JPI)
(sorted by overall JPI preference score)

Item #	Item Description	Total Sample Score	ChemCo Mean Score	InsureCo Mean Score	Mean Difference	Significance Level
6	Allows you to be treated and evaluated fairly	6.36	6.30	6.44	+0.06	N.S.
9	Provides sense of accomplishment	6.32	6.30	6.35	+0.02	N.S.
7	Is creative and challenging	6.30	6.29	6.33	+0.01	N.S.
1	Provides a competitive benefits package	6.14	6.17	6.10	-0.07	N.S.
19	Provides opportunity to learn new technical skills	6.18	6.03	6.15	-0.12	N.S.
3	Provides opportunity for promotion within IS area	5.98	6.04	5.88	+0.16	N.S.
8	Allows independence to make your own decision	5.97	6.06	5.83	+0.23	p=0.12
2	Provides security and stability	5.97	6.17	5.67	+0.50	p=0.01*
5	Allows opportunity for you to use state-of-art equipment and processes	5.91	5.88	5.96	-0.08	N.S.
4	Provides above average income	5.80	5.75	5.88	-0.13	N.S.
18	Provides feedback on how well you are doing	5.80	5.83	5.75	+0.08	N.S.
10	Requires high level of skill	5.76	5.73	5.81	-0.08	N.S.
20	Provides opportunity to learn about the business itself	5.43	5.57	5.23	+0.34	p=0.051*
14	Brings you into close contact with system users	5.35	5.45	5.19	+0.26	N.S.
11	Allows you to perform a variety of different tasks each day	5.29	5.36	5.19	+0.17	N.S.
13	Requires you to perform as a member of a team	5.25	5.27	5.21	+0.06	N.S.
12	Allows you to have significant impact on the overall business	5.24	5.37	5.04	+0.33	p=0.071
15	Allows you to develop professional friendships	5.08	5.09	5.06	+0.03	N.S.
21	Provides the opportunity learn project management skills	4.98	5.17	4.69	+0.48	p=0.046**
17	Allows you to begin and complete assignments without relying on others	4.82	4.61	5.12	-0.51	p=0.015*
16	Where you are supervised (but not constantly)	4.52	4.46	4.60	-0.14	N.S.

Analyzing Differences on the JPI between Chemco and Insureco Respondents

The field studies in Chapter 4 showed that Chemco is more innovative in terms of its use of IT compared to Insureco, which is more traditional. The description of Insureco's organizational culture also suggested that its IS employees conform more closely to the traditional stereotype of the IS employee: technologically-focused, with departmental and cultural barriers separating them from business users. Given this distinction between the culture of Chemco versus Insureco, I expected that Insureco employees would express higher preferences for those needs/values that characterize the traditional or stereotypical IS employee, while Chemco employees would be more "innovative" or "non-traditional" (Myers, 1991) in their stated needs/values.

Given this traditional pattern, Insureco respondents are expected to score more highly on items related to technical challenge, working with technology (as opposed to people), desire to learn more about technology, and to work alone. Conversely, on the set of items dealing with "non-traditional" behaviors (Myers, 1991), it was expected that Chemco employees will state stronger preferences compared to Insureco employees. These items include the desire to work closely with users, to learn about business issues, to learn management skills, and to work in teams. No differences were anticipated between employees in the two firms on the hygiene factors (pay, job security, benefits).

Given these expectations for directional differences between Chemco and Insureco employees, on certain items,¹⁷ these results were evaluated by using one-tailed T-tests. For the remaining items where no differences between employees in the two firms were expected, two-tailed T-tests were employed. In reviewing differences between the two firms, there

¹⁷ To specify the expected differences, Insureco employees were expected to score higher on the following items: to begin and complete assignments without relying on others (item 17), to have independence to make your own decisions (8), to have a sense of accomplishment (9), to have a job which demands high levels of skill (10), to learn more about technology itself (19), and to have challenging and creative work (7), to use state-of-the-art equipment (5). In contrast, ChemCo employees were expected to score higher on "non-traditional" for IS personnel: willingness to work in teams (13), to interact with users (14), desire to learn more about the business itself (20), to learn about project management (21), desire to develop professional friendships (15), and to have a significant impact on the overall organization (12).

were five items with statistically significant difference. Surprisingly, some of these items were found to run in the opposite direction from that expected. These results are classified into the following three categories: confirmations of *a priori* predictions, predictions that were not supported, and other differences between firms that were not anticipated.

Three items demonstrated a confirmation of *a priori* predictions. Consistent with expectations above, Insureco employees showed stronger desire to work alone (item 17), while Chemco employees expressed a stronger desire to learn about the business itself (item 20) and to learn project management skills (item 21). These differences were all statistically significant (at $p < 0.05$). In addition, to these significant differences, Chemco employees expressed a stronger desire to have an impact on the overall organization (item 12), although this was only borderline significant ($p = .07$). Of the anticipated differences between Chemco and Insureco employees, four items showed differences in the expected direction. These results partially support the notion that Chemco employees have a stronger orientation toward understanding and having an impact on the business, and learning to manage projects. Conversely, Insureco employees display a stronger preference for working alone independently, consistent with the past research on IS employees (Couger & Zawacki, 1980).

Beyond these anticipated differences that were supported, several expected differences were not supported by the data. First, Chemco employees did not express a stronger preference for social interaction (items 13, 14, 15) were not supported, nor did Insureco employees express a stronger desire for challenge (items 7, 9, and 10) or to focus on technology (items 5 and 19) and challenge were *not* supported. Finally, there were some differences that had not been anticipated — where results ran counter to the expectations stated above. One result was that Chemco employees stated a higher need for job security/stability (item 2), although no differences were expected on this item (or others) related to hygiene factors. Respondents from both firms scored this item very high, although

Chemco respondents expressed a significantly higher need ($p < 0.01$).¹⁸ Another result that contradicted prior expectations was the result that Chemco employees stated a slightly higher need to make decisions independently rather than Insureco employees, as anticipated (although this difference was a *trend* ($p = .12$), rather than statistically significant).

Calculation of Preference versus Reality "Difference Scores"

The JPI scores were subsequently analyzed by comparing the scores on each individual JPI item with the corresponding question from the Job Characteristics Inventory (JCI). The JCI items posed the question to respondents: "How much does your current job provide", followed by the same list of 21 items from the JPI. A *difference score* was computed for each item by subtracting the item's JPI score from its corresponding JCI item score.

In most cases (18 out of 21 items), a *negative* difference occurred, indicating a need/value which is not fully met by the job. Where a *positive* difference score results, this suggests a need which is more than satisfied — or even a situation where too much of that attribute is present in the job. Although the absolute size of such difference scores has no intrinsic meaning, by comparing the magnitude of the difference scores relative to each other, the extent to which different types of needs are fulfilled can be analyzed. These gaps are listed in Table 7.6, with the largest gaps first.

This section first analyzes the relative sizes of these difference scores, then the next section compares the difference scores between Chemco and Insureco respondents. As stated above, 18 of the 21 items revealed a negative difference score calculation, which are labelled here as *gaps* between needs/values and current job patterns of reinforcers (Dawis & Lofquist, 1984). This section analyzes patterns in the difference scores, referring to Table 7.6.

¹⁸ Chemco had conducted a sizeable layoff between 1993-1994 — amounting to 7% of all employees in the business. This may have explained Chemco employees' concerns about job security. Insureco had not conducted a firm-wide lay-off since 1989, however there was a sizeable reduction in 1991 for one business unit only. These factors may explain the greater desire expressed by Chemco respondents regarding job security.

Table 7.6
Comparison of *Difference Scores* Between Chemco and Insureco
(sorted by difference score size)

Item #	Item Description	Overall Difference Score	Chem Co	Insure Co	Significance level (p value)
2	Provides job security and stability	-1.593	-1.814	-1.271	0.07+
6	Allows you to be treated and evaluated fairly	-1.525	-1.500	-1.563	N.S.
3	Provides opportunities for promotion within the IS area	-1.500	-1.486	-1.521	N.S.
18	Provides feedback on how well you are doing	-1.364	-1.386	-1.333	N.S.
9	Provides sense of accomplishment	-1.331	-1.143	-1.604	N.S.
4	Provides above average income	-1.288	-1.143	-1.500	N.S.
16	Provides sufficient supervision	-1.178	-1.600	-0.563	0.002**
12	Allows you to have a significant impact on the organization	-1.068	-1.086	-1.042	N.S.
8	Independence to make your own decisions	-0.975	-0.771	-1.271	0.06+
7	Is creative and challenging	-0.876	-0.700	-1.146	0.07+
17	Allows you to begin and complete assignments without relying on others	-0.814	-0.514	-1.250	0.02*
19	Provides opportunity to learn new technical skills	-0.720	-0.571	-0.938	N.S.
1	Provides a competitive benefits package	-0.644	-0.686	-0.583	N.S.
5	Allows opportunity for you to use state-of-the-art equipment and processes	-0.517	-0.443	-0.625	N.S.
21	Provides the opportunity to learn project management skills	-0.483	-0.514	-0.438	N.S.
11	Requires you to perform a variety of different tasks each day	-0.212	-0.143	-0.313	N.S.
10	Requires a high level of skill	-0.186	0.000	-0.458	0.051
20	Provides the opportunity to learn about the business itself	-0.178	-0.243	-0.083	N.S.
13	Requires you to perform as a member of a team	+0.22	+0.157	+0.313	N.S.
14	Brings you into close contact with system users	+0.07	+0.143	-0.042	N.S.
15	Allows you to develop professional friendships	+0.05	-0.143	+0.146	N.S.

There were three items for which the difference scores were positive (where no "gap" resulted). All three of these items were concerned with social interaction on the job (items 13, 14 and 15). One interpretation is that IS employees in both firms have their need for social interaction on the job *more* than fulfilled. A more cynical perspective would interpret this result in terms of Couger's (1981) observation that IS employees have extremely low social need strength, and that their jobs force them to interact with others more than they would prefer.

The difference scores resulting from the other 18 items revealed *gaps* representing varying levels of unmet needs. For both groups of employees combined, there were minimal gaps in items related to technical challenge and opportunities to work with new technology (items 19, 5, 10, and 20).

It was surprising that some of the largest gaps occurred on the hygiene factors — such as job security/stability and income. According to motivation theory, hygiene factors are expected to motivate IS professionals only if they are deficient (McClelland, 1957; McLean, Smits & Tanner, 1996). The large gaps for job security/stability and income may indicate that this need is not met. For example, there may be concerns about potential lay-offs. These were also large gap scores for several items related to positive working conditions,¹⁹ in general (i.e., fair treatment, opportunities for promotion, feedback). Sizeable gap scores were identified for several of these attributes (items 6, 18, 9, 16 and 12). Chapter 8 uses factor analysis to evaluate which gap scores tend to cluster together and how much each cluster influences job satisfaction.

¹⁹ These are characteristics that were identified by Hackman (1980) as important in creating a job's high motivating potential score — autonomy, variety, task significance, task identify, and feedback from immediate supervisors.

Comparison of Gap Scores between Chemco and Insureco Respondents

Several notable differences were found between the magnitude of the gap scores for Chemco and Insureco employees.²⁰ Chemco employees reported a sizeable "supervision gap," (item 16) indicating that they received less supervision on the job than desired. The magnitude of this gap for Chemco respondents was considerably larger than for Insureco respondents ($p = 0.002$). Insureco respondents reported a much larger "autonomy gap" compared to Chemco respondents Insureco employees: this difference was highly significant on one item ($p = 0.02$ on item 17) and borderline significant for another ($p = 0.06$ on item 8). Considered together, these items suggest that Insureco employees perceive inadequate autonomy — whether to work independently or to take individual initiative. The corresponding gap scores for autonomy were relatively small for Chemco employees.

It is interesting that these three gap scores suggest very different unmet needs at Chemco compared to Insureco. The "supervision gap" (lack of sufficient supervision) at Chemco essentially represents the opposite of the "autonomy gap" at Insureco. While Chemco respondents indicated that they have more autonomy in their jobs, this appears to occur at the expense of having insufficient supervision. Acknowledging that apparent trade-off between autonomy and supervision is important, however it is impossible to indicate which type of gap is better or worse than another. Some employees may be comfortable sacrificing autonomy for greater job security, while others may not. This underscores the advantage of the Theory of Work Adjustment as a theoretical framework for understanding employee fit to the job environment.

Two other important differences between firms were that Chemco respondents demonstrated larger gap on job security/stability (item 2), but a smaller gap on having a job that is "creative and challenging" (item 7). Although these differences were only borderline significant ($p = 0.07$), they provide some additional support for a general pattern of

²⁰ Since no *a priori* predictions were offered regarding the relative sizes of these gaps for the two firms, these gap differences are evaluated in an exploratory fashion, using two-tailed T-tests.

differences between Chemco and Insureco. This general pattern is elaborated and its implications are discussed below.

Summary and Observations of Descriptive Data

This section identified results from descriptive analyses conducted on the survey data. Several areas of convergence were identified between the field studies reported Chapter 4 and the descriptive results in this chapter. Key questions are raised here, and then explored more fully in Chapters 8 and 9.

Although the analysis of employees' preference for technical challenge (on the JPI) showed no significant differences between Chemco and Insureco employees, these gap scores demonstrated a general pattern that Chemco employees perceived their desire for challenge as better fulfilled, compared to Insureco employees. This pattern exhibited itself on the items already mentioned above (autonomy and independent decision-making) and also on items related to the job's perceived degree of creativity, level of skill required, and sense of accomplishment provided by the job. Difference scores revealed that these needs were better met for Chemco employees, compared to Insureco, although these differences were only borderline significant.²¹

Insureco employees appear to worry less about job security, but have less opportunity for autonomy or individual decision-making. At Insureco, where the data suggest that employees have too little autonomy, the ambition and autonomy may be stifled in these employees, such that the most ambitious individuals will become frustrated by the corporate culture and they will choose to pursue job options elsewhere. Other, more complacent employees may find the environment to be a better fit with their needs. This shows that there are potential disadvantages to any given organizational culture, and that some individuals may be better adapted to work in one or the other environment. There may even be a "grass is always

²¹ Chemco employees expressed greater fulfillment (smaller difference scores) for their jobs to provide a high level of skill ($p = 0.051$), creativity and challenge ($p < 0.06$), and a sense of accomplishment ($p = .12$).

greener" effect, whereby employees recognize only what they perceive as lacking in their present job, rather than acknowledging those positive, but less salient attributes, which nevertheless improve their job environment.

Relying on these data alone, it is impossible to say whether Chemco employees actually have insufficient supervision, or whether Insureco employees have excessive supervision and bureaucracy. If it is the former, then Chemco employees may become frustrated as they try to learn and adapt to using new technologies on their own — without adequate supervision. This may mean that only those Chemco employees who have the strongest need for challenge and who are characterized by a particular cognitive style (i.e., tolerance of ambiguity) will be fulfilled working in such an environment. Those Chemco employees who lack such attributes may become frustrated and dissatisfied working in an environment where self-reliance and autonomy are critical.

First, regarding the contrast between the "autonomy gap" and "supervision gap" identified by Insureco and Chemco respondents, respectively, it is not obvious which gap is more problematic. Chemco has an organizational culture that emphasizes individual initiative, and apparently assumes that IS employees can motivate manage and themselves. Insureco, in contrast, is characterized by a more bureaucratic culture, with greater levels of supervision and structure. Such constraints, which may be familiar to and welcomed by many Insureco employees, may frustrate those employees with greater need for autonomy and challenge. This highlights the importance of considering employee—organization fit when explaining employee job satisfaction. There is no one work environment or organizational culture that is best for all employees. Instead, employees' job satisfaction, performance and turnover intentions will be influenced by the degree of fit between the employees' talents and preferences and the corresponding requirements and *reinforcer patterns* of the work environment (Dawis & Lofquist, 1984). This insight validates the choice of the methodology, which combines field studies and survey methods. It also underscores the argument that there is no one best type of job or organizational culture for IS employees; instead employees' job

satisfaction and turnover intentions will be influenced by the mosaic of individual needs and values, and the set of challenges raised by job demands, technological innovations, and the organization's culture.

Overall Conclusions

The material in this chapter focused on descriptively presenting the results from the survey. Here, the objective was to identify some general patterns in the data — both in aggregate, and for each firm separately. In general, there is evidence that Insureco has a somewhat more traditional IS culture, consistent with the evidence from the field studies. Insureco employees expressed less desire to interact with users, to learn about business, or to have an impact on the business. Insureco employees also expressed a stronger desire to work alone, rather than in teams, relative to Chemco employees. These results reflect that Insureco employees are more "traditional IS employees," based on Couger & Zawacki's (1980) description of IS professionals as interested in technical challenge, but not other challenges related to learning the business or working with people. These results have identified a general, underlying pattern of differences between the job preferences of Insureco and Chemco employees, with Insureco employees being more traditional, consistent with the field study results which characterized Insureco as having traditional IS department attributes — such as being focused on technology and distant from the business units.

This chapter has also contrasted Chemco and Insureco respondents, in terms of the perceived gaps in their current jobs. These gaps were identified by computing a difference scores between respondents' stated preferences (on the JPI) and the characteristics of their current jobs (on the JCI). The general pattern of results showed Insureco respondents as perceiving Insureco as a less challenging place to work, given the differences in autonomy, creativity and challenge. Since the most prominent theories for explaining the determinants of satisfaction among IS employees have identified challenging work as critical (Couger & Zawacki, 1980; Hackman, 1980), it is not surprising that, overall, Insureco respondents expressed lower job satisfaction, compared to their counterparts at Chemco. Although

Chemco respondents reported higher job satisfaction and lower turnover intentions and these outcomes are, arguably, related to better fulfillment of their challenge needs. These results, which suggest a more challenging and motivating work environment at Chemco are tempered by two unexpected results: Chemco employees perceive insufficient supervision from their managers and strong concerns about job security. These concerns about job security and supervision were represented by gap scores which are both large in absolute size, and also much larger than the corresponding gap scores expressed by Insureco employees. One question for consideration is whether shortcomings in supervision and job security are the necessary price to pay for the privilege of working in a technically leading-edge firm, one where employees enjoy considerable autonomy and are challenged to push themselves to their limits. This question will be examined more fully in Chapter 9, following the results of hypothesis-testing in Chapter 8.

Limitations of these Analyses

The results from this chapter add support to a general pattern of Insureco employees as more traditional than Chemco employees (Myers, 1991). Like other generalizations, the pattern portrayed in this chapter has its limits. First of all, this general patterns identified in the data offer a simplification or stereotype of key differences observed between the two firms, rather than a complete portrait. This characterization is based on a comparison of the average scores and central tendencies *between* the two firms within each firm, but obviously, there is some variation *within* each firm.

Two other limitations to this general pattern of findings are: first, the many other anticipated differences between Chemco and Insureco employees that were *not* confirmed,²² and second, this chapter has analyzed differences between Chemco and Insureco employees on each construct *alone*, without analyzing how these constructs correlate with or influence each

²² For example, the results did *not* show that Chemco employees express greater interest in teamwork or interacting with users, compared to Insureco employees (as predicted). Neither did the results show that Insureco employees express a stronger preference to learn new technologies or to make decisions independently, compared to Chemco employees (as predicted).

other. One caution is that the mere existence of a significant difference between firms on a particular measure (or lack thereof) does not indicate whether that measure is important in explaining relationships between constructs. For example, simply because there was no overall difference between Chemco and Insureco respondents on *personal resilience*, does not mean that this construct is irrelevant to job satisfaction. Similarly, the *lack of* differences in employee age or company tenure (noted above) does not show that these demographic variables have no bearing on employee's job skills and performance. On the contrary, Chapter 8 will show that certain demographic and cognitive style variables do influence certain outcome variables.

Obviously, the failure to detect overall differences between Chemco and Insureco respondents on certain measures may be due to the large variance that exists for these constructs *within* each firm. Where large variances exist for particular constructs, such constructs may be important for explaining other variables. Although this chapter has not attempted to explain such relationships between attributes, these are explored in Chapter 8 which tests the propositions stated in Chapter 5.

Chapter 8

Survey Results

The purpose of this chapter is to analyze the results of the survey by validating the constructs used in the survey, demonstrating the internal reliability of each construct, and testing relationships between various constructs. This introductory section provides an overview of the rationale for using each statistical technique; the details for each follow later in the chapter. Throughout this chapter, all employee data are aggregated together for analysis. The primary difference between this chapter and Chapter 7 is that in the prior chapter, responses were split into two groups — corresponding to the two firms participating in the study — and overall differences were examined.

Through the three statistical methods used below, the results describe the antecedents of three outcome variables of interest, following the adoption of client/server technology in the respondent group. These outcome variables are employee job satisfaction, turnover intentions, and job performance. Since a larger number of completed surveys were returned by employees ($n=120$) than by managers ($n=72$), analyses based on these two data sets are presented separately. First, all the employee data will be presented and analyzed, followed by the manager data.

Overview of Relationships to be Examined

I first explore the variables that were expected to explain employee job satisfaction examining first the demographic variables and then constructs based on the Theory of Work Adjustment (TWA). Specifically, these attributes are the difference scores computed between employees' job needs/values on the Job Preference Inventory (JPI) and the extent to which these needs are satisfied in the current job on the Job Characteristics Inventory (JCI). The explanatory power of these difference scores is described below. Next, the influence of three different measures of cognitive style are evaluated, showing that each cognitive style measure explains job satisfaction — both *independent* of the TWA difference scores and also in addition to them.

The analysis of job satisfaction also includes some exploratory analyses that go beyond the propositions advanced in chapter 3, to analyze the relationships among employee attitudes toward client/server technology, cognitive style, and job satisfaction. Since no propositions were stated for the expected relationships among these constructs, these analyses are presented in Appendix 9.1. This appendix explores some alternate causal mechanisms as responsible for these results (i.e., how cognitive style may influence attitudes toward client/server technology, and whether these attitudes influence general job satisfaction, or vice-versa).

The second dependent variable to be analyzed is job turnover intentions. Analysis of turnover intentions shows that job satisfaction is significantly associated with employees' intention to leave the job. Some additional demographic variables are also analyzed, showing weak (non-significant) effects of gender, age and tenure on turnover intentions.

The third dependent variable to be analyzed is job performance. This set of analyses develop evaluate a model of job performance, based on three skill sets (technical, business and general work habits) plus employee job attitudes. Together these four factors determine IS employees' overall job performance: they are labeled *facets* of job performance. This set of analyses examine the influence of demographic, job tenure, and cognitive style measures on overall job performance and its various facets.

The final set of analyses examine the relationship between job satisfaction, turnover intentions, and job performance. Although no relationship between satisfaction or turnover intentions and performance was expected, evidence for some limited influence of satisfaction on performance and performance on turnover intentions is presented.

Overview of Statistical Methods

Three primary statistical methods were used to analyze the survey data in this chapter: reliability analysis, factor analysis, and multiple regression analysis. This section briefly

reviews the purpose for using each method; specific details for each method are described below.

The first two methods — reliability analysis and factor analysis are used to evaluate individual constructs in the survey, rather than the relationship between two or more constructs. First, each construct's internal reliability was examined by computing its Cronbach alpha. Cronbach alpha specifies the extent to which the scale items are internally consistent — with a potential range from 0 to 1.0. Next, a factor analysis was conducted for each scale to identify whether the scale was unidimensional. In many cases, prior research has already shown many of these scales to incorporate multiple sub-constructs, and thus multiple factors were expected to emerge from the factor analysis. Where this occurred, separate *factor scores* were saved for each subject to use in the multiple regression analysis. Even in those cases where a construct had not *previously* been shown to be multi-dimensional, if the factor analysis results show the construct to be multi-dimensional, then separate factor scores were saved for each factor to be analyzed in the multiple regression calculations.

The third technique employed, multiple regression analysis, evaluates the relationships among multiple constructs. It is here that the propositions offered in Chapter 5 are explicitly tested by regressing the dependent variable (either employee satisfaction, turnover intentions, or job performance) on one or more predictor variables. Multiple regression determines the proportion of total variance in the dependent variable that is explained by the predictor variables, and the fit of the overall regression equation is represented by the value *Adjusted-R²* (hereafter labelled as R^2_{adj}). Since R^2_{adj} can range from 0 to 1.0, an R^2_{adj} above 0.50 is considered good for social science research, since this means that at least 50% of the variance in the dependent variable is explained by the predictor variables. Additional details of the statistical tests to evaluate the overall regression equation and the coefficients for specific predictor variables are explained below.

Table 8.1
Results of Internal Reliability Analysis
for Constructs on Employee Survey

Construct Name	Initial # of items	Initial Cronbach alpha	# of items deleted	# of items remaining	Revised Cronbach alpha
Job Satisfaction	13	0.85	1	12	0.89
Difference scores (JCI – JPI)	21	0.87	0	21	0.87
Turnover Intentions	4	0.73	1	3	0.85
Tolerance of Ambiguity	8	0.45	1	7	0.53
Kirton Adaption-Innovation Inventory	22	0.74	4	18	0.82
Personal Resilience Profile	21	0.88	0	21	0.88
Attitudes toward client/server technology	18	0.65	1	17	0.68

Evaluation of Scale Reliabilities

Each construct in the conceptual framework consisting of two or more items was analyzed for internal reliability, by calculating its Cronbach alpha, which represents the scale's average inter-item correlation. While a value of 1.0 indicates perfect correlation and, hence, perfect internal reliability, values above 0.80 are considered high, and values between 0.70 - 0.80 are also considered *acceptable* for basic social science research (Nunnally, 1978; Pedhazur & Schmelkin, 1991).¹

Where the Cronbach alpha for a scale was low (less than 0.80), this may occurred as a result of: a) the scale being multi-dimensional; b) the scale being unidimensional but having one or more items that correlate poorly with the others; c) a combination of both reasons. If the results of factor analysis showed that the scale was unidimensional, then the solution to low reliability was to delete the item with the lowest average inter-item correlation. Conversely, if the low internal reliability was due to the existence of multiple factors, then the items loading on each factor were first identified, and then the internal reliability analysis was repeated for each factor separately. The analysis of internal reliabilities and factor analysis were thus closely related to each other, and were conducted iteratively: as separate factors were identified, the internal reliability of items loading on that factor was re-analyzed.

Table 8.1 shows, for each multiple-item construct, the original results of the reliability analysis. For those scales demonstrating an initial Cronbach alpha of less than 0.80, or with items that loaded poorly on the overall construct, the table indicates whether items were deleted from the scale, and the new calculation of Cronbach alpha that resulted. Each construct is labelled by its scale name. The *difference scores* refer to the difference computed by subtracting respondents' scores on the *Job Preference Inventory* (JPI) from their scores on

¹ In general, this research seeks to follow the standard of 0.80 as desirable, although for original constructs, various authors have suggested that lower values in the range of 0.50 - 0.60 are "adequate for basic research" (Nunnally, 1978; Pedhazur & Schmelkin, 1991).

the *Job Characteristics Inventory*. The details of the factor analyses performed on each scale are explained in the following section.

Factor Analysis

Factor analysis was conducted for all multiple-item scales. If the results of factor analysis determined that multiple factors existed for a given construct, then two additional steps were taken: first, the patterns of items loading on individual factors were reviewed to suggest possible names for each factor. Second, the factor scores were saved for each respondent to use in the multiple regression analysis.

Factor analysis was conducted using the principal components method of factor extraction, and oblique factor rotation were identified. In general, oblique rotation of factors was preferred as the default, unless *both* the prior theory and the present data suggested that the factors should be independent (orthogonal). This is consistent with advice offered by Pedhazur & Schmelkin (1991):

The decision whether to rotate factors orthogonally or obliquely reflects one's conception regarding the structure of the construct under consideration. It boils down to the question: are aspects of a postulated multi-dimensional construct intercorrelated? ... [We] question the wisdom of limiting oneself to orthogonal rotations ... The preferred course of action is, in our opinion, to rotate *both* orthogonally and obliquely. When, on the basis of the latter [oblique rotation results], it is concluded that the correlations among the factors are negligible, the ... simpler orthogonal solution becomes tenable.

— Pedhazur & Schmelkin, 1991, p. 615

Identifying the number of factors to be extracted was determined by three criteria, in the following order of preference: a) based on the *scree test*, b) based on the identifiability of factors, and c) based on the number of factors with *eigenvalues* greater than 1.0. In those cases where these criteria conflicted, preference was given to the criteria in the order stated above.² Every multiple-item scale in this study was subjected to factor analysis and each

² For example, if the scree test suggested the existence of three factors, and the names of three factors were identifiable based on the pattern of item loadings, then the three-factor solution was accepted, even if there were four or more factors with *eigenvalues* exceeding 1.0.

found to be multi-dimensional (with the exception of *Turnover Intentions*). Table 8.2 indicates for each scale, the number of factors extracted from the factor analysis, the number of items loading on each factor, the labels for each factor, and the Cronbach alpha for each.

Table 8.2
Factor Analysis Results
for Constructs on Employee Survey

Construct Name	# of Items	Factors	Factor #	# Items per factor	Factor Name	Alpha for factor
Job Satisfaction	12	3	1	7	Stimulating/interesting	0.89
			2	3	Stressful/overworked <i>(reverse-scored factor)</i>	0.61
			3	3	Feeling of usefulness	0.78
Difference Scores (JCI - JPI)	21	5	1	6	Technical challenge/ high skill levels	0.84
			2	6	Business/user department orientation	0.71
			3	5	Hygiene factors <i>(pay, benefits, security)</i>	0.71
			4	5	Positive working conditions <i>(autonomy, variety, feedback)</i>	0.77
			5	1	Adequate Level of Supervision	—
Tolerance of Ambiguity	7	3	1	4	Cognitive Tolerance of Ambiguity <i>(enjoys open-ended problems)</i>	0.51
			2	3	Social Tolerance of Ambiguity <i>(enjoys unfamiliar social situations)</i>	0.50

Construct Name	# of Items	Factors	Factor #	# Items per Factor	Factor Name	Cronbach alpha
Innovativeness (Kirton Adaption-Innovation Inventory)	23	4	1	8	Originality (ability to generate original ideas)	0.83
			2	4	Efficiency/Orientation to Detail <i>(reverse-scored factor)</i>	0.72
			3	5	Rule-Conformity <i>(reverse-scored factor)</i>	0.82
			4	5	Adaptability/Desire for Change	0.72
Personal Resilience Profile	21	7	see footnote ³			0.89
Turnover Intentions	4	2	1	3	Looking for another job	0.85
Attitudes toward Client/ Server	17	4	1	8	Client/server is <i>useful / effective</i>	0.95
			2	4	Client/server is <i>easy to use</i>	0.89
			3	2	Client/server is <i>compatible with prior methods</i>	0.68
			4	2	Client/ server <i>requires significant effort and is a significant change</i> ⁴	0.52

³ This 21-item version of the Personal Resilience Profile was provided to me by the Director of Research at ODR (Organizational Development Resources) in Atlanta. It is a reduced version of the original 77-item scale. Due to ODR's concern about the proprietary nature of their scale, my agreement with ODR was that I would not divulge details such as the wording of items, individual item loadings, or scoring procedure. The Cronbach alpha in the table is a value provided to me by ODR's Research Director, as was each respondent's total scale score. In addition, my own factor analysis replicates the 7-factor solution specified by ODR, however, I was unable to validate the scale's internal reliability without additional information about scoring procedures, which is proprietary to ODR.

Multiple Regression Analysis

This section presents the results of testing the propositions offered in Chapter 3. First, the "conventional wisdom" propositions were tested — the arguments advanced in the computer trade press regarding the relationship between employees' age or job tenure and their ability to adapt to client/server technology. These propositions are stated essentially as "straw men," and no association between these variables were expected. Consistent with the expectations of this study, and contrary to the "conventional wisdom," no support for any direct relationship between age or job tenure and employee satisfaction was found.

Second, the hypotheses specific to this study, related to employees' job satisfaction are tested. These include the relationship between employees' job fit (on five dimensions of fit) and their job satisfaction. Nearly all five of the job fit dimensions were found to explain job satisfaction.⁵ Third, the influence of the three measures of cognitive style are examined, and each is found to be statistically significant in explaining job satisfaction, beyond the existing job fit factors in the regression equation. Fourth, the relationship between employee satisfaction and job turnover intention is examined and found to be statistically significant. Fifth, the relationship between employee skill levels (as rated by their direct supervisors) and their overall job performance rating are analyzed. Sixth, the influence of age and other demographic variables of on job performance are analyzed, followed by an examination of

⁴ This is a novel factor, and has not been identified in any previous studies of technology adoption. It is composed of two negatively-worded items which should have, in theory, loaded on the two prior factors. The item "Client/server requires significant mental effort to use," should have loaded negatively on the *easy to use* factor. Similarly, the item "Client/server is a significant change from the way we used to do things here," should have loaded negatively on the *compatibility* factor. Not only did these items *not* load on the factors which prior research dictates they should have, but they were moderately correlated with each other ($r = 0.36$). The difficulty in naming this factor lies in the fact that the only common feature shared by these two items is their use of the word *significant*.

⁵ As will be shown below, of the five dimensions of job fit that were tested in a multiple regression analysis with satisfaction as the dependent variable, three of the five factors were statistically significant. In addition, one other factor was borderline significant ($p = 0.054$), but in the *next* step of the analysis, when the cognitive style variables were individually added to the regression equation, this factor (business/user orientation) becomes significant as well. In short, three of the five job fit factors were statistically significant when the five job fit factors were the *only* variables in the regression equation, but four of the factors were significant when cognitive style was added to the regression equation.

the effects of cognitive style. Next, the relationship between job performance and both satisfaction and turnover intentions are examined.

Finally, some exploratory analyses were conducted on employees' attitudes toward client/server technology. This included analyzing the relationship between employees' attitudes to the client/server technology and their job satisfaction. All of the attitude factors were found to influence job satisfaction. The last exploratory analysis was to determine whether employees' attitudes toward client/server technology were influenced by their cognitive style. This analysis suggested that only Personal Resilience (but not the other two cognitive style variables) influences employees' attitudes toward client/server technology.

Some of these analyses employed only simple linear regression, however most used multiple regression. Where multiple variables were entered into the regression equation, stepwise regression was used. Since the purpose of analyzing the statistical significance of multiple regression has two goals: a) to analyze the significance of the overall regression equation, and b) to analyze direction and significance of the coefficient for each variable in the regression equation, results for each proposition are presented in two separate tables, labelled "a" and "b" (i.e., 8.3a and 8.3b). For all propositions, the "a" table analyzes the overall regression equation, presenting values for the proportion of variance explained (R^2), the proportion of variance adjusted for the number of predictor variables (R^2_{adj}), the unexplained variance of the dependent variable (the Standard Error), the F-statistic associated with the overall equation, and the significance level of the F-test. In comparing two similar models, R^2_{adj} is the metric used to compare models, to determine the better one: the higher the R^2_{adj} value, the better the model fit. For this reason, when new predictors are added to an existing regression equation (nested regression), if the value of R^2_{adj} increases, this indicates that the increase explained variance is statistically significant, as indicated by the column titled "Change in R^2 ." Where the "Change in R^2 " is positive, and the p value associated with this change is statistically significant, then the new variable is a useful addition to the multiple regression equation. Conversely, if either the "Change in R^2 " is negative, or the p value is

not significant, then this additional variable does not significantly add to the explanatory power of the regression equation. This information is all represented in the "a" table (i.e., 8.3a), which is useful for representing the overall *strength* of the regression equation (its explanatory power), but it does not show the *direction* of each variable's influence (positive or negative). The "b" tables (i.e., 8.3b) includes the data relevant to each variable's regression coefficient. It is here that the *direction* of the variable is represented — in terms of the sign of its unstandardized regression coefficient. Where unstandardized coefficient is negative, this indicates that the predictor variable is negatively associated with the dependent variable.⁶

Conventional Wisdom Propositions

The purpose of testing the conventional wisdom hypotheses is to determine whether the relationships between the demographic variables (age and job tenure) and job satisfaction were supported. According to the IS trade publications, older IS employees will be less willing and able to learn to use new technologies, a relationship that should undermine job satisfaction and performance for older employees or those with more seniority. Since every proposition evaluated in the study relates only to IS developers who were obliged to use client/server technology, by virtue of working in IS departments that had adopted this new technology, this restriction will be implicit in every hypothesis stated below. The following hypotheses were tested:

Proposition 1: Employees' age will be negatively related to job satisfaction.

Proposition 2: Employees' job tenure will be negatively related to job satisfaction.

Since three different measures of job tenure were available, three variations on proposition 2 are stated below, relevant to each of the measures:

⁶ Finally, note that for a simple linear regression, the last column (the p values) of the two tables will be identical (since the p value associated with the F-statistic in Table A will be the same as the p-value associated with the T-test in Table B). This is not the case for multiple regression.

Proposition 2a: Employees' *career tenure* (total years in IS field) will be negatively related to job satisfaction.

Proposition 2b: Employees' *company tenure* (total years at current employer) will be negatively related to job satisfaction.

Proposition 2c: Employees' *position tenure* (total years in current position) will be negatively related to job satisfaction.

None of these relationships were found to be statistically significant for the *overall* sample of employees, as shown in Table 8.3. These relationships were also evaluated for employees in each firm (Chemco and Insureco) separately. It is possible that such relationships between these demographic variables and job satisfaction exist for employees in one firm, but not the other. Although *company* alone (represented by a dummy variable) was a significant predictor of job satisfaction (as described in Chapter 7), with ChemCo employees having significantly higher job satisfaction than InsureCo employees, the results of separate analyses were consistent with the overall analysis: none of these demographic variables above (age or job tenure) were successful in explaining job satisfaction.

Finally, the possibility of each predictor variable having an interaction with *company* was evaluated. This interaction effect was tested by computing a product term consisting of each predictor variable multiplied by *company* (the dummy variable), and adding the product term to the regression equation (Venkatraman, 1989).

Table 8.3 (a)
Results of Hypothesis Testing for Demographic Variables
Proportion of Variance in Job Satisfaction Explained

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p Value
1	Age	.00297	-.0057	.79761	.34210	0.560
2a	Career Tenure	.00007	-.00862	.79877	.00828	0.928
2b	Company Tenure	.00000	-.00869	.79880	.00013	0.991
2c	Position Tenure	.01366	.00509	.79332	1.59298	0.209

Table 8.3 (b)
Regression Coefficients

Prop. #	Construct	Regression Coefficient (b)	S.E. (b)	T-statistic	p Value
1	Age	-.006040	.010326	-0.585	0.560 (n.s.)
2a	Career Tenure	.001178	.012942	0.091	0.928 (n.s.)
2b	Company Tenure	.000136	.012160	0.011	0.991 (n.s.)
2c	Position Tenure	-.033390	.026455	-1.262	0.209 (n.s.)

Of the four possible interaction terms, only one was significant (the one corresponding to proposition 2c). Both Tables 8.4 (a) and (b) are necessary to interpret the meaning of this interaction term. Table 8.4 (a) shows that this interaction term contributed an additional increment to explain employee job satisfaction (an additional 3.7% of the variance), small but statistically significant. Table 8.4 (b) shows that the sign of the interaction term coefficient is *negative*, indicating that job satisfaction is lowest for employees at InsureCo (coded as Firm 2) who have been in their present jobs the longest, whereas it is highest for ChemCo employees (coded as Firm 1) who have been in their jobs the shortest amount of time. These extremely high or low reports of job satisfaction exhibit an *interaction effect*, because they are more extreme than would be expected by taking into account either *main effect* individually (employees' position tenure or company).

Table 8.4 (a)
Regression Analysis for Interaction Effects

Prop. #	Construct	R ²	Adjusted R ²	Change in R ²	Change in F-statistic	p Value (of change)
2c	Interaction: Position Tenure x Company	.03663	.02826	.0371	4.37301	0.039 *

Table 8.4 (b)
Coefficients for Interaction Analysis

Prop. #	Construct	Regression Coefficient (b)	S.E. (b)	T-statistic	p Value
2c	Interaction: Position Tenure x Company	-.03456	.01652	-2.091	.039 *

Position tenure was the only demographic variable that exhibited a significant interaction with company, although none of these measures of job tenure variables exhibited a significant main effect. In addition, it is worth commenting that operationalizing job tenure as *number of years in the present job* differs from the common meaning of "job tenure" as *total years in the same company* (which was also tested in Proposition 2b, *company tenure*). Thus, this interaction term relates only to a very specific definition of job tenure — years in the same job.

This interaction effect for *position tenure* by *company* makes sense, if we realize several points: First, employees at InsureCo were generally less satisfied in their jobs, a statistically significant finding ($p = .04$; see chapter 7). Second, position tenure had a negative, but weak main effect that was not statistically significant ($p = 0.21$). This result suggests a *trend*, with employees who are new to their current positions reporting slightly higher job satisfaction, compared to employees with more experience in their positions. Third, employees with longer *position tenure* are those who have not been promoted to new positions for awhile, and they may be unhappy or bored in their jobs.

Since greater *position tenure* is related to lack of recent promotions, and since InsureCo employees are generally less satisfied in their jobs than ChemCo employees, one interpretation is that Insureco employees with long position tenure are those who are less promotable — either due to their inferior technical skills or due to other factors that render them less promotable (e.g., work style or attitudes). It is not surprising then, that InsureCo employees who have been in their current jobs the longest would be the least satisfied with their jobs. Conversely, Chemco employees who are new to their current positions may perceive more novelty and challenge in their jobs, compared to veteran employees. The significance of the interaction effect says that the very high job satisfaction for new Chemco employees and very low job satisfaction for veteran InsureCo employees are more exaggerated than one would expect, based on the two separate main effects (*company* or *position tenure*) alone.

Analysis of the Job Fit Factors Based on the *Theory of Work Adjustment*

This section analyzes the relationship between employees' *fit* to the job environment and their job satisfaction, based on the job fit dimensions of the Theory of Work Adjustment. The general proposition is that employees who have more of their job needs met by their current job will report higher levels of job satisfaction. Job fit was operationalized by creating a set of *difference scores* by subtracting employees' preferences for 21 characteristics (on the Job Preference Inventory) from their perceptions of their current job (the same 21 items on the Job Characteristics Inventory). The general proposition is:

Proposition 3: The fit between *employees' needs/values* and the *patterns of reinforcement* provided in their current job will be related to job satisfaction.

Since 21 pairs of variables were employed in the survey to operationalize "job fit," each of the 21 difference scores *could*, in principle, be added to the regression equation, to determine the influence of each on job satisfaction. However, since many of these 21 items are related to each other, the problem of multicollinearity would arise from such a hypothetical 21-variable regression equation. To avoid the multicollinearity problem, factor scores obtained from the factor analysis of the 21 *difference scores* were used as predictor variables in the multiple regression equation.⁷

Each factor score represents the difference between the employees' job preferences and their current perceptions of the job on a dimension extracted from the factor analysis. Since there

⁷ These five factors were based on an orthogonal factor rotation, since the oblique rotation did not converge. Because the factors are orthogonal, they can safely be included in the multiple regression equation without incurring problems due to multicollinearity.

were five factors identified in the factor analysis in Table 8.2, separate propositions are stated for each factor.⁸

Proposition 3.1: Employees' perceived job fit, in terms of having a job that is *technically challenging and requires high levels of skill*, is related to job satisfaction.

Proposition 3.2: Employees' perceived job fit, in terms of whether it provides a *focus on the business and user departments*, is related to job satisfaction.

Proposition 3.3: Employees' perceived job fit, in terms of whether it provides *traditional hygiene factors* (e.g., pay, benefits, security), is related to job satisfaction.

Proposition 3.4: Employees' perceived job fit, in terms of whether it provides *positive working conditions*, is related to job satisfaction.

Proposition 3.5: Employees' perceived job fit, in terms of whether it provides *adequate levels of supervision*, is related to job satisfaction.

Using multiple regression analysis, job satisfaction was regressed on the five factors to assess the effect of all five factors simultaneously. Since stepwise regression was employed, the table shows the results for each proposition in the sequence that each one was automatically entered into the regression equation. (Stepwise regression enters variables into the equation based upon the variable with largest explanatory power, followed by the second largest, etc.).

⁸ As explained in Chapter 7, a positive difference score occurs when employees report that their current job exceeds their needs on a specific dimension. Conversely, a negative score indicates unmet needs. This detail is important in interpreting the sign of the regression coefficients below. Chapter 7 showed that all difference scores were at least slightly negative. It is the *magnitude* of the difference scores that matters, not just the fact that they are generally *negative* in sign. Employees who perceive their present job as not meeting their needs will report larger negative difference scores compared to employees whose jobs provide more appropriate levels of reinforcement (and who therefore report small difference scores).

The multiple regression analysis demonstrated that three of the job fit factors were statistically significant (in decreasing order of explanatory power): work that is *technically challenging*, provides *positive working conditions* and reinforcement of *hygiene factors*. In addition, a fourth factor, *business/user orientation* was borderline significant ($p = 0.075$) in explaining job satisfaction.⁹ The fifth factor, *adequate supervision* was unrelated to satisfaction.

These results show that of the 21 difference scores based on job fit, the items that were related to the job's technical challenge and employees' opportunity to use high skill levels on the job are the best predictor of job satisfaction. Other aspects of the job matter as well: attributes that have been labelled as hygiene (Herzberg, 1965) or security (Maslow, 1952) factors, and attributes that have lead to positive working conditions or — in Hackman & Oldham's (1980) terminology, a high motivating potential score. These two other factors are important, but have less influence on job satisfaction than to technical challenge. The fact that *business/user orientation* (the fourth factor) was only borderline significant indicates that it is a subordinate factor in explaining job satisfaction, even among employees who do have a strong business/user orientation.

Relationship between Employees' Cognitive Style and Job Satisfaction.

This section analyzes the relationship between employees' cognitive style and job satisfaction. Since the survey collected data for each respondent on three different cognitive style scales, propositions for each scale are stated separately.

Proposition 4: Employees' *Tolerance of ambiguity* is positively related to job satisfaction.

Proposition 5: Employees' *Personal Resilience* is positively related to job satisfaction.

Proposition 6: Employees' *Innovativeness* (creative style) is positively is related to job satisfaction.

⁹ This fourth factor becomes a significant predictor of job satisfaction in the next set of analyses, incorporating cognitive style.

Table 8.5 (a)
Regression Analysis of Satisfaction on Job Fit Factors

Prop #	Construct	R ²	R ² _{adj}	Standard Error	F-statistic	p value	R ² Change	Change in F-Statistic	p Value (of change)
3.1	Technical Challenge	.2013	.1944	.7513	29.240	.000**	.2013	29.240	.0000**
3.4	Positive Working Conditions	.3984	.3880	.6549	38.076	.000**	.1970	37.668	.0000**
3.3	Hygiene Factors	.4394	.4246	.6350	29.781	.000**	.0410	8.335	.0047**
3.2	Business/User Orientation	.4580	.4339	.6298	18.934	.000**	.0187	1.932	.1500 (n.s.)
3.5	Adequate Supervision	.4412	.4159	.6424	16.912	.000**	-.180	2.457	.912 (n.s.)

Table 8.5 (b)
Regression Coefficients

Prop. #	Construct Tested	Unstandardized coefficient (b)	S.E. (b)	T-statistic	p Value
3.1	Technical Challenge	.455553	.056572	8.053	.0000**
3.4	Positive Working Conditions	.380747	.058039	6.560	.0000**
3.3	Hygiene Factors	.164072	.056830	2.887	.0047**
3.2	Business/User Orientation	.104743	.058226	1.799	.075 (n.s.)
3.5	Adequate Supervision	.048847	.058226	.839	.403 (n.s.)

Two tests of association between employee cognitive style and job satisfaction were analyzed. In the first test, a simple regression analysis was conducted, with job satisfaction regressed on each cognitive style variable separately.¹⁰ This is a fairly *weak* test of the effect of cognitive style on job satisfaction, since it does not take into account the effect of the job fit factors described above. A stronger test of the influence of cognitive style on job satisfaction is to analyze the effect of cognitive style *after* the difference score factors have already been entered into the regression equation. First, the results of the weaker test of cognitive style (simple linear regression) are presented, followed by the stronger test. (multiple regression).

Based on simple linear regression, two of the three cognitive style significantly explained job satisfaction, personal resilience and tolerance of ambiguity ($p < 0.01$). The only construct not directly related to job satisfaction was employees' *innovativeness*. As shown below, however, all three cognitive style variables were statistically significant in explaining job satisfaction, after the job fit variables were already included in the equation.

Table 8.6 (a)
Simple Regression Analysis for Cognitive Style Variables

Prop. #	Construct Tested	R ²	Adjusted R ²	Standard Error	F-statistic	p Value
4	Tolerance of Ambiguity	.06849	.0604	.7709	8.4561	.0044 **
5	Personal Resilience	.19944	.19241	.7177	28.400	.0000 **
6	Innovative-ness Score (KAI scale)	.00307	-.0054	.8381	0.3600	.5500 (n.s.)

¹⁰ Since each of these cognitive style scales are moderately correlated with each other, the three measures of cognitive style are not entered into the same regression equation, to avoid the problem of multicollinearity. Instead, each construct was entered separately.

Table 8.6 (b)
Significance of Regression Coefficients

Prop. #	Construct Tested	Unstandardized regression coefficient (b)	S.E. (b)	T-statistic	p Value
4	Tolerance of Ambiguity	.200567	.06990	2.908	0.004 **
5	Personal Resilience	.037988	.007128	5.329	0.000 **
6	Innovativeness Score (KAI scale)	.00393	.00654	0.600	0.550 (n.s.)

Multiple Regression Analysis with Cognitive Style Variables

The following hypotheses represent the *stronger* test of the effect of employees' cognitive style on job satisfaction:

Proposition 7: **Employees' *Tolerance of Ambiguity* is positively related to their job satisfaction, beyond the five job fit factors described above.**

Proposition 8: **Employees' *Personal Resilience* is positively related to their job satisfaction, beyond the five job fit factors described above.**

Proposition 9: **Employees' *Innovativeness* (creative style) is positively related to their job satisfaction, beyond the five job fit factors described above.**

To test these propositions, each cognitive style variable was entered into a multiple regression equation that already included the job fit factors (corresponding to Propositions 3.1 - 3.5, above). Since stepwise regression (based on the five job fit factors) had only included three variables in the regression equation (corresponding to propositions 3.1, 3.4 and 3.3), then the *additional* variance explained by each of the cognitive style variables was calculated by

determining the improvement to R^2 and R^2_{adj} beyond the regression equation consisting of these three variables. The first row in Table 8.7a (below) shows the relevant statistics for the regression equation *before* the addition of each cognitive style variable. The table presents the results corresponding to Propositions 7, 8 and 9.

When added as *additional* predictor variables (in addition to the five job fit factors), all three of the cognitive style variables were statistically significant, since each explains a statistically significant *additional* amount of variance in employees' job satisfaction scores beyond the job fit variables. This difference is captured by the last three columns of Table 8.7 (a), which shows the "Change in R^2 " caused by the new, cognitive style variable, as well as the change in the F-statistic, and its associated p value.

Of the three cognitive style variables, however, Personal Resilience was most powerful, in terms of explaining the largest proportion of variance in job satisfaction. The other two cognitive style constructs (*Tolerance of Ambiguity* and *Innovativeness*), explained a much smaller amount of the remaining variance, compared to *Personal Resilience* (based on the column in Table 8.7 (a) showing the Change in R^2 as 0.034, 0.121, and 0.019, for variables *Tolerance of Ambiguity*, *Personal Resilience*, and *Innovativeness*, respectively).

In addition to themselves being significant, when each of the cognitive style variables was added to the multiple regression equation, the job fit factor associated with employees' *Business/User Orientation* also became a significant explanatory variable. Thus Table 8.7 (a) shows the statistical outputs for each cognitive style variable, as well as for Proposition 3.2, the *Business/User Orientation* variable, when this variable automatically entered the stepwise regression, along with each cognitive style variable.

Table 8.7 (a)
Multiple Regression with Job Satisfaction Regressed on Cognitive Style

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p value	Change in R ²	Change in F-Statistic	p Value (of change)
3.1, 3.4, 3.3	All Job Fit Factors	.4397	.4248	.6375	29.556	.0000**	—	—	—
7	Tolerance of Ambiguity	.41727	.3961	.62115	19.691	.0000**	.03525	6.653	.0112**
3.2	Business/ User Orientation	.4434	.4179	.6098	17.370	.0000**	.0262	5.217	.0255*
8	Personal Resilience	.5058	.4877	.5745	27.895	.0000**	.1209	26.662	.0000**
3.2	Business/ User Orientation	.5238	.5017	.5666	23.755	.0000**	.0179	4.062	.0462*
9	Innovativeness Score (KAI scale)	.4620	.4428	.6275	24.041	.0000**	.0223	4.639	.0334*
3.2	Business/ User Orientation	.4808	.4574	.4574	20.556	.0000**	.0188	4.022	.0473*

Relationship between Job Satisfaction and Turnover Intentions

The next relationship examined is that between job turnover intentions and employee satisfaction. In this case, however, job satisfaction is the *predictor* variable and turnover intention is the dependent variable.

Proposition 10: **Employees' job satisfaction is negatively related to their *turnover intentions*.**

Since job satisfaction was the sole predictor variable related to turnover intentions, the relationship was evaluated with using simple, linear regression model. The results showed that this relationship was very strong and highly statistically significant, with job satisfaction explaining over 19% of the variance in turnover intentions. The negative coefficient indicates that more satisfied employees were *less* likely to consider leaving their jobs, consistent with Proposition 10.

Table 8.8 (a)
Turnover Intentions Regressed on Job Satisfaction

Prop. #	Construct Tested	R ²	Adjusted R ²	Standard Error	F-statistic	p Value
10	Job Satisfaction	.1920	.18498	1.354	27.33	.0000 **

Table 8.8 (b)
Regression Coefficients

Prop. #	Construct Tested	Unstandardized regression coefficient (b)	S.E. (b)	T-statistic	p Value
10	Job Satisfaction	-.8265	.1581	-5.228	.000 **

Summary of Results of Employee Survey

Based on the respondent data collected from IS employees in two firms that had recently adopted client/server technology, no support was found for any connection between employees' age or tenure in their firm and job satisfaction. This is consistent with the framework developed and tested in this research — namely that employees' attitude toward the challenge of integrating new skills is *not* contingent upon the age or seniority of workers. These "conventional wisdom" propositions were tested to evaluate conventional notions that have circulated in the IS trade press. Neither age nor any of three measures of employees' job tenure were found to have a main effect on job satisfaction, however, one measure of tenure, position tenure (number of years in the present job) was found to interact with the company in which the employee worked.¹¹ This interaction effect resulted in Chemco employees who had been in their present jobs for a short time having significantly *higher* job satisfaction, and Insureco employees who have been in their present job for many years having *lower* job satisfaction than would be expected on the basis of either main effect evaluated separately (company or position tenure). It may be that position tenure is inversely related to promotability: employees who have been in their present jobs the longest are those who have not been promoted in recent years.

Support was found for all of the propositions explaining employee satisfaction. First of all, employees' job satisfaction was found to be closely linked to three job fit variables (technical challenge, positive working conditions, and hygiene factors) and borderline significant for one other factor (business/user orientation), consistent with the Theory of Work Adjustment, which explains job satisfaction in terms of whether employees' needs receive sufficient reinforcement from the job and the environment in which they work.

¹¹ As explained in Chapter 7, *company* (expressed as a dummy variable) has a significant main effect on job satisfaction, with Chemco employees scoring significantly higher than Insureco employees on job satisfaction. The main effect for *position tenure* (length of time in current job) was weak and negative. Employees who had been present in their jobs the longest had lower job satisfaction, although this effect was only borderline significant. The product term formed by multiplying company times position tenure, however, demonstrated a strong interaction effect ($p = 0.035$).

most importantly, all three cognitive style variables that were hypothesized to influence job satisfaction were found to explain a significant amount of the variance *after* accounting for the job fit factors above. Of the three cognitive style variables, *Personal Resilience* had considerably more explanatory power than the other two, explaining an additional 12% of the variance in job satisfaction beyond the job fit factors, as compared with 3.5% and 1.9% for *Tolerance of Ambiguity* and *Innovativeness* (the score on Kirton's Adaption-Innovation Inventory), respectively. Job satisfaction was a significant predictor of employees' turnover intentions, with satisfied employees significantly less likely to consider quitting their present job, or to search for a new one.

Results of the IS Manager Survey

This section of Chapter 8 analyzes the employee performance data by combining results of the manager survey with the employee data (analyzed in the prior section). Since managers provided performance evaluation data for 72 of the 120 employees, 60% of the employees had matching performance data to compare with their self-reported data. This section of the chapter follows the same structure as the data analysis of the employee data in the previous section.

Factor Analysis Section

First, overall job performance was evaluated and found to be a unidimensional construct, with high internal reliability ($\alpha = 0.84$).¹² Of the 24 items on which IS managers rated employees' skills and behaviors, four factors were identified, using an oblique rotation. The factors are: technical/analytical skills, business knowledge, general work habits and communication skills, and employee attitudes.¹³ These four factors are hereafter labeled the *facets* of job performance since they are the components that comprise IS developers' job performance. For conciseness, the factor called technical/analytical skills is simply labeled

¹² These items were: "How would you rate the following for this employee?" the quality of work, the quantity of work, their overall performance.

¹³ Job attitudes are not skills per se, but they influence behavior which, in turn, affects overall job performance.

labeled *technical skills*, and the factor comprising general work habits and communication skills is labeled *general work habits*.

Table 8.9 identifies the internal reliability (Cronbach alpha) of the overall job performance construct and of each facet of performance.

Table 8.9
Factor Analysis Results
Data Provided by IS Managers

Construct Name	# of Items	# of Factors	Factor #	# Items per factor	Factor Name	Cronbach Alpha
Overall Job Performance Evaluation	3	1	1	3	Overall Job Performance Factor	0.84
Employee Skills and Behaviors	24	4	1	8	Technical/Analytic Skills	0.91
			2	5	Business Knowledge	0.80
			3	7	General Work Habits/Communication Skills	0.86
			4	4	Job Attitudes	0.91

Calculation of Overall Job Performance Scores

Since the data collected from managers asked for their input regarding both the importance of a set of specific job skills as well as their ratings of each employee's skill level, these two items of data were multiplied to form a set of product scores. These product scores represent weighted performance scores for each skill item (with each employee's skill rating weighted

by the importance of that skill). Next, weighted product scores were identified for each performance facet by calculating the arithmetic means of each set of product scores.

Proposition 11: **The fit between employees’ skills/ability and the skill requirements of the job is related to their job performance.**

The explanatory power for each facet of performance was assessed through simple regression, using overall performance as the dependent variable. These regression calculations show that overall job performance is significantly influenced by all four facets. Due to the high correlations among the four facets, they are not employed in the same multiple regression equation, since this would create problems with multicollinearity.

Table 8.10
Simple Regression of Overall Job Performance
on Four Facets of Performance

Facet #	Facet Name	R ²	Adjusted R ²	Standard Error	F-statistic	Regression Coefficient	p Value
1	Technical Skills	.2390	.2281	.2723	22.00	.1696	.000**
2	Business Knowledge	.2720	.2617	.2663	26.16	.1192	.000**
3	General Work Habits	.4206	.4133	.2376	50.81	.2548	.000**
4	Job Attitudes	.6388	.6336	.1876	123.80	1.10	.000**

Legend: ** = p < 0.01 * = p < 0.05 + = 0 < 0.10

The results of simple regression in Table 8.10 show that all four facets are significantly related to overall job performance (at p < 0.01). Based on an examination of these correlations, it is important to note that the technical skills facet is the *least* correlated with

the other facets, which suggests that managers' evaluation of employees' technical skills are largely independent of the other facets. In contrast, job attitudes and general work habits are very highly correlated with each other and with overall job performance.¹⁴ A second-order factor analysis was conducted and found to support the existence of such a halo effect. A single factor emerged from the second-order factor analysis, accounting for 63% of the total variance in the four performance facets (but only 50% of the variance in technical skills).

**Correlation Coefficients Between
Overall Job Performance and Its Facets**

Construct Name	Technical Skills	Business Knowledge	General Work Habits	Job Attitudes	Overall Performance
Technical Skills	1.000				
Business Knowledge	0.349*	1.000			
General Work Habits	0.342*	0.695**	1.000		
Job Attitudes	0.543**	0.515**	0.586**	1.000	
Overall Performance	0.490**	0.522**	0.649**	0.800**	1.000

¹⁴ Technical skills had the lowest correlations with the other three factors, suggesting that this halo effect may be weaker for technical skills — perhaps because these skills can be evaluated somewhat more objectively than business knowledge, general work habits, or job attitudes. Technical skills has an average intercorrelation of 0.41 with the other three facets; by contrast, the facets of general work habits and attitudes have a 0.70 correlation with each other.

The remainder of the chapter presents results from testing the propositions that predict employees' job performance. Since overall job performance consists of the four facets identified above, the analyses below test the relationship between each independent variable on overall job performance, as well as on its four facets. All relationships are examined through simple regression, using non-directional, two-tailed tests.¹⁵ The performance and skill ratings are based on managers' perceptions rather than derived from objective performance metrics. First, the "conventional wisdom" propositions were tested — the arguments advanced in the computer trade journals regarding the relationship between employees' age or job tenure in the IS profession and their ability to adapt to client/server technology. These propositions are stated essentially as "straw men," and no association between these variables and performance was expected.

Proposition 12: Employees' age is negatively related to overall job performance.

Table 8.11 below shows the results of the regression analyses between age and job performance. Age was not related to overall job performance ratings, however it was *negatively* related to employees' technical skills. Managers apparently perceive older employees as having lower levels of technical skills. No other relationships were found between employees' age and the other facets of performance (business knowledge, general work habits, or employee attitudes). Thus, consistent with the "conventional wisdom," and contrary to the expectations of this study, age was negatively related to IS employees' technical skills. Since the conventional wisdom was supported regarding the negative relationship between employees' age and their technical skills, and since the computer trade press suggested that this relationship may be due to the fact that older IS employees have been in the same jobs for many years, the relationship between job tenure and performance was also investigated. This proposition is expressed in null form below.

¹⁵ Additional tests, based on multiple regression, were performed below only if the independent variables were uncorrelated or weakly correlated with each other in order to avoid problems with multicollinearity.

Table 8.11
Job Performance Regressed on Employee Age
(based on Simple Regression Analyses)

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p Value	Coefficient (Direction)
12	Overall Job Performance	.0002	.0000	.3051	.0145	.9045	.0000
12a	Technical Skills	.0592	.0454	.8488	4.283	.0423*	-0.0290*
12b	Business Knowledge	.0174	.0030	1.367	1.206	.2760	+0.0248
12c	General Work Habits	.0000	.0000	.7782	.0031	.9554	.0000
12d	Job Attitudes	.0000	.0000	.2141	.0378	.8465	.0000

Three different measures of job tenure were available (career tenure, company tenure, and position tenure), leading to three variations on proposition 2, which are stated and tested below.¹⁶

Proposition 13: Employees' job tenure is negatively related to overall job performance.

Proposition 13a: Employees' *career tenure* (total years in the IS profession) is negatively related to job performance.

Proposition 13b: Employees' *company tenure* (total years at current employer) is negatively related to job performance.

Proposition 13c: Employees' *position tenure* (total years in current position) is negatively related to job performance.

¹⁶ Because the three measures of job tenure had fairly large correlations with each other, they were introduced into separate regression equations to avoid problems with multicollinearity.

Results of the tests between these measures of job tenure, overall job performance and its facets are shown in Tables 8.12, 8.13, and 8.14, reporting the results of simple regression equations. Of the relationships tested, one was statistically significant, one was borderline significant, and one represented a strong trend in the data. Due to the paradoxical nature of this latter trend, both this result and its implications are discussed below. (These important findings appear in bold-face in these tables).

A significant relationship was found between employees' career tenure (total years in the IS profession) and their business knowledge ($p < 0.01$). This means that IS employees who had been in the IS profession longer were perceived as having greater business knowledge. The borderline-significant relationship was between company tenure and business knowledge ($p < 0.06$), which is a similar finding to the career tenure findings, but company tenure only includes years that an employee has spent in the same company.

Table 8.12
Job Performance Regressed on Career Tenure
(based on Simple Regression Analyses)

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p Value	Coefficient (Direction)
13a	Overall Job Performance	.007	.000	.304	0.493	0.480	+0.0046
13a.1	Technical Skills	.000	.000	.875	0.044	0.833	-0.0040
13a.2	Business Knowledge	.095	.0816	1.312	7.130	.009**	+0.0760
13a.3	General Work Habits	.008	.000	.775	.055	.460	+0.0125
13a.4	Job Attitudes	.010	.000	.213	.726	.400	+0.004

Table 8.13
Job Performance Regressed on Company Tenure
(based on Simple Regression Analyses)

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p Value	Coefficient (Direction)
13b	Overall Job Performance	.002	.000	.304	.111	0.739	-0.0020
13b.1	Technical Skills	.009	.000	.871	.602	.440	-0.013
13b.2	Business Knowledge	.051	.038	1.34	3.70	.059+	+0.050
13b.3	General Work Habits	.047	.000	.777	.150	.702	+0.006
13b.4	Job Attitudes	.007	.000	.214	.469	.500	+0.003

Table 8.14
Job Performance Regressed on Position Tenure
(based on Simple Regression Analyses)

Prop. #	Construct	R ²	Adjusted R ²	Standard Error	F-statistic	p Value	Coefficient (Direction)
13c	Overall Job Performance	.002	.000	.305	.170	.681	.0000
13c.1	Technical Skills	.042	.028	.857	2.97	.089 ⁺	+0.065
13c.2	Business Knowledge	.017	.003	1.37	1.18	.280	+0.066
13c.3	General Work Habits	.003	.000	.777	.194	.660	-0.015
13c.4	Job Attitudes	.023	.009	.212	1.60	.21	-0.012

Although both these measures of tenure (career tenure and company tenure) appear to influence business knowledge (and are highly correlated with each other) it is noteworthy that career tenure is the stronger predictor of business knowledge. This implies that total years of IS work experience — even experience at another company — is relevant to increasing IS employees' business knowledge. The type of business knowledge required for IS employees is apparently not firm-specific.¹⁷

The paradoxical trend found in the data was that position tenure (years in current job) was *positively* related to technical skills. This is surprising given the finding (above) that age is negatively related to technical skills. If this is the case, how can position tenure (years in the same job) be positively related to technical skills? This means that managers perceive that

¹⁷ Company tenure was only borderline significant with business knowledge ($p < 0.06$), while total IS career tenure was highly significant ($p < 0.01$). Thus, additional years that an IS employee worked in another firm (in an IS-related job) appear to be relevant to his or her stock of business knowledge, regardless of the employer. Field interviews also showed that when IS employees do move between firms, it is often within the same industry. Both these measures of tenure are strongly correlated with employees' age.

older IS employees have weaker technical skills, but their skills increase the longer they remain in the same job. Both age and position tenure are, in principle, related to the passage of time, but they are themselves statistically uncorrelated. While managers regard older employees as having technical skills that are somewhat outdated, these same skills appear to improve the longer employees remain in the same jobs, perhaps due to additional training or hands-on learning. An alternate explanation may be that it is managers' confidence in employees' skills that increases with time, rather than employees' actual skills per se. Regardless of the underlying cause of this paradoxical relationship, it suggests that older employees who have been in their current jobs the shortest amount of time are perceived as having the weakest technical skills, whereas younger employees who have been in their current positions the longest are perceived as having the strongest technical skills. There are two factors which are apparently at work influencing technical skills, and each is affected in an opposite manner by the passage of time.¹⁸

These demographic findings for age and tenure suggest that age itself is a double-edged sword: first, older employees, by virtue of their years in the IS profession and in the same firm, are perceived as having greater business knowledge but weaker technical skills. Second, for IS employees who remain in the same job over time, their technical skills (or managers' perceptions of these skills) will increase. These findings support the conventional wisdom from the IS trade press: older employees have greater familiarity with business issues but are perceived as having less technical proficiency than younger developers. In fact, the relative size of the unstandardized regression coefficients for the age/business knowledge and age/technical skills equations suggests that managers perceive technical skills as declining for older employees at approximately the same rate that business knowledge increases.¹⁹ The net effect of age on overall job performance was neutral: no relationship was found

¹⁸ No interaction, however, was found between age and position tenure when a product term was added to the regression equation to represent the product of age times position tenure. Thus, the negative effect of age on technical skills and the positive effect of position tenure on technical skills do not themselves interact.

¹⁹ The relative size of the unstandardized regression coefficients are similar, based on the simple regression equations: These are: $b = -0.029$ for technical skills regressed on age versus $b = +0.025$ for business skills regressed on age.

between age and overall job performance measures nor between age and general work habits or job attitudes. This may be because the gains (in terms of business knowledge) and the losses (in terms of technical skills) appear to cancel each other out.

Exploratory analyses were conducted to identify the performance effects of two other demographic variables — level of education and gender. No effects were found for level of education on job performance (or its facets), however a trend was noted in terms of the effect of gender on overall job performance ($p < 0.12$). Although the trend in overall job performance showed women scoring higher than men, curiously, gender was not significantly related to any of the four facets of performance.²⁰

Relationship between Employees' Cognitive Style and Job performance.

Next the relationship between employees' cognitive style and job performance was analyzed. Since the survey collected data for each respondent on three different cognitive style scales, propositions for each construct are stated and tested separately.

Proposition 14: **Employees' *Tolerance for Ambiguity* is related to job performance.**

Proposition 15: **Employees' *Personal Resilience* is related to job performance.**

Proposition 16: **Employees' *Innovativeness* (creative style) is related to job performance.**

These cognitive style variables were investigated in two ways: first to identify whether any cognitive style variable exerted a *main effect* on job performance (or its facets) and second,

²⁰ This is an unusual finding, because since gender is related to overall job performance — even weakly — one would expect that it would be related more strongly to one (or more) of its facets. This was not the case: further analysis of the relationship between gender and employees' ratings on the job facets showed no significant differences between men and women. In fact, the only findings were very weak trends that favored women having better general work habits ($p=0.17$) and more positive job attitudes ($p=0.15$). These effects are, of course, far from significant. The trend for somewhat higher overall job ratings for women is thus not rooted in significantly better ratings on any one performance facet.

to determine whether cognitive style interacts with any of the previously analyzed demographic variables (age, tenure, education, gender).

No direct relationships were found between any measure of cognitive style and overall job performance, nor between cognitive style and the facets of job performance. Although these negative findings reject the above propositions, some more complex relationships between cognitive style and performance were investigated through multiple regression. In order to examine the prior finding that age was negatively associated with employees' technical skills (described above), multiple regression equations were analyzed regressing technical skills on age and cognitive style. Similarly, to investigate the career/business knowledge association, multiple regression analyses were conducted. These multiple regression equations also showed no significant findings, suggesting that, even after controlling for age, cognitive style is not a significant predictor of technical skills (or other performance facets). None of these analyses provided significant findings for cognitive style and age, suggesting that managers' ratings of weaker technical skills among older employees could *not* be explained by differences in cognitive style.

Despite the lack of main effects of cognitive style on overall job performance, and lack of effect on technical skills, after controlling for age, other multiple regression analyses of the relationship between cognitive style and performance, after controlling for demographic variables, showed one result that was borderline significant: personal resilience and business knowledge were *negatively* related ($p < 0.09$). On the surface, this finding implies that employees with *greater* personal resilience accrue *less* business knowledge or conversely, that those who gain more business knowledge may become less resilient over time. Since neither of these apparent relationships make sense, further multiple regression analyses were conducted to better understand the observed relationship between resilience and business knowledge. Due to the complexity of these analyses and their interpretation (involving three independent variables in a multiple regression equation), these analyses are deferred to the end of the chapter.

Examination of Relationship between Satisfaction and Performance

Since prior research has suggested that job satisfaction and performance are only very weakly related among employees (Brayfield & Crockett, 1957), no relationship between these constructs was expected here. The following proposition was tested:

Proposition 17 *Employees' job satisfaction is not related their job performance.*

Consistent with prior research, there was no significant relationship between employee satisfaction and *overall* job performance, however, the fact that satisfaction and overall performance are unrelated does not preclude that some facets of performance may be related to job satisfaction.²¹ In fact, Table 8.17 shows that some facets of performance are directly related to satisfaction, while some others are unrelated, and others appears to be related to satisfaction, but only after controlling for a third variable.

**Correlation Coefficients Between
Job Satisfaction, Overall Job Performance and Its Facets**

Construct Name	Pearson's Correlation Coefficient
Job Satisfaction	1.000
Technical Skills	0.032
Business Knowledge	0.210 ⁺
General Work Habits	0.226 ⁺
Job Attitudes	0.230 ⁺
Overall Performance	0.168

²¹ The overall correlation between job performance and satisfaction here was $r = +0.20$. As described in Chapter Two, prior research has consistently shown satisfaction and performance to have weak correlations ranging from +0.10 to +0.15. In fact, it is more appropriate to discuss the *correlation* between satisfaction and performance, since this leaves the direction of causality unspecified. Prior researchers have disagreed over whether satisfaction leads to better performance or vice-versa, or possibly even a cyclical relationship incorporating rewards (Herzberg, 1959; Mowday, Porter & Steers, 1982).

The results show that satisfaction is significantly related to managers' perceptions of employees' job attitudes ($p < 0.01$) and their general work habits ($p = 0.02$), but not to their technical skills. Job satisfaction was unrelated to technical skills, suggesting that employees with the strongest technical skills are not those who are most satisfied and vice-versa. There was a borderline significant relationship between employee satisfaction and business knowledge ($p=0.067$), which becomes significant when a control variable (company tenure) is added to the regression equation. When company tenure is controlled, satisfaction is positively and significant related to business knowledge ($p = 0.04$).²²

These results show that employees' self-reported level of job satisfaction is related to *some* aspects of job performance that can be readily observed by managers (employees' general work habits and job attitudes), but not to other aspects (technical skills). Job satisfaction is also related to business knowledge, although this relationship is significant only after controlling for company tenure.²³ The fact that different facets of job performance have different patterns of association with job satisfaction helps to explain the weak findings between job satisfaction and overall performance noted in prior research, as well as the overall weak correlation noted in this study.

Analysis of Relationships between Performance and Turnover Intentions

The relationship between job performance and turnover intentions was examined next. The Theory of Work Adjustment predicts no relationship between performance and voluntary turnover intentions and thus, no relationship was expected here. This lack of an expected relationship is due to the difference in expectations between the traditional and contemporary IS job market trends. The traditional IS literature has suggested high-performers tend to remain with their current firm over time whereas poorer performers tend to leave. The

²² Job satisfaction and business knowledge are related, although not significantly ($p = 0.067$), but when the additional effect of company tenure was controlled, satisfaction and business knowledge are significantly related ($p < 0.04$). Note that employee satisfaction is unrelated to company tenure ($p < 0.99$).

²³ This finding may also be conceptualized as indicating a relationship between company tenure and business knowledge, after controlling for job satisfaction.

recent job market trends, however, suggest that high-performing IS professionals have marketable skills and may change jobs more frequently. Due to the contrary implications of these predictions, there was no expected relationship between job performance and turnover intentions.

Proposition 18: Employees' *job performance* is not related to their *turnover intentions*.

No significant relationships between job performance (and its facets) and turnover intentions were found, although in examining the various job facets, one interesting trend was noted. While higher-performing employees (based on their overall performance) were neither more nor less likely to consider quitting their current jobs, employees with greater technical skills showed slightly stronger turnover intentions ($p = 0.12$). This finding is a non-significant trend, which provides qualified support for the contemporary notion that top performers are more likely to switch jobs and that employers must create a challenging and satisfying work environment lest these top performers seek greener pastures. This finding was also supported by a comment from one Chemco developer who voluntarily provided open-ended feedback at the end of the survey:

I generally feel that my position is secure, perhaps for the rest of my working career, however, I am aware of the changes taking place here and in the marketplace worldwide [e.g., competition, instability, and lay-offs] that may change that... I believe that if I did lose my position or decided to leave, I have highly marketable skills that would allow me to get another job fairly easily.

Other than this weak but positive relationship between technical skills and turnover intentions, there were no significant relationships between turnover and performance on the other facets of job performance. Of course, poor performers may be more likely to *involuntarily* leave their jobs — through termination or lay-offs — although such outcomes are not examined in this study. Although no findings between employees' demographic attributes (age, tenure, education, and gender) were anticipated, these attributes were analyzed to determine whether they were related to turnover intentions.

Turnover intentions were regressed on all demographic variables (age, level of education, gender, and job tenure) and two borderline significant findings were identified. First, employees with greater IS career tenure or greater company tenure reported *lower* turnover intentions ($p < 0.06$). Second, after controlling for job satisfaction, women reported higher turnover intentions than men ($p < 0.08$). Although these relationships are not statistically significant, they are borderline significant and therefore interesting.

Employees with more IS career tenure or company tenure may be less likely to quit because they are closer to retirement and have greater personal and financial investments in the firm (such as pension plans, higher salaries, and other benefits). The possibility that women are more likely to consider leaving their jobs (after controlling for job satisfaction), may be due to factors associated with child care. For example, two women from Insureco voluntarily provided the following comments to the miscellaneous feedback item:

With regard to leaving this company, I'd like to clarify that I sometimes think about leaving to become an independent consultant. I already have (or will soon have) the skill set to work on my own. This is attractive to me primarily because I'd like to cut back on the number of hours I work to spend more time with my daughter, however I have not done this yet because of the benefits I have here at Insureco.

Another woman said:

Regarding the question of leaving my current employer, I would like very much to work closer to home. The convenience of a workplace is very desirable to me, and working in [name of city] is not very convenient.

As reported in Chapter 7, turnover intentions were not high in either firm, although there was a statistically significant difference between the turnover intentions of Chemco and InsureCo employees, with Chemco employees expressing higher turnover intentions ($p < 0.05$).

Summary of Relationships between Job Performance, Demographic Measures and Cognitive Style

Taken as a whole, the job performance analyses show that:

- age is negatively related to IS employees' technical skills,
- position tenure has a weak but positive relationship to technical skills (which appears to contradict the negative relationship above),
- career tenure and company tenure are directly and positively related to IS employees' business knowledge,
- all measures of employee cognitive style are unrelated to job performance, despite the fact that they are significantly related to employees' job satisfaction,
- one measure of cognitive style (personal resilience) is negatively related to business knowledge, however this relationship is paradoxical (and examined further below).

In aggregate, these performance findings are critical — not because they supported many of my initial propositions regarding the determinants of job performance, but because they contradicted so many of these propositions. In fact, the few significant findings described above were directly opposite to the propositions: for example, whereas no relationship was anticipated between age and job performance (or its facets), age was negatively related to technical skills. Furthermore, both career tenure and company tenure (which themselves are correlated with age) were strongly related to employees' levels of business knowledge. Also, contrary to the stated propositions, cognitive style was not related to any measures of job performance, and (with the exception of the negative relationship between personal resilience and business knowledge) it did not help to explain the negative relationship to weaker technical among older employees.

Analysis of Negative Relationship between Personal Resilience and Business Knowledge

The borderline significant ($p < 0.09$) finding between personal resilience and business knowledge is a paradoxical one: while resilience was previously shown to be associated with greater job satisfaction, here it is shown to be negatively related to business knowledge

($p < 0.09$). On the surface, this finding appears to demonstrate that employees with *greater* personal resilience accrue *less* business knowledge or conversely, that those who learn more about the business may become less resilient over time. Due to the important implications of this borderline significant findings for research methodology and theory development, the results are described here in greater detail.

The direction of causality between personal resilience and business knowledge is equivocal, since it cannot be known whether resilience influences business knowledge, or vice-versa, or whether this is a spurious relationship due to a latent third variable. To investigate further, this paradoxical finding was explored through various multiple regression equations. The possibility of a spurious relationship was explored by including demographic variables such as age and tenure. Since business knowledge was shown above to be related to both IS career tenure ($p < 0.01$) and company tenure ($p < 0.06$), these variables were separately added to the multiple regression analysis (with business knowledge regressed both on company tenure and resilience), to detect whether the relationship between resilience and business knowledge might be spurious, resulting from an interaction with job tenure.

These analyses revealed that company tenure can help to explain the paradoxical relationship between resilience and business knowledge. This insight was prompted by the recognition that resilience and company tenure are also *negatively* correlated ($p < 0.04$). These results show that more resilient people stay in the same company for *less* time compared to their less-resilient peers. Although this may appear to be at odds with the fact that resilient people are more satisfied in their present jobs, the fact is that, after taking into account their greater job satisfaction, greater resilience appears to trigger an "appetite for change" which, in turn leads employees to "job hop." Thus, due to the greater desire of highly resilient people for change, they may not remain with the same employer long enough to accrue large reserves of business knowledge, compared to their less resilient co-workers. Highly resilient people may instead seek new challenges by changing companies or even changing careers (to a profession other than IS).

This interpretation helps to explain the negative correlation between business knowledge and resilience, although it prompts some additional questions: Why does resilience appear to lead to greater job satisfaction (which itself reduces turnover intentions) but it is also associated with lower business knowledge (which is, arguably, due to the fact that resilient people may change jobs more often)? There are some obvious contradictory effects between the *beneficial* effects of resilience on job satisfaction, its *negative* effects on business knowledge, and its lack of influence on several other performance measures (technical skills, general work habits, job attitudes). Since contributions to knowledge often occur through surprising or contradictory findings (Robey, 1995; Van de Ven & Poole, 1989), these contradictory findings are grounds for future research on how resilience affects employees' attitudes and behavior in the workplace.

Chapter 9

Discussion

This research has elaborated upon and tested and a framework to explain the adaptation of users to a new technology. The correspondence framework selected as the foundation for my conceptual framework (the Theory of Work Adjustment) suggests that three outcome variables, satisfaction, job performance and turnover intentions, can be explained by the fit between the individual and characteristics of the specific job environment.

Chapter 7 descriptively analyzed the survey data, testing some propositions that were offered, based on the field studies. While these data were based on individual survey results, the chapter focused on *general* patterns of difference between Chemco and Insureco, including both constructs that represent attitudes inherent to the employees themselves, as well as those reflecting attitudes to the work environment. From this chapter, I identified few differences in terms of the two groups of employees themselves — suggesting that they were similar.¹ While few differences were identified in terms of needs between the two firms, there were several important differences in their reactions to their respective job environments. In general, Chemco employees expressed higher job satisfaction (5.0 versus 4.67, $p = 0.056$). Job satisfaction was higher for Chemco employees due to their more positive perceptions of their current jobs, rather than based on inherent differences in employees' needs. These differences in Chemco employees' perceptions of their work environment were due to the following factors:

¹ The only differences that were statistically significant were ChemCo employees' stronger orientation to the business, such as their greater desire to "learn about the business itself," to "learn project management skills," and "to have a significant impact on the overall business," compared to InsureCo employees. Furthermore, ChemCo employees expressed a higher need for job security, while InsureCo employees expressed a greater desire to "begin and complete assignments without relying on others."

- their *need for technical challenge* was better satisfied
- their *need for a positive work environment* was better satisfied.
- their *hygiene factors* were generally better satisfied.²

Chapter 8 analyzed the survey data, testing the multi-variate model which explains job satisfaction, turnover intentions, and job performance. For job satisfaction, the framework used difference scores to capture the extent to which employees perceived their jobs as fitting their needs in each general area that determined satisfaction, not the absolute level of this need, by itself. For job performance, this study used a weighted average formed by multiplying supervisors' importance rating for a specific skill multiplied by their assessment of each employee's skill. This chapter will review the major findings of the study, analyzing and integrating them with prior literature on IS professionals and management of technology change.

This study showed that none of the demographic variables collected (age, level of education, or job tenure) were significantly related to job satisfaction, following the adoption of new technology. In contrast to the poor predictive ability of these demographic variables, however, a framework based on the Theory of Work Adjustment (TWA), showed strong explanatory power in explaining job satisfaction and turnover intentions. Specifically, three of the five factors in the TWA framework explained employees' job satisfaction: *need for technical challenge*, *need for a positive work environment*, and importance of *hygiene factors*. Furthermore, job satisfaction was strongly — but inversely — related to turnover intentions, as predicted by the framework. Beyond the strong explanatory power of the TWA in explaining these outcome variables, the inclusion of measures of individual cognitive style significantly improved the fit between the TWA and job satisfaction. These cognitive style measures captured individual tolerance of ambiguity, openness to change, and willingness to try to confront change. Each of these variables, when individually added to the explanatory

² ChemCo employees generally expressed greater satisfaction with the items loading on the hygiene factor (discussed below), they expressed more dissatisfaction with the level of job security. The job design trade-off which may lead to insufficient supervision are discussed in the section titled "Optimal Fit between Employee and Work Environment."

model, significantly improved the model's ability to explain employee satisfaction following adoption of client/server technology.

Findings from the Theory of Work Adjustment Framework

Consistent with some early research on the motivations of IS professionals, this study has shown that the single best predictor of job satisfaction is whether the employee's *need for technical challenge* is fulfilled, a finding that is both reassuring and puzzling. Although this result is consistent with Couger's work (Couger, 1979; Couger & Zawacki, 1980), it contradicts some more recent results. Couger's work has consistently shown that IS professionals have a high need for achievement and need for challenging work, but low need for socialization. During the late 1980s and 1990s, other researchers showed that IS professionals were not interested in technical challenge and proficiency alone, but that they had a similar motivational profile to other technical/professionals employees (Ferratt & Short, 1986; 1988). Recent evidence suggests a new breed of "nontraditional IS professionals" who are less concerned with technology itself, and more interested in having an impact on the business, serving and interacting with users, and working in teams (Myers, 1991; McLean, Tanner, & Smits, 1991).³ Keen (1988) argued that a variety of new roles for IS professionals were emerging — with some of these roles primarily focused on technology, but others focused on service to and integration of technology with the business.⁴

Three outcomes from the present study suggest that this trend may have been overstated or short-lived, and that the focus now appears to have shifted *back* to an emphasis on technology. First, based on the needs/values expressed by respondents on the Job Preference Inventory (JPI), *need for technical challenge* was extremely important to respondents.

³ Myers argued that the nontraditional IS professionals had the following attributes: more "focus on service to the organization ... a user orientation ... important strengths in patience, flexibility, and creativity ... a focus on liaison functions ... and increasing the strategic impact of systems on the business as a whole." (Myers, 1991: 34).

⁴ Keen argued that the future IS roles would consist of a new set of roles with titles such as: Business Services, Business Support, Development Support, and Technical Services. Of these new roles only the latter two are technical in nature. Most of the new roles emphasize planning and liaison skills. (Keen, 1988:27).

Second, the items related to the factor labelled *business/user orientation* were rated fairly *low* in terms of their importance. Of the six items loading on this factor, the average JPI importance score was only 5.2 — considerably lower than the mean for all scale items on the JPI (5.6). In fact, all six of these items were rated *below* the overall scale mean. This shows that a focus on the business, users, and teamwork was less important, on average, than other needs captured by the JPI scale. This is inconsistent with Myers' (1991) claim that these "nontraditional" interests represent an important shift in priorities among IS professionals.⁵

A third reason why the importance of *business/user orientation* may have been overstated in Myers' (1991) research is suggested by the multiple regression analyses in Chapter 8. If these needs were truly important to IS professionals, then the extent to which they are satisfied should influence job satisfaction, but it did not. In the regression analysis, the magnitude of the difference scores for business/user orientation was not related to job satisfaction. In short, these needs are relatively weak, and their fulfillment does not predict job satisfaction. This general pattern of results suggests that perhaps Couger's original description of IS professionals as primarily motivated by challenging work, with little emphasis on social needs and service orientation, may still be accurate. Despite respondents' needs for *business/user orientation* being fairly low, they were generally met: there was an average difference score of zero (0.00) on these items, compared to the large average difference score of -0.78 for all items. This suggests that subjects' needs were generally satisfied — although this may be a direct consequence of their limited needs in this area.

In addition to the high importance of *need for technical challenge* and its influence in determining job satisfaction, the combined results from Chapters 7 and 8 show that *positive working conditions* and *hygiene factors* are also determinants of explaining job satisfaction. *Positive working conditions* is the factor that encompasses autonomy, independence, sense of

⁵ One caveat is that there were *some* respondents who rated these needs as high in importance, and the descriptive analysis in Chapter 7 (using means and variances) did not attempt to distinguish this subgroup from the overall respondent sample. Further analysis could be conducted, based on other analytic techniques, such as cluster analysis or multi-dimensional scaling, to identify respondents who correspond to the profiles suggested by Myers (1991) and Keen (1988).

accomplishment, intrinsic feedback from the job — a list identical to Hackman's (1980; Hackman & Oldham, 1976) conditions that create a high *motivating potential score* in his *Job Characteristics Model*. Employees rated these items high in importance on the JPI, and the difference score for this factor (*positive working conditions*) was significantly related to job satisfaction. These items loading on *positive working conditions* were above-average in importance (5.85), and this factor was second only to *need for technical challenge* in explaining job satisfaction (Hackman, 1976; Couger & Zawacki, 1980). This latter result validates both Hackman's and Couger's work, because both researchers emphasized the importance of challenge to employee satisfaction.⁶ The results of this study confirm the prior findings, since I have shown that having sufficient challenge is critical to job satisfaction — whether the challenge stems from using new technologies or from a job design that has the job characteristics leading to high motivating potential score (Hackman, 1976) such as autonomy, inherent feedback, and sense of accomplishment.

The other significant result concerned the *hygiene factor* — so named because the items loading on this factor correspond to Maslow's (1954) lower-order needs of safety and security. Over the years, considerable evidence has emerged that ensuring that such *hygiene* needs are met (Herzberg, Mausner & Snyderman, 1959) is necessary to prevent *dissatisfaction*, but does not lead to job satisfaction. This was recently validated by Smits, Tanner & McLean (1995), who showed that pay was a poor predictor of satisfaction among IS professionals. The items loading as hygiene factors⁷ were rated as very high in importance (the average JPI rating was 6.0), and they were also statistically significant in explaining job satisfaction. Thus, contrary to the view that these items cease to be important once they are satisfied, at which point employees focus on higher needs (challenge, self fulfillment), these results show that these needs do matter and are significantly related to job

⁶ Couger's research was modelled on Hackman's theory (Job Characteristics Model) and measurement scales (Job Diagnostic Survey).

⁷ These items were pay, fringe benefits, job security, and fair treatment.

satisfaction. One possibility is that these *hygiene factors* do matter to IS professionals because they are not sufficiently met on the job,⁸ a result consistent with the historical formulation of hygiene factors (Maslow, 1954; Herzberg, Mausner & Snyderman, 1959).

The other factor that emerged from the factor analysis was a single item associated with having an *appropriate level of supervision*. This factor was not related to job satisfaction in the multiple regression analysis, perhaps because Chemco employees reported higher levels of job satisfaction, but greater dissatisfaction with the amount of supervision they received. Hence the observed results on the JPI for *appropriate supervision* ran contrary to the other results. (Namely, Chemco employees reported inadequate supervision, which leads to lower job satisfaction in general; this was contrary to the general pattern that Chemco employees had higher job satisfaction, due to the other factors). This pattern of inconsistent findings will be analyzed and shown to result from an inherent tension between job reinforcers in the section titled "Optimal Fit between Employee and Work Environment," below.

Importance of Cognitive Style Variables

When using the framework to explain job satisfaction and performance, the addition of cognitive style variables was valuable. Each of the three variables (tolerance of ambiguity, resilience, and the Kirton Adaption/Innovation scale), when added separately to the multiple regression equation, significantly improved the explanatory power of the model in explaining job satisfaction and performance. This underscores the value of capturing additional information about employees beyond their needs/values and skills, in order to predict their response to technological change. These cognitive style variables contributed to the explained

⁸ A review of the difference scores strongly suggests that these needs were not met in this study. The average difference score for these *hygiene factor* items was -1.30, compared to the average difference score of -0.78. Most of these *hygiene factor* items exhibited large difference scores, ranging from -1.3 to -1.6. The only exception was benefits, which exhibited a small gap score of -0.6. In particular, job security had a very large gap score of -1.6 for all respondents and -1.8 for ChemCo respondents, indicating a high level of concern that job security was at risk. In fact, ChemCo employees were *much* more concerned about security than InsureCo employees, with ChemCo employees having a larger gap score (-1.8 v. -1.3). The fact that job security needs were unmet (in Chapter 7) may explain why the overall *hygiene* factor was such a strong predictor of job satisfaction (in Chapter 8). Where employees are anxious about their future employment in the future, this may reduce their job satisfaction.

variance of satisfaction and performance, showing that employees' openness to new ideas (tolerance of ambiguity), readiness to accept change (resilience), and willingness to experiment (innovativeness) help to explain satisfaction and performance following changes in technology and work processes.

Where the job does not take advantage of the employees' capabilities — on any one of these dimensions — the employee may be unchallenged and possibly frustrated. While this is true for needs/values, it is also true for cognitive style. It is useful to consider ability to adapt to change as a type of capability, which should be exercised in order to derive some benefits to the company. Like other capabilities, an individual cognitive style that is open and adaptable must be tested or put to use, if it is to have value. This line of reasoning is pursued in the last section of the chapter, "Fit versus Adaptability as Determinants of Success."

Based on the TWA, the *individual* component of the individual - firm *fit* is based on what the employee brings to the firm — the employees' needs/values, skills and other attributes — such as cognitive style. Yet if these constructs are conceptualized as capabilities — representing the employees' potential — they are only useful to the firm if they are put to use. Employees who possess these capabilities can only effectively use them, if the job provides an opportunity to exercise them. Examples of three groups of capabilities that have been explored in this research are listed below:

<i>General construct</i>	<i>Example of Individual Factor</i>
Needs/values	Desires to learn new technical skills
Skills/knowledge	Ability to develop strategic IS plans
Cognitive Style	High Tolerance of Ambiguity

Where the job does not take advantage of the employees' capabilities — on any one of these dimensions — the employee may be unchallenged and possibly frustrated. While this is

obvious for a capability like "skills," it may be equally true for cognitive style. Like other capabilities, an individual cognitive style that is open and adaptable must be tested or put to use if it is to have value. This line of reasoning is pursued in the last section of the chapter, "Fit versus Adaptability as Determinants of Success."

Optimal Fit between Employee and Work Environment

The prior section emphasized the role of cognitive style as a resource that employees can draw upon to enable adaptation to changing work conditions. This section will emphasize how the job environment may or may not match the capabilities or resources that employees have available. This section elaborates on this point in three ways. First certain job reinforcers may be inconsistent, such that the more of one reinforcer enjoyed by employees in the firm (autonomy), the less they necessarily experience of another (job security). Second, in considering the different ways that a job may fulfill employees' needs and motives, it is unlikely that any job environment will sufficiently reinforce employees' needs in all areas. Third, for a particular need (autonomy), some organizations may satisfy only employees with low-to-moderate needs, while other firms may better satisfy employees with very high needs. Each of these arguments will be supported below with evidence from the study.

The first argument — that some reinforcers in an organization are inconsistent with others — is supported by results of Chapter 7. The descriptive results showed that Chemco employees reported high levels of autonomy, independence, and technical challenge (Chemco), but insufficient levels of job security and supervision. At Insureco, the pattern was just the opposite: employees reported adequate job security and supervision, but insufficient autonomy, creativity, demand for new technical skills, or opportunity for challenge. These results suggest (rather than conclude) that various reinforcers in the job environment are inherently contradictory. Yet, it can be argued that in a firm where employees enjoy high levels of autonomy and creativity, supervision will be relatively low. Moreover, in firms where employees are highly challenged and expected to "stretch" themselves to accomplish

the job, it may be that any guarantee of employment is only as secure as their continued ability to deliver. This appears to be an apt description of Chemco as a highly challenging environment where employees are expected to consistently excel. One drawback of Chemco's high expectations, however, is that some employees receive less direction than they desire and perceive insufficient job security. These are unfortunate, but necessary, trade-offs to Chemco's challenging environment. In many ways, Chemco is an archetype for the 21st century organization: the IS function is distributed and reports to business unit managers; work is fast-paced, with high expectations of employees and managers; project teams are rapidly formed and disbanded once the work is completed and employees are expected to demonstrate initiative to learn on their own. These features are evident in each of Chemco's IS departments, especially the division that adopted the concept of *RAD Rooms* and *RAD House*.⁹ The alternative to this demanding, *organic* environment at Chemco is the more *mechanistic* environment (Burns & Stalker, 1966) of Insureco. In the latter case, both the firm's structure and pace of change are more deliberate. Insureco followed a more centralized, deliberate approach to implement client/server technology, perhaps because this is consistent with its mechanistic culture. Given that insurance is a more traditional, risk-averse, and technologically-cautious industry, such an implementation strategy would appear to fit both the industry and firm culture. One advantage, given the implementation strategy and industry characteristics of Insureco, was that employees enjoy better job security and receive more supervision from management, although with less autonomy, challenge, and opportunity to be creative.

While this dichotomy between the *organic* (Chemco) versus *mechanistic* (Insureco) work environments is based on only two firms, it is useful to stake out these extremes, while acknowledging that most firms will occupy intermediate positions along this continuum.

⁹ As explained in Chapter 4, a *RAD Room* was an innovation which co-located IS professionals and business unit analysts to work together for short, intensive periods in a specific room called a *Rapid Application Development* (RAD) room. These short projects were targeted to last between 12-16 weeks, during which some module of actual system functionality would be completed. In aggregate, several *RAD Room* projects would happen concurrently, creating the concept of a *RAD House* where many such project teams labored.

Since the firm's organizational culture and work environment appear to influence the strategy for implementing client/server development this means that, in choosing a strategy, firms must necessarily make trade-offs between different objectives. It may be that there is an inherent tension between managing change in such a way that employee autonomy, creativity, and challenge are emphasized versus the alternative approach that ensures high levels of managerial guidance and job security for employees. Given that certain objectives are inconsistent, then IS managers who implement change need to consider which objectives are more important: will they reduce management supervision of employees in order to maximize autonomy? Similarly, employees need to consider which type of organizational climate best fits their needs: are employees willing to sacrifice job security for the promise of high autonomy and technically challenging work? Those employees who require high levels of challenge may only be satisfied in a job environment with high levels of autonomy. This study provides some tentative evidence that some work environments with high levels of autonomy and challenge may be those where the levels of supervision job security are relatively low, although counter-examples (with high autonomy, supervision, and job security) must certainly exist.

The second argument — that no job environment can provide sufficient levels of reinforcers in all areas — is an extension of the above argument. If researchers study many job attributes, it is unlikely that any organization will be perceived as providing high levels of reinforcement on *all* attributes. Certainly there are firms that meet or exceed a certain threshold on a variety of reinforcers, as demonstrated by publications that compile statistics evaluating the "best companies to work for" (Graham, 1993; Levering, 1993; Zeitz & Dusk, 1988),¹⁰ but even these firms score highly by being better than average, rather than uniformly high on all possible criteria. This is because for a job environment to provide high levels of reinforcement in some areas, it may need to sacrifice in others.

¹⁰ These are all publications that review best companies to work for: Graham (1988) *The Best Companies for Minorities*; Levering & Moskowitz (1993) *The Best Companies to Work For in America*; and Zeitz & Dusk (1988) *The Best Companies for Women*.

This leads to the third argument, that some firms may satisfy only employees with low-to-moderate needs in a particular area, while disappointing employees with very high needs. Other firms may satisfy employees regardless of their level of needs, perhaps by allowing specific job assignments to adapt to fit the employees' needs. There is evidence that Chemco may use various techniques which permit employees to move around or adapt their existing jobs to their particular level of need. This argument is based on an integrative analysis of data presented in Chapters 7 and 8, specifically examining the relationship between employees' *need for technical challenge* and job satisfaction.¹¹ This evidence indicates that Chemco employees are more satisfied the higher their *need for technical challenge* (a direct linear relationship), whereas for Insureco employees, average job satisfaction increases as *need for technical challenge* grows from low to moderate, but declines for Insureco employees with high technical challenge needs (a curvilinear relationship). This difference between the two firms was surprising for reasons described below, however this finding also validates the use of mixed methods in this study because it requires integration of both qualitative and quantitative data. The paradoxical findings that required an integrative analysis are first identified, before demonstrating this integration between insights from Chapters 7 and 8.

Whereas Chapter 7 showed the mean JPI and difference scores, allowing contrasts to be drawn between employees from the two firms, Chapter 8 showed how the constructs in the conceptual framework related to each other. While it is not my intention to separately test and validate the TWA for the two firms (especially given the small respondent numbers at Insureco), one question persisted, despite the findings in Chapters 7 and 8. Chapter 8 showed that the level of fit between employees' *need for technical challenge* and the perceived challenge provided by the job is the best predictor of job satisfaction. Level of fit is represented by a difference score computed by subtracting the individual employee's

¹¹ This integrative analysis was conducted on *need for technical challenge* for two reasons: first, the items loading on this factor were rated high on the Job Preference Inventory, and since the difference score calculated from *need for technical challenge* was the best predictor of job satisfaction (Chapter 8).

perception of the current level of challenge from the amount of challenge desired (as in equation 1, below), then, other things being equal, a higher *need for technical challenge* should lead to a larger difference score, and should predict lower job satisfaction, on average.

$$\text{Difference score} = \text{Current level of technical challenge} - \text{Need for Technical Challenge}$$

This assumption is demonstrated by showing three hypothetical respondents, with each perceiving their job as providing a "moderate" level of challenge, but having different levels of *needs for challenge*.

For employee A:	$4 - 6 = -2$
For employee B:	$4 - 7 = -3$
For employee C:	$4 - 4 = 0$

Given this formulation of the difference score, such that a larger (negative) difference score leads to lower job satisfaction, one corollary would be that having a higher *need for technical challenge*, then *ceteris parabis*, the larger will be the difference score, and hence the lower their job satisfaction. Given the same level of current technical challenge on the job, those employees who desire high technical challenge on the job (Employee B) should be less satisfied with the work, whereas those employees with low need for technical challenge should be more satisfied, on average (Employee C.) *Need for technical challenge* alone by itself should be negatively related to job satisfaction. The data do *not* support this corollary, however, leading to a potential contradiction. Instead, the data show that need for technical challenge is correlated exactly 0.00 with job satisfaction.¹² This zero correlation result suggests two possibilities: 1) that, regardless of their need for technical challenge, all employees are equally satisfied -- meaning that their difference score, which reflects unmet needs, is constant across employees, or 2) that this zero correlation fails to take into account

¹² Similarly, the regression analysis shows that for job satisfaction regressed on *need for technical challenge*, there is no relationship -- the regression coefficient is zero.

other factors that may explain the relationship. An integrative analysis of the results from Chapters 7 and 8 shows the latter explanation to be the case, because *company* itself serves as this critical moderator variable.¹³

In examining the same correlation coefficient for Chemco and Insureco employees separately, two different — entirely opposite patterns — were observed.

**Correlation Coefficient between
Need for Technical Challenge and Job Satisfaction**

Overall Respondent Sample	0.000
Chemco Employees Only	+ 0.214
Insureco Employees Only	— 0.222

The relationship between the need for technical challenge and job satisfaction differs dramatically between the two firms in the study. Based on these results, it appears that "all else" is certainly *not* equal! At Chemco, this moderately large positive correlation coefficient means that the greater the employees' technical ambition, then the more satisfied they are. This suggests that somehow the level of challenge provided in the job rises to meet their needs — regardless of how this is accomplished.¹⁴ In contrast, at Insureco, the moderate negative correlation coefficient suggests the opposite influence (or pattern) — that greater ambition at Insureco is largely unrewarded, or unacknowledged, actually leading to greater frustration of employees' needs. These contrary findings using correlational analysis were also supported by an analysis which trichotomized the data into three groups (corresponding to highest, middle or lowest need for challenge). When graphing the results of this triad analysis for Chemco employees, the result is clearly linear: increasing need for technical

¹³ This was demonstrated in two different ways: by conducting analyses for ChemCo versus Insureco employees separately, and by employing a dummy variable representing *company* in the regression equation.

¹⁴ For example, whether employees request challenging temporary assignments, or get promoted to new jobs; or whether the least ambitious employees were laid off in a recent downsizing.

challenge is associated with higher job satisfaction. The relationship for Insureco employees is more complex, roughly forming an inverted-U-shaped curve, with a peak in the middle, as shown in Figure 9.1.

These results might appear contradictory without the additional perspective provided by the field studies. One advantage of this study's research design is that it combined both survey research and field studies. This anomalous result — different correlations between job satisfaction and employees' need for technical challenge across the two firms — would be difficult to explain in the absence of information about the firm context and culture. The field studies provided this background information, showing Chemco's culture to be fast-changing and demanding of initiative on the part of employees. The field study at Insureco also provided information showing that Insureco's IS department has historically been slow to change and subject to strong centralized controls, and has introduced client/server technology through a centralized initiative.

Based on the correlations shown above and the different ways that need for challenge is satisfied in the two firms, this shows the fallacy of the prior assumption that "*ceteris paribus* employees with greater need for technical challenge will be less satisfied in their jobs." Specifically, this assumption was proven incorrect at Chemco. The *ceteris paribus* caveat does not apply here, for two reasons: all else is not equal, because employees do self-select for certain companies and jobs. Employees seek an employer and a job with the appropriate level of challenge (Schneider, 1987). I cannot assume "all else being equal," because employees work in specific companies — each with its own norms, cultures, and strategies for managing technology change — and these different environments will challenge and reward them differently. The second problem with the *ceteris paribus* caveat is that it assumes a *static* model of employees who either fit or don't fit into their jobs, but which does not consider the changes employees can effect themselves. Employees can actively influence the level of challenge in their jobs by requesting more challenge in their current job, by transferring to a new job, or even by assuming more responsibility on their own. In certain

firms, employees may thus actively shape their job assignments to satisfy their needs, rather than merely reacting to the job as given. Therefore, the ideal job environment is one that is fluid or flexible in terms of having a job that can adapt to fit the expectations of its employees. Although this may be the ideal, the actual corporate culture must support this flexibility for employees to shape their work environment, whether through job rotations, assignment to short-term projects, or through assuming new challenge within the same job. Both the field studies and survey results suggest that Chemco provides this flexibility to a greater extent than Insureco, given the positive correlations between *need for technical challenge* and job satisfaction. It is not clear how this shaping of the job environment occurs, however. Research in the human resource management area has not developed adequate frameworks to explain how this occurs. Some researchers, in fact, argue that jobs do not change, in response to workers' needs (Kohn & Schooler, 1983), however, they leave open the possibility that such changes may occur over the long term (five to ten years). One promising area that seeks to how jobs change to fit employees is Miner's work on *idiosyncratic jobs* — but this explains how *new* jobs are created to fit employees' unique skills and needs, rather than how existing job evolve (Miner, 1987, 1990). Another possible area to use for developing frameworks would be structuration theory (Giddens, 1984), since employees' actions in the firm may alter the job definitions and role expectations, thereby creating a relationship between structure and action.

Fit versus Adaptability as Determinants of Success

The value of the framework developed and tested in this study is that it highlights the dynamic nature of both fit and adaptability in employees' jobs. This framework both builds and improves upon assumptions implicit in the original TWA. Despite the actual title of the original theory as a Theory of Work *Adjustment* — the original theory is actually a static theory, since it does not reflect employees' capacity for adaptation to change over time, nor their opportunity to modify the job over time. By operationalizing the individuals' adaptive capacity according to three measures that have been used in organizational research (tolerance of ambiguity, personal resilience, and Kirton's Adaption/Innovation profile), this study has

shown that such constructs *are* important because they capture essential information about the person which influences and explains outcomes better than the basic TWA framework. This is an improvement over the basic TWA, which assumes that individuals vary in their suitability for a given job, depending on how well the job fits their specific skill/abilities and needs/values. Yet the TWA implies a static fit between the person and the job, so that when either the job or the person changes, the fit may no longer be suitable and this mismatch must be reconciled by having the individual change jobs or continue working but remain dissatisfied with the job.

The assumptions of the original TWA theory — or any framework which assumes a *static* fit between the person and the environment — may be too simplistic for *dynamic* jobs where the work environment and skill requirements are constantly changing. Contrary to the static notion that an employee may be *fit* or suited for a particular job, what matters more is whether the employee can be flexible to grow and adapt as the job requirements change. The field studies demonstrated, however, that adoption of new technology requires not just a one-time change in employees' skills, but rather an ongoing process of learning and adaptation. Rather than the conventional notion of sending employees to receive training (which assumes that training can deliver a step-function change in skills), employees must assume the burden of continuous change — not only for adapting to new technologies, but also for prompting other changes in the business. Thus, the relevant question for assessing an employee's potential for working with a new technology is not simply "does the employee have the required skills to *use* the innovation?" but instead "does the employee have the necessary curiosity, initiative, and perseverance for ongoing learning and mastery of the innovation?" The value of this broader concept of learning was underscored in another recent study of client/server adoption, as previously mentioned in Chapter 5:

Client/server changes the skill requirements for IS professionals ... [it] demands that IS professionals rely more on learning and less on what they [already] know. [IS employees must] learn these new technologies by experimenting with them and ... engage more aggressively in continuous education and self-teaching than has traditionally been the case.

— Beath, Goodhue & Ross, 1993: 17

Employees' *current* skills (or skill set at a discrete point in time) do not matter as much as the *capacity to acquire* new skills and to adapt to other changes, in terms of reinforcers in the work environment. The evidence to support this latter view was presented in Chapter 8, showing the importance of employees' cognitive style (using three scales capturing tolerance of ambiguity, innovativeness, and resilience) as additional elements in the framework. One should not consider this dichotomy between current skills versus ability to acquire new skills as a trade-off, but as synergistic: current skills are an important precursor of a person's ability to acquire new skills. In fact, strategy research has developed the concept of *absorptive capacity* (Cohen & Levinthal, 1990) as an organization-level variable that captures this synergy regarding the firm's current knowledge and its ability to change in the future.

One insight from this study is that there exists an individual-level analog to absorptive capacity which is best approximated by the individual's cognitive flexibility. Of course, just as at the firm level, this capacity for the individual to learn new skills and to adapt to new routines also depends on the employee's current store of knowledge and skills, not just cognitive style. Thus, rather than being a tradeoff between skills or adaptability, both factors matter. There is most likely a synergistic or multiplicative effect between the two, such that a higher cognitive capacity to adapt to change and high levels of current skills lead to stronger performance outcomes, compared to the main effects of both attributes separately. There are many analogies that may be drawn with research at the organizational level that has examined issues of technology learning and adaptation at the organizational level (Van de Ven & Polley, 1995; Fichman, 1995). This is an area where future research might examine and test the relative contribution of these two factors in explaining successful outcomes over time.

Having the required skills to fit a particular job is only one predictor of performance. The limitations of a model of job satisfaction or performance that takes into account only the individual's characteristics at a single point in time are numerous. In fact, it can be argued that the notion of an employee being perfectly *fit* to a particular job is, at best, simplistic, and possibly misleading. In fact, extremely high fit to a specific environment can actually

undermine the employee's *adaptability* to potential changes, since an employee with perfect fit to the job may, over time, lose flexibility to adapt to new jobs. By employing the biological analogy of species adaption to its current environment (here labelled *adaptiveness*), there is evidence that "too much fit" does occur, and can handicap species' long-term survival. Drawing a contrast between *adaptiveness* (current fit) and *adaptability*, this critical distinction was articulated by biologist E.O. Wilson:

Adaptiveness and adaptability are antagonistic requirements, and each species must maintain a compromise between the two. The most successful players of the game of evolution somehow strike a balance between adaptiveness — the capacity to cope with their present environment — and adaptability. The more variable [adaptable] the species, the less perfect the adaptiveness [fit] to any particular environment at a given moment.

— E.O. Wilson *et al.*, 1973: 767.

In recognizing that employees evolve amidst a background of changing business and technological demands, then the biological metaphor of species attempting to survive amidst a changing natural environment is a useful one. While this analogy demonstrates that fit and adaptability are contrary requirements, they are both necessary because they reinforce opposite tendencies toward stability and change, respectively. The new conceptual framework validated in this study argues that for IS employees in today's workforce, both fit and adaptability are necessary.

One limitation of this study is that it has given greater emphasis to *change* than to *stability*. This was intentional, given that the topic of study is adaptation to new technologies. This study has assumed a *changing* or dynamic work environment, because the study focuses on technology change, and because IS departments have been changing rapidly during the 1990s. It is important, nevertheless, to acknowledge this assumption, in particular, that not all jobs or environments require change. In stable job environments, the concept of employees being perfectly fit to the job makes sense. Perhaps in stable environments, firms should approach their human assets in a *mechanistic* fashion (Burns & Stalker, 1966), precisely specifying their skill requirements, and carefully analyzing the fit of prospective employees to these requirements. Matching employees' skills to jobs in this way may be the best determinant

of successful performance outcomes under stable conditions. In *turbulent* environments, however, where business conditions, technologies, skills and employee roles are dynamically changing, one's ability to adapt to change over time becomes more critical for success than fit based on a specific skill set at a single point in time. So the relative importance of fit versus adaptability in predicting employee outcomes, hinges on the *amount of variability in the work environment* — a construct that has been widely used in macro-level organizational research (Tushman, 1979). It is not my objective to introduce new constructs for analysis at this point in the study, but merely to acknowledge that this study focused on high-turbulence environments. All the firms which served as field sites for this study were undergoing rapid change, due to both business competition and technological innovation reasons. This study purposely did not study workers in stable environments. Thus, the contribution of this research — that a true Theory of Work "*Adjustment*" must incorporate measures of individual flexibility and adaptability to change — may not be important, or suitable for all work environments.

It may be that there are certain environments or jobs where the employee who is talented but static will be the best role occupant. This is a question which may be addressed empirically through future research: does employee adaptability matter in *all* job environments, or are there environments where adaptability is somehow a handicap? In a fast-changing world, such as information technology, it is difficult to imagine individual adaptability being a limitation. Yet, it is conceivable (in theory at least) that IT and the IS profession will stabilize in the future, if the pace of technology and business change diminishes, and employee adaptability may then become a capability without much value — possibly even a liability. While I do not predict that this set of assumptions seems likely (at least not for IS professionals), by acknowledging that adaptability to change is a resource, then under certain conditions, there may be no demands made upon it, and it will cease to have value and even be a liability. Realistically, however, it is difficult to imagine such a scenario. Given the history of the IS profession and IT itself, the speed of change has only accelerated during the past few years, and it shows no signs of relenting (Tapscott & Caston, 1993). I leave it to

future research and possibly simulation to investigate whether the value of *adaptability to change* varies with the level of technological or *environmental turbulence* (Tushman, 1979), as hypothesized here, and to identify under what circumstances it may undermine performance or other outcomes.

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Appendix 4.1

Reskilling Information Systems Employees: New Roles and Skills for a Revitalized Workforce

Michael J. Gallivan
Ph.D. Candidate
MIT Sloan School

John F. Rockart
Thesis Supervisor
Director, Center for IS Research

Overview

Many firms are adopting new approaches for systems development to respond to pressures for shorter cycle times and better aligned systems. Adoption of these new tools and methodologies — also known as software process innovations — can include the migration to client/server platforms, graphical interface development tools, object-oriented analysis and design, and changes in the working relationships with user departments. One of the greatest challenges to successfully achieving these changes is the need to change the skills and roles of the IS workforce.

Although the challenge of reskilling IS staff pervades many of the required technical and organizational changes, the processes and outcomes of reskilling efforts have not been studied in a comprehensive way. My research examines how firms reskill their IS staff during the process of implementing a new software process innovation and the factors that lead to successful reskilling. Phase I of this study revealed that firms are using a broad set of approaches to reskill. These include formal training, hiring employees with relevant experience, assigning mentors to guide less experienced staff, partnering with system integration firms, and encouraging IS employees to take initiative for their own learning.

Research Objective

Phase II of this research will use a survey format to study IS employees in firms that have recently adopted software process innovations. The goal is to understand how company-initiated activities, individual efforts, and individual characteristics influence IS employees' ability to effectively learn and use these innovations.

Participant Involvement

During February, 1995, I will distribute a brief survey on a diskette to IS employees who have adopted new software process innovations. The survey will take approximately 20 minutes for employees to complete. Following this, a separate survey will be distributed to IS team leaders or supervisors to collect additional information about the introduction of the innovation and employees' effectiveness in using it.

Confidentiality of the Research

Some of the data being collected may be sensitive in nature. All information discussed will be held in strictest confidence. Project reports will disguise the company names, firm characteristics, and individual identifications. Individual identities of participants will not be disclosed in any results.

Benefits to Participants

Results will be presented to each firm in writing and in an oral presentation during summer, 1995. Results from the individual firm will be provided, as well as a comparison to the other participating firms. Practical suggestions will be highlighted, including learning mechanisms and individual characteristics that are associated with successful use of the innovation.

Appendix 4.2

Reskilling Information Systems Employees: New Roles and Skills for a Revitalized Workforce

*Michael J. Gallivan
Ph.D. Candidate
MIT Sloan School*

*John F. Rockart
Thesis Supervisor
Director, Center for
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Revised Interview Protocols

Form 1. IS Managers

Limited Background Information

What is your position here?

Title:

Years in organization:

Responsibilities:

Types of professionals managed:

Change Goals

What goals for IS reskilling have been identified?

Who was involved in setting these goals?

Why have these goals been identified for change? What are the expected benefits?

Approach to implementing change

What stage of implementing change is the organization currently in?

What has been accomplished?

What is planned for the near, distant future?

What has been put on hold?

What parties have been involved in the implementation, and what have their roles been?

What criteria for evaluating the success of the changes have been identified (if any)?

How and when do you plan to evaluate the success of the changes?

Are there financial criteria to evaluate the effectiveness of change? (cutting heads) 231

Is the performance of IS to be evaluated by line managers or by user survey?

be discontinued (or downplayed) in the future?

What are the "new" skills, roles, and behaviors which will be emphasized in the future?

Who participated in identifying the goals for what needs to be changed?

What approach is used to achieve these new skills, roles, behaviors of IS staff and managers?

(For example, does the firm seek to hire new workers? make use of outside contractors? Use formal (forced) re-training of IS workers? Informally encourage individuals to re-train themselves through training seminars, self-study courses?)

What has been the level of morale among staff toward the intended changes?

How has resistance to change been handled -- in IS department, and in business units?

What change management (communication, persuasion, etc.) techniques have been used to gain the acceptance of staff toward the plan?

Depending on the response to the above question, probe for more information about goals and expectations, and intended mechanisms for achieving them.

- if retraining existing staff is the goal, which employees were selected for retraining, and why? Were other employees not selected for retraining? Why?

- if hiring new staff, what were the criteria for hiring new staff? Why were existing staff not perceived to have the requisite talents or abilities?

- if using contractors/consultants, what special skills do they bring? Why were in-house staff not perceived to have these skills? Is skill-transfer or knowledge-transfer from these contractors to the in-house staff and important goal?

How are the new skills reinforced on the job?

Does the culture that exists within the IS department and the firm support these new skills?

Potential individual-level variables influencing success

Are there employees that you perceive as more or less likely to achieve the necessary transition?

What talents do you perceive as lacking in those employees who cannot achieve the transition to the new skills? (probe for whether the respondent perceives it as motivational, cognitive limitations (inability to learn something new; personality differences (introvert v. extrovert); or other?).

Approximately what proportion of employees may fall into various sub-groups, in terms of their likelihood of making the necessary transition?

(e.g., my prior research shows that many managers believe that approximately 1/3 will achieve the new skills with ease, 1/3 with somewhat more challenge, and 1/3 either not at all, or with significant difficulty).

What are the job options for individuals perceived as lacking the necessary motivation/abilities to master new skills?

History and context of research site

What other historical and contextual changes at the site are relevant to the IS changes?

What major events have occurred in the past 3-5 years?

(e.g., major lay-offs, restructuring, new leadership, company merger, outsourcing, etc.)

What strengths/weaknesses have been identified in the past and/or current approach to IS?

(major project success/failures; attitudes of line managers and users, etc.)

Appendix 6.1
IS Employee Survey Version
(101 pages)

INTRO

```
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WELCOME!

I am conducting this survey to learn about new software development tools and approaches that are used in IS departments, and how developers like you learn to use them. This survey will take approximately 20-25 minutes to complete. Your answers will be saved automatically to the diskette.

Press Any Key to Continue

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INTRO-2
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-----1-----2-----3-----4-----5-----6-----7-----8
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The survey is divided into three sections. Each section takes about 6-8 minutes to complete. It is possible to begin the survey, then stop part-way through and resume later.

If you want to complete the survey now press the ENTER key or click the mouse on answer #1 below. Otherwise, move the cursor to answer #2 below and you can start the survey at a later time.

- 1 CONTINUE WITH SURVEY
- 2 EXIT FOR NOW

INTRO-3

-----1-----2-----3-----4-----5-----6-----7-----8

1
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3
4 The information that you provide will be confidential. Your responses
5
6 will not be shared with anyone from your company. The only people who
7
8 will have access to the data are me and my research advisors at MIT.
9
10 You also have the right to informed consent about your involvement in
11
12 this research. The answers you provide will be combined with the data
13
14 from other employees in the company and used in a company-wide analysis.
15
16 In exchange for your participation in the research, you will receive
17
18 a copy of the results. You have the right to decline to participate,
19
20 or to refuse to answer a particular question.
21
22 Press Any Key to Continue
23
24
25

-----1-----2-----3-----4-----5-----6-----7-----8

INTRO-3A

-----1-----2-----3-----4-----5-----6-----7-----8

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7
8 You can press the F1 to see customized help for each question.
9
10 Press F1 now to view the help screen with other information.
11
12
13
14 There are customized help screens available for each question
15
16 type throughout the survey. Press F1 at any time to view Help.
17
18 Press Any Key to Continue
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SPI-00

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Changes in System Development Activities

The following section will ask you questions about how the system development activities within your department have changed during the recent past. Please consider changes that have occurred over approximately the past 18 months, since late 1993.

If the activity described in your job has not changed during this time period, simply move the cursor to the NO response.

Press Any Key to Continue

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SPI-01

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During the period from late 1993 until now, have you begun using ...

1. a new programming language?

1 YES
2 NO

If you answer YES, name the new programming language below.

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spi-01a

```
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9 |
10 |           What was the previous programming language
11 |             that you were using before this?
12 |
13 |
14 |
15 |           Press the ENTER key twice when you are finished.
16 |
17 |
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25 |-----1-----2-----3-----4-----5-----6-----7-----8
```

SPI-02

```
-----1-----2-----3-----4-----5-----6-----7-----8
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7 |
8 |   During the period from late 1993 until now, have you begun using ...
9 |
10 |
11 |           2.      a new application development tool?
12 |
13 |
14 |   (for example, a CASE tool or GUI development tool such as PowerBuilder)
15 |
16 |
17 |           1      YES
18 |           2      NO
19 |
20 |   If you answer YES, please name the new tool or tools below.
21 |
22 |
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24 |
25 |-----1-----2-----3-----4-----5-----6-----7-----8
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spi-02a

-----1-----2-----3-----4-----5-----6-----7-----8

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What was the previous application development tool
that you were using before this?

Press the ENTER key twice when you are finished.

-----1-----2-----3-----4-----5-----6-----7-----8

SPI-03

-----1-----2-----3-----4-----5-----6-----7-----8

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During the period from late 1993 until now, have you begun using ...

3. a new hardware platform for development?

- 1 YES
- 2 NO

If you answer YES, please name the new hardware platform below.

-----1-----2-----3-----4-----5-----6-----7-----8

spi-03a

-----1-----2-----3-----4-----5-----6-----7-----8
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9
10 What was the previous hardware platform
11 that you were using before this?
12
13
14
15 Press the ENTER key twice when you are finished.
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-----1-----2-----3-----4-----5-----6-----7-----8

SPI-04

-----1-----2-----3-----4-----5-----6-----7-----8
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8 During the period from late 1993 until now, have you begun using ...
9
10
11
12
13 4. a new approach for defining system requirements?
14
15
16
17 1 YES
18 2 NO
19
20 If YES, please name the new requirements definition approach below.
21
22
23
24
25
-----1-----2-----3-----4-----5-----6-----7-----8

spi-04a

-----1-----2-----3-----4-----5-----6-----7-----8

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What was the previous approach for capturing system requirements that you were using before this?

Press ENTER twice when you are finished.

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SPI-05

-----1-----2-----3-----4-----5-----6-----7-----8

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During the period from late 1993 until now, have you begun using ...

5. a new methodology for system design?

- 1 YES
- 2 NO

If you answer YES, please name the new design methodology below.

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spi-05a

-----1-----2-----3-----4-----5-----6-----7-----8

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What was the previous system design methodology
that you were using before this?

Press the ENTER key twice when you are finished.

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SPI-06

-----1-----2-----3-----4-----5-----6-----7-----8

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During the period from late 1993 until now, have you begun using ...

6. new approaches for involving business users?

- 1 YES
- 2 NO

If you answer YES, please name the new approach for users below.

-----1-----2-----3-----4-----5-----6-----7-----8

spi-06a

-----1-----2-----3-----4-----5-----6-----7-----8
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9
10 What was the previous approach for involving users
11 that you were using before this?
12
13
14
15 Press ENTER twice when you are finished.
16
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SPI-07

-----1-----2-----3-----4-----5-----6-----7-----8
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7
8 During the period from late 1993 until now, have there been ...
9
10
11
12
13 7. any other changes in system development work?
14
15
16
17 1 YES
18 2 NO
19
20 If you answer YES, please type your answer below, then press ENTER twice.
21
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SPI-08

-----1-----2-----3-----4-----5-----6-----7-----8

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Can you specify below the one change that has made the
greatest difference to your work process?

1. YES

-----1-----2-----3-----4-----5-----6-----7-----8

LEARN-00

-----1-----2-----3-----4-----5-----6-----7-----8

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Learning Processes and Activities

The following set of questions will ask for information about the
training and other methods you used for learning to use the new
software development approaches that you described above.

Press Any Key to Continue

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LEARN-01

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4      1.   Please reflect on how you actually learned the new
5           tools and methods listed above.  Then rank order
6           the following activities in terms of how important
7           they have been for learning new skills.
8
9           Select the MOST useful activity by moving the cursor
10          to it and pressing ENTER.  Then select the SECOND MOST
11          useful activity, and then the THIRD MOST useful.
12
13
14          1.  classroom-based training led by an instructor
15          2.  college extension classes
16          3.  reading computer manuals
17          4.  reading computer trade magazines
18          5.  reading books (other than computer manuals)
19          6.  working informally with a mentor one-on-one
20          7.  discussions during project meetings
21          8.  trial-and-error learning from hands-on practice
22          9.  SAVE ANSWERS AND CONTINUE TO NEXT QUESTION
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24
25-----1-----2-----3-----4-----5-----6-----7-----8
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LEARN-02

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10      2.   What different approaches or techniques have you used
11           over the past 18 months to learn the new software
12           development tools and methodologies you listed above?
13
14           This is an open ended question.
15
16           Your answer can be as long as the white box below.
17
18           Press the ENTER key twice when you are finished.
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25-----1-----2-----3-----4-----5-----6-----7-----8
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LEARN-03

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3. Did you take any training classes to learn the new tools and approaches you listed above?

- 1. No, I did not take any classes
- 2. Yes, I took daytime training or classes
- 3. Yes, I took part-time evening classes
- 4. Save answer and go to next question

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LEARN-3A

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How many total hours of actual classroom time did your day-time training include?

Please take a moment to calculate how many hours of classroom training you attended.

For example, a course that met for eight hours, four days each would be a 32 hour course.

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LEARN-3b

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How many total hours of actual classrom time
did your evening classes include?

Please take a moment to calculate how many
hours of evening classes you attendad.

For example, a course that met twice per week
two hours for 10 weeks would be a 40 hour course.

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LEARN-04

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4. Are there ANY OTHER learning processes that you used
to learn and reinforce your new skills that were not
included in the list above?

If you did not take part in any other activities, type NONE.

Press the ENTER key twice when you are finished.

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ATT-00

-----1-----2-----3-----4-----5-----6-----7-----8

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The next set of questions will ask you for your attitudes
toward the new application development tools and approaches
that you listed above.

Press Any Key to Continue

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ATT-01

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Earlier you said that you now use *[name of software innovation]*
in your system development work. Please answer the following
questions with regard to this particular change.

Press Any Key to Continue

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AT-EOU-1

-----1-----2-----3-----4-----5-----6-----7-----8

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In my opinion, [name of software innovation]

1. is easy for me to learn

-----	-----	-----	-----	-----	-----	-----
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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-RA-1

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In my opinion, using [name of software innovation]

2. makes it easier to do my job

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-EOU-2

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In my opinion, using [name of software innovation]

3. requires a lot of mental effort

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1 2 3 4 5 6 7

STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

AT-RA-2

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In my opinion, using [name of software innovation]

4. improves the quality of the software produced

-----1-----2-----3-----4-----5-----6-----7-----8

1 2 3 4 5 6 7

STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

AT-RA-3

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In my opinion, using [name of software innovation]

5. is useful in my job

-----	-----	-----	-----	-----	-----	-----
1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----2-----3-----4-----5-----6-----7-----8

AT-GEN-1

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In my opinion, [name of software innovation]

6. overall I like using

-----	-----	-----	-----	-----	-----	-----
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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-CPT-1

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In my opinion, using [name of software innovation]

7. is compatible with all aspects of my work

|-----| |-----| |-----| |-----| |-----| |-----| |-----|

1 2 3 4 5 6 7

STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

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AT-EF-2

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In my opinion, using [name of software innovation]

8. enhances my effectiveness on the job

|-----| |-----| |-----| |-----| |-----| |-----| |-----|

1 2 3 4 5 6 7

STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

-----1-----2-----3-----4-----5-----6-----7-----8

AT-EOU-3

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In my opinion, [name of software innovation]

9. it is easy to become skillful at using

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-RA-4

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In my opinion, using [name of software innovation]

10. increases my productivity for developing systems

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-EF-1

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In my opinion, using [name of software innovation]

11. improves my job performance

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-EOU-4

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In my opinion, [name of software innovation]

12. is easy to use

-----	-----	-----	-----	-----	-----	-----
1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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AT-EQU-5

-----1-----2-----3-----4-----5-----6-----7-----8

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In my opinion, [name of software innovation]

13. is often frustrating to use

1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----2-----3-----4-----5-----6-----7-----8

AT-CPT-2

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In my opinion, using [name of software innovation]

14. fits with the way I like to work

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----2-----3-----4-----5-----6-----7-----8

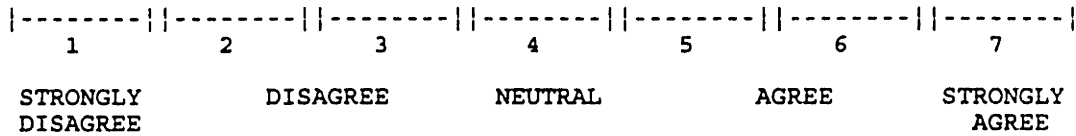
AT-RA-5

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In my opinion, using [name of software innovation]

15. allows me to perform tasks more quickly



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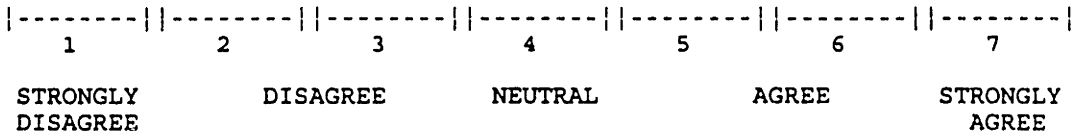
AT-EOU-6

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In my opinion, when using [name of software innovation]

16. it is easy to get it to do what I want to do



-----1-----2-----3-----4-----5-----6-----7-----8

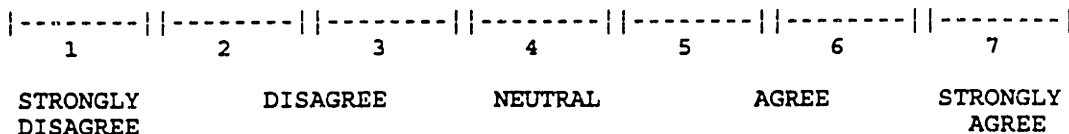
AT-CPT-3

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In my opinion, using [name of software innovation]

17. is a significant change from the way we
traditionally developed systems here



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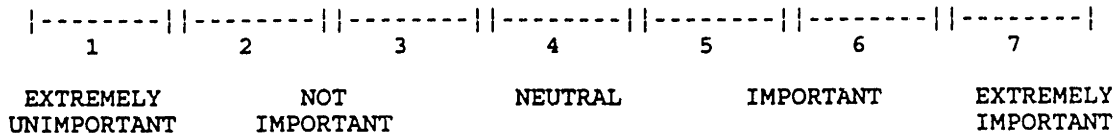
JPI-00

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This set of questions will ask you to rate on a scale from
1 to 7 how important certain job characteristics are to you.
For example, if having a large office is very important for you
(relative to other aspects of the job), then choose "6" or "7" in
response to the following question. This is a sample question:

"How important is it to you to have a large office?"



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JPI-01

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How important is it for you to have a job that

1. Provides a competitive benefits package

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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JPI-02

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How important is it for you to have a job that

2. Provides security and stability

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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JPI-03

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How important is it for you to have a job that

3. Provides opportunities for promotion
within the IS area

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UNIMPORTANT IMPORTANT

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JPI-04

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How important is it for you to have a job that

4. Provides above average income

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UNIMPORTANT IMPORTANT

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JPI-05

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How important is it for you to have a job that

5. Allows you to use leading-edge equipment
tools and processes

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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JPI-06

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How important is it for you to have a job that

6. Allows you to be treated and evaluated fairly

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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JPI-07

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How important is it for you to have a job that

7. Is creative and challenging

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EXTREMELY UNIMPORTANT NOT IMPORTANT NEUTRAL IMPORTANT EXTREMELY IMPORTANT

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JPI-08

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How important is it for you to have a job that

8. Allows you independence to make your own decisions

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EXTREMELY UNIMPORTANT NOT IMPORTANT NEUTRAL IMPORTANT EXTREMELY IMPORTANT

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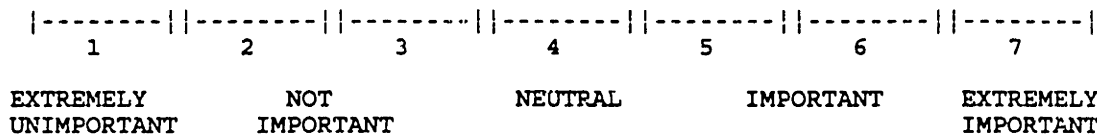
JPI-09

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How important is it for you to have a job that

9. Provides a sense of accomplishment



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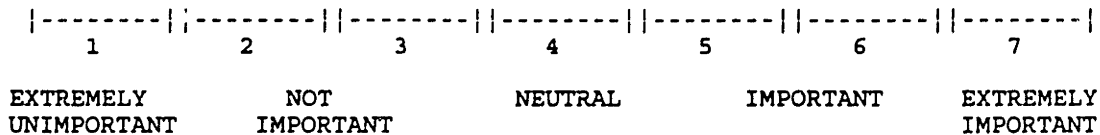
JPI-10

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How important is it for you to have a job that

10. Requires a high level of skill



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JPI-11

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How important is it for you to have a job that

11. Allows you to perform a variety of different tasks each day

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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JPI-12

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How important is it for you to have a job that

12. Allows you to have significant impact on the overall organization

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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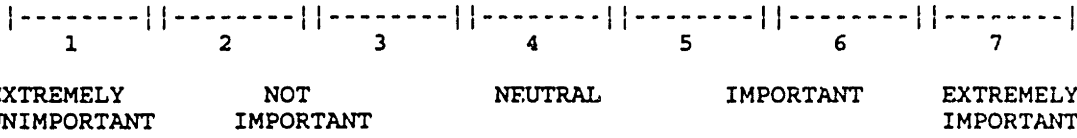
JPI-13

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How important is it for you to have a job that

13. Requires you to perform as a member of a team



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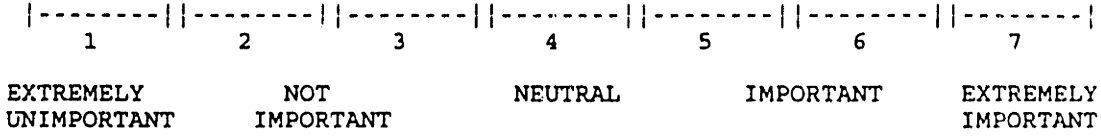
JPI-14

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How important is it for you to have a job that

14. Brings you into close contact with users



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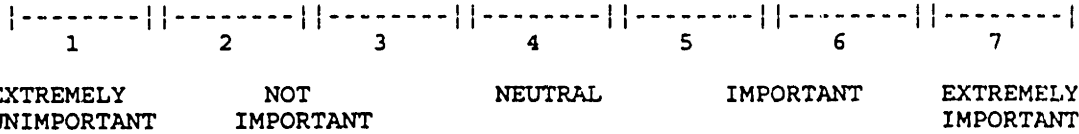
JPI-15

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How important is it for you to have a job that

15. Allows you to develop professional friendships



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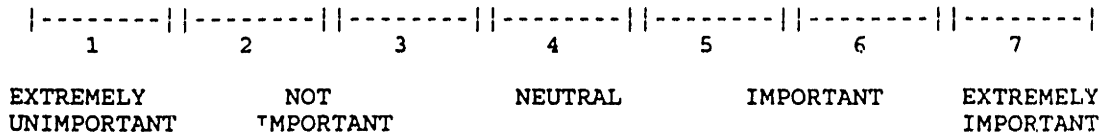
JPI-16

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How important is it for you to have a job that

16. Allows you to have some supervision,
(but not constantly)



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JPI-17

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How important is it for you to have a job that

17. Allows you to complete assignments
without relying on others

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UNIMPORTANT IMPORTANT

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JPI-18

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How important is it for you to have a job that

18. Provides feedback on how well you are doing

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

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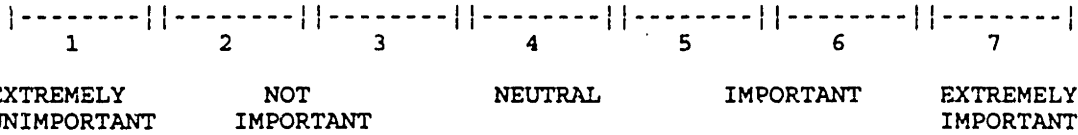
JPI-19

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How important is it for you to have a job that

19. Provides the opportunity to learn
new technical skills



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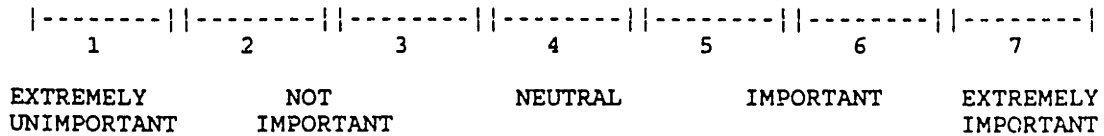
JPI-20

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How important is it for you to have a job that

20. Provides the opportunity to learn
about the business itself



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JPI-21

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8 How important is it for you to have a job that
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12 21. Provides the opportunity to learn
13 project management skills
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THANKYOU

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9 Thank you for participating in this survey.
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11 This is the end of Part 1.
12
13 Press Any Key to Continue with Part 2.
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15 It will take just a few seconds to save your answers
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17 from Part 1 and to load the questions for Part 2.
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INTRO

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This is Part 2 of the survey.

The next set of questions will ask you to rate how much
of certain attributes are present in your current job.

Press Any Key to Continue

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JCI-01

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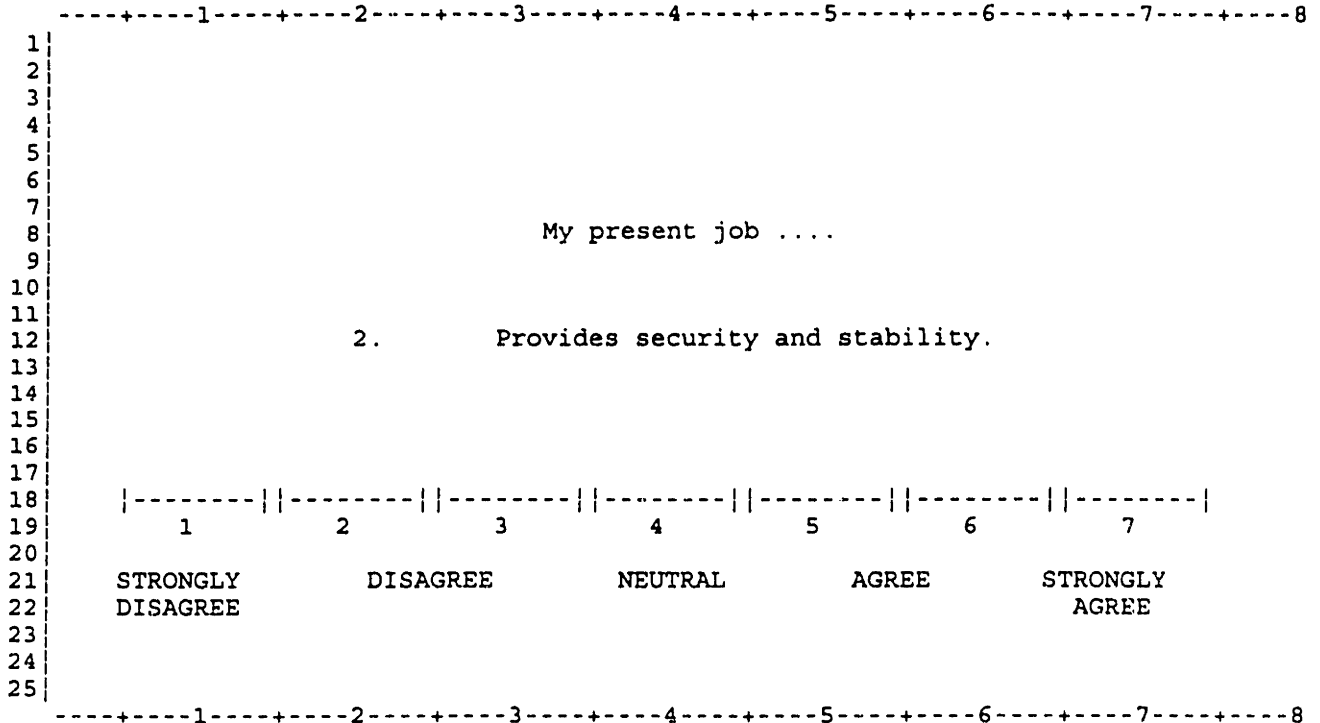
My present job

1. Provides a competitive benefits package.

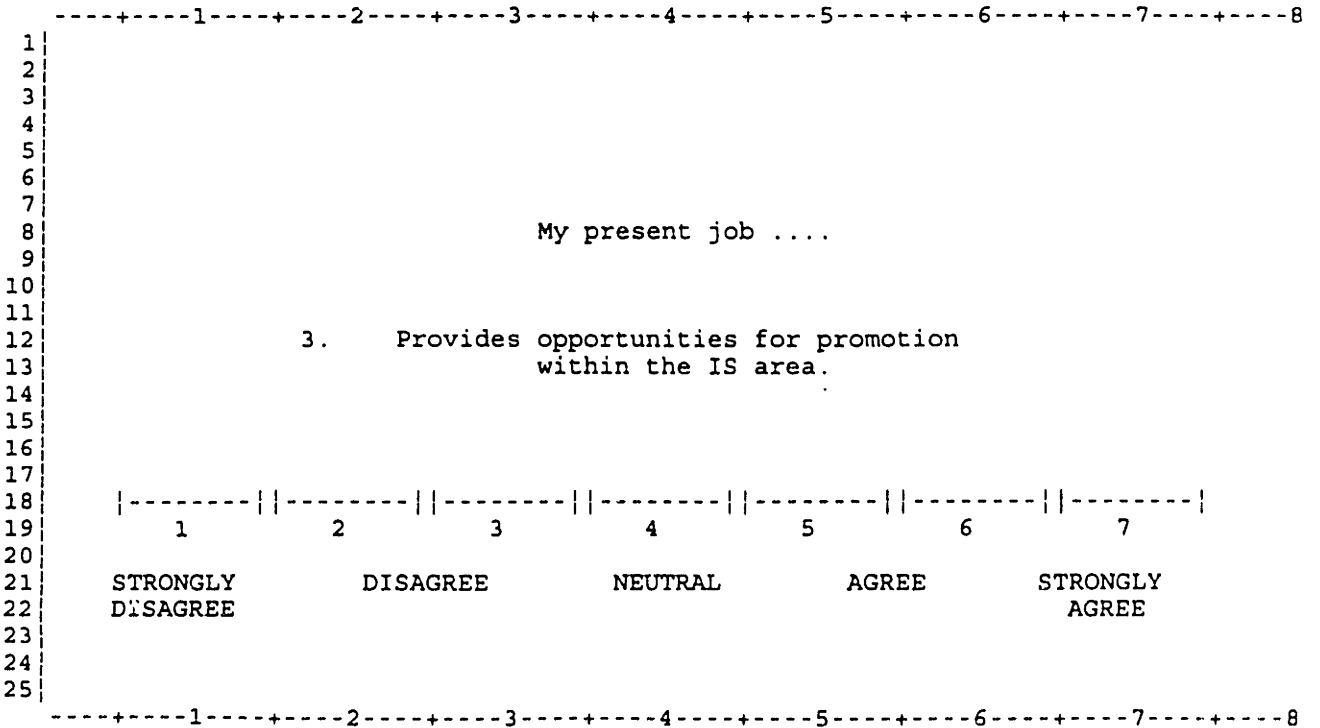
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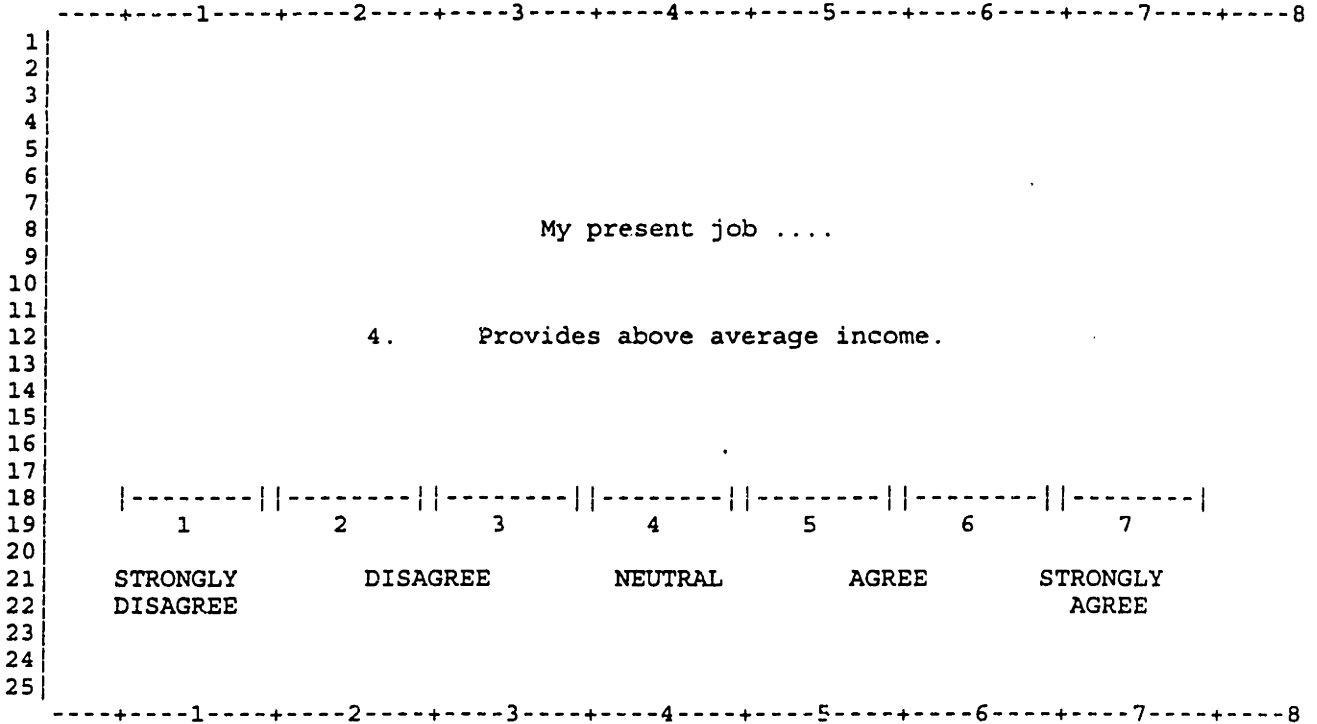
JCI-02



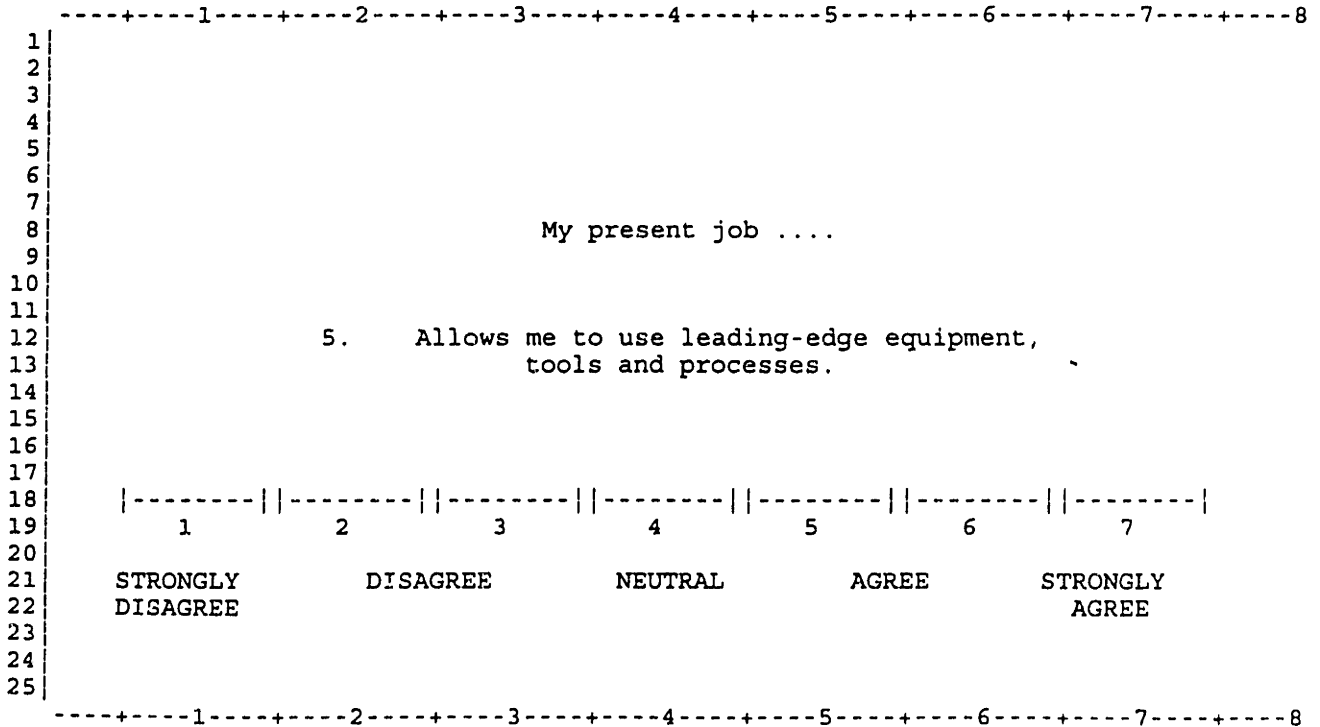
JCI-03



JCI-04



JCI-05



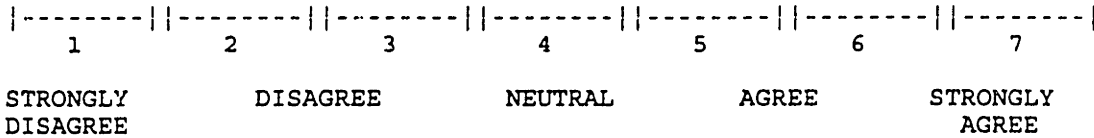
JCI-06

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My present job

6. Allows me to be treated and evaluated fairly.



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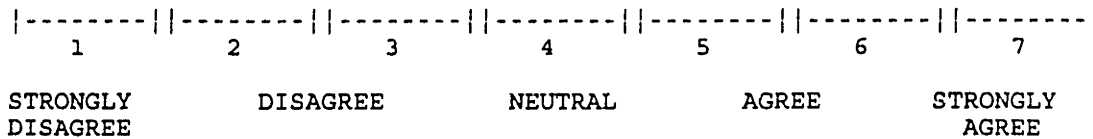
JCI-07

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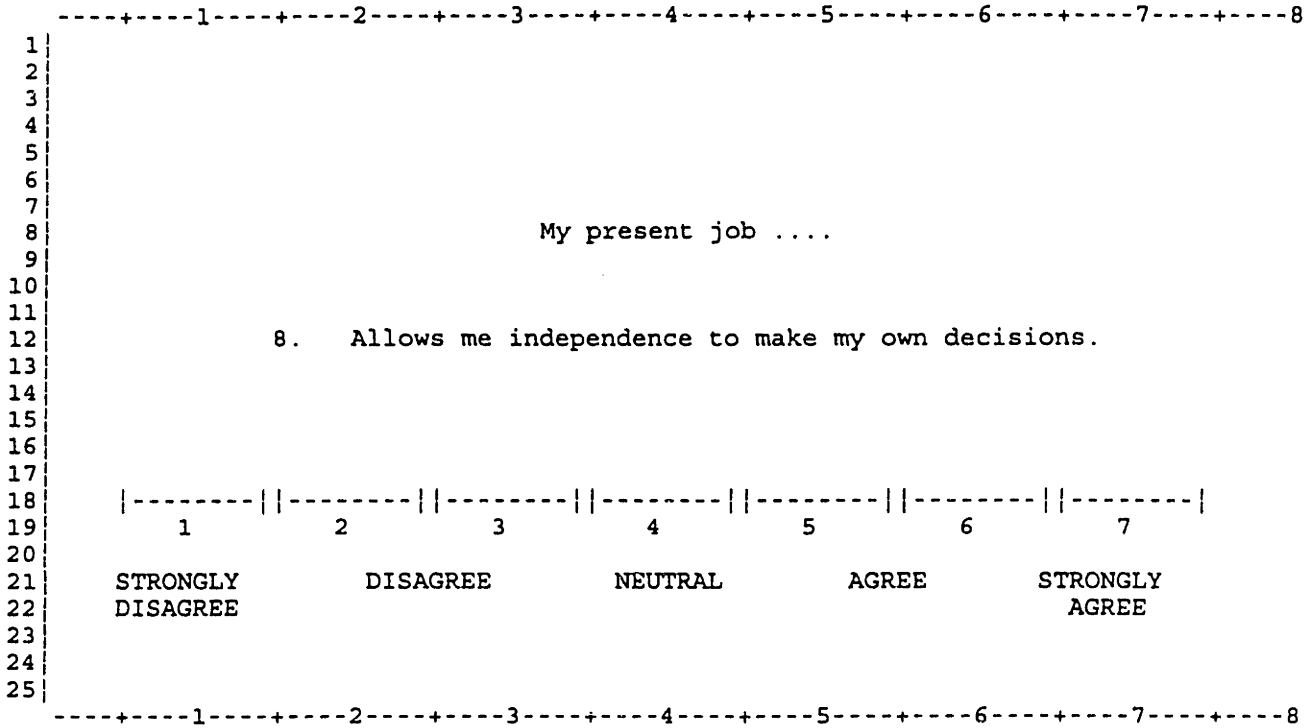
My present job

7. Is creative and challenging.

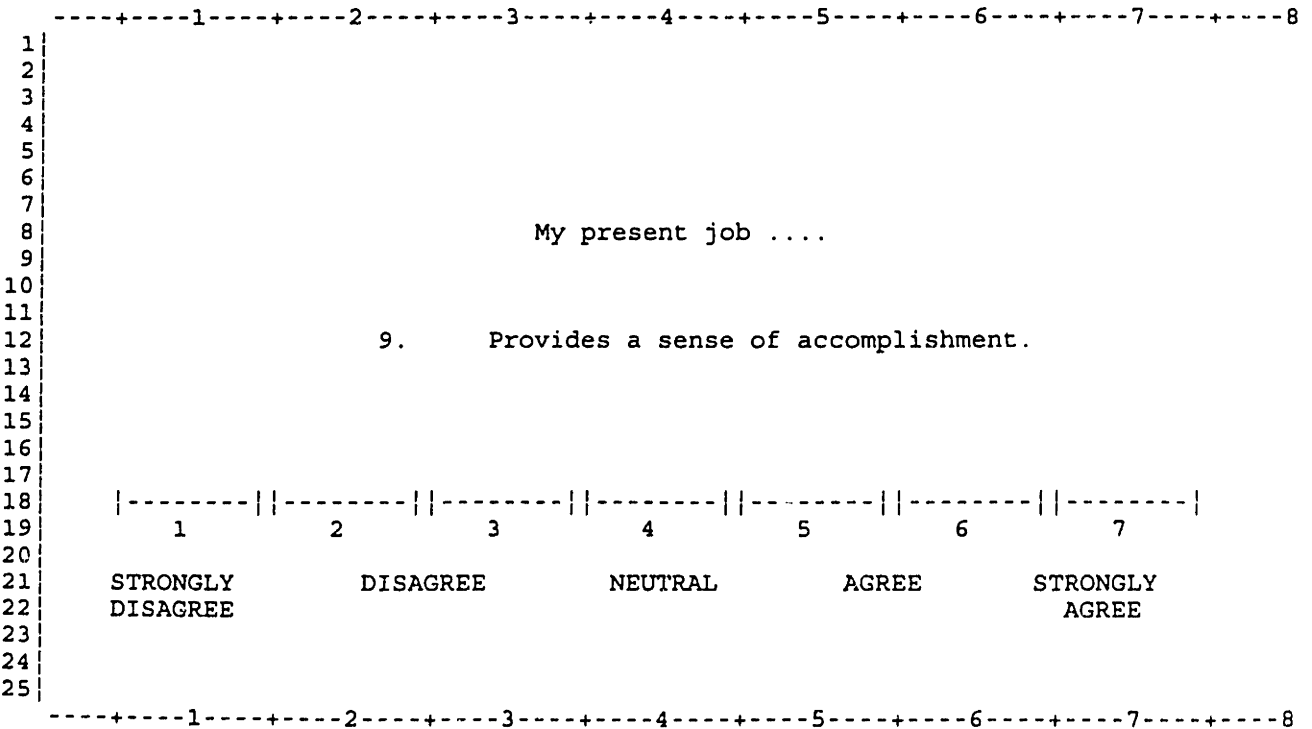


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JCI-08



JCI-09



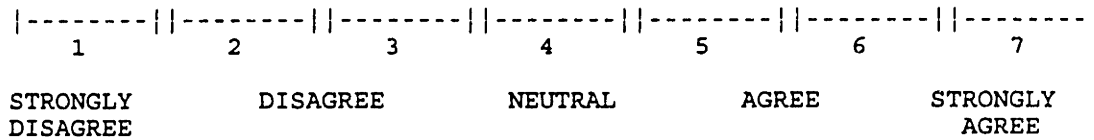
JCI-10

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My present job

10. Requires a high level of skill.



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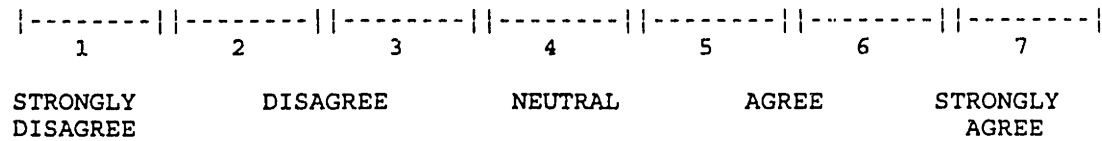
JCI-11

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My present job

11. Allows me to perform a variety of different tasks each day.



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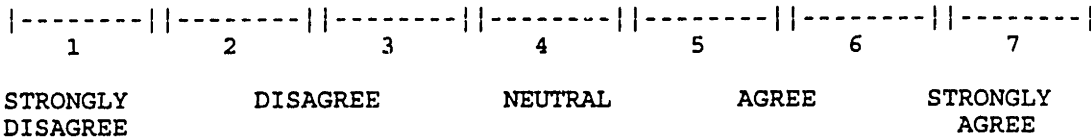
JCI-12

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My present job

12. Allows me to have significant impact
on the overall organization.



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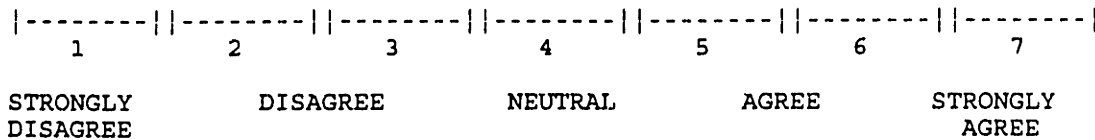
JCI-13

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My present job

13. Requires me to perform as a member of a team.



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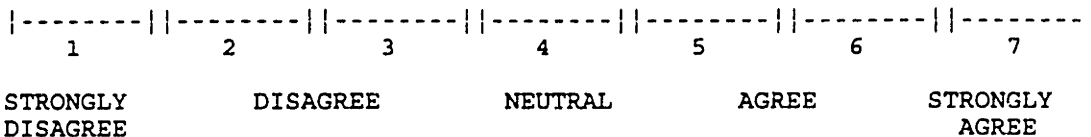
JCI-14

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My present job

14. Brings me into close contact with system users.



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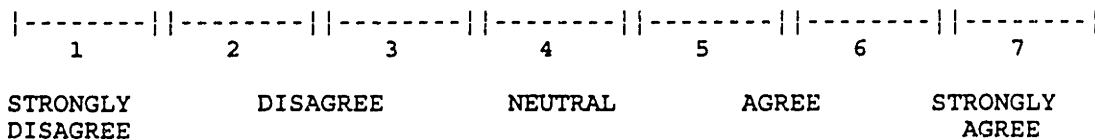
JCI-15

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My present job

15. Allows me to develop professional friendships.



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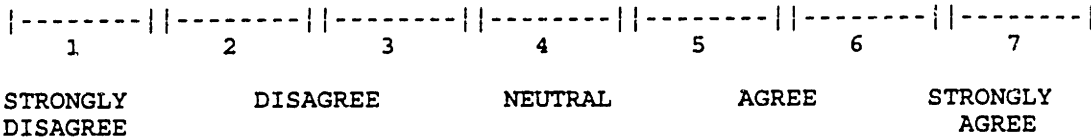
JCI-16

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My present job

16. Provides lots of supervision.



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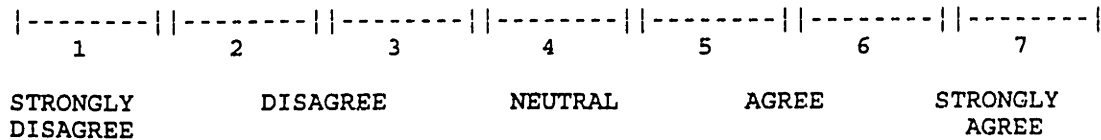
JCI-17

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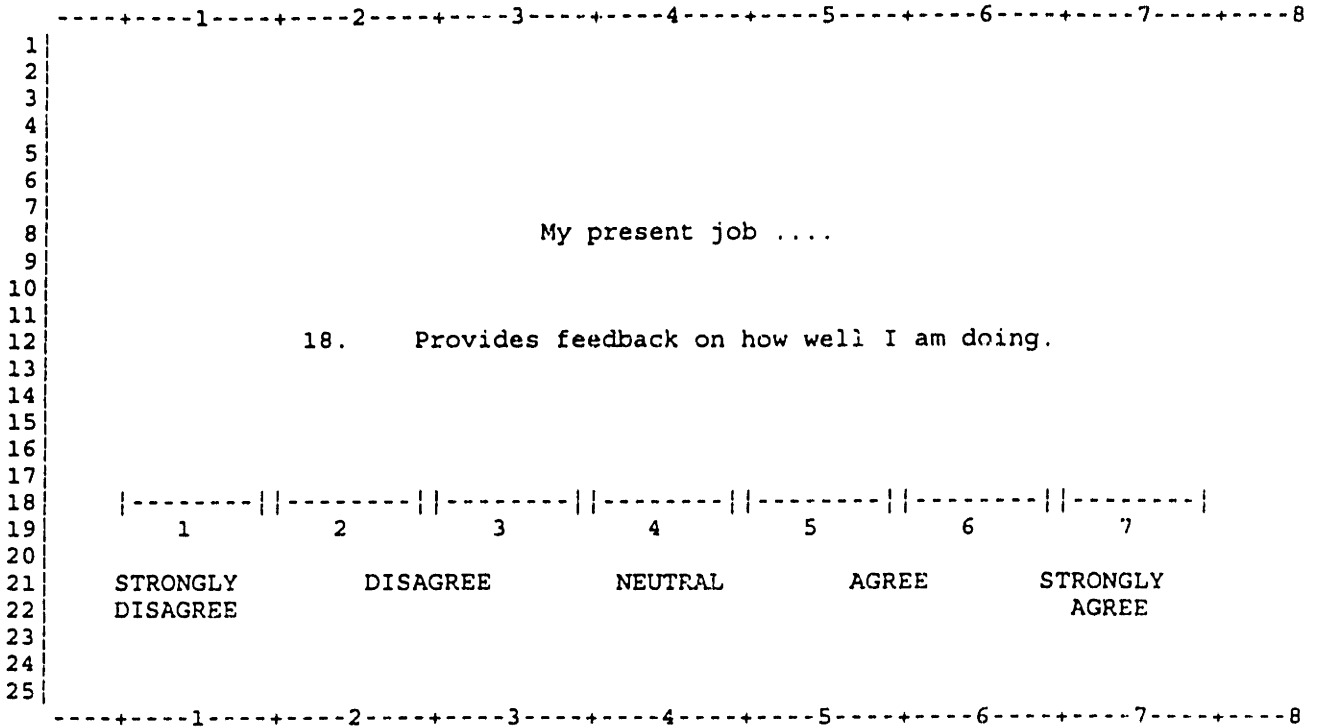
My present job

17. Allows me to complete assignments without relying on others.

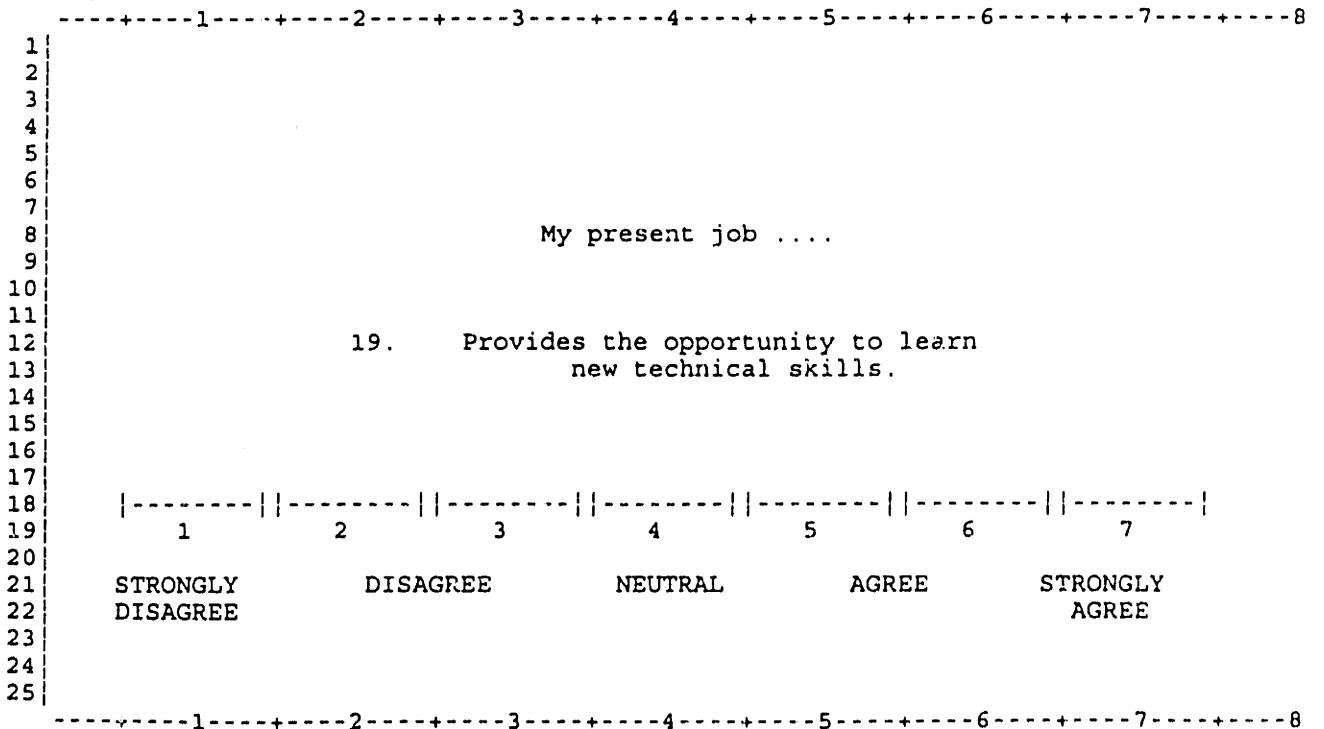


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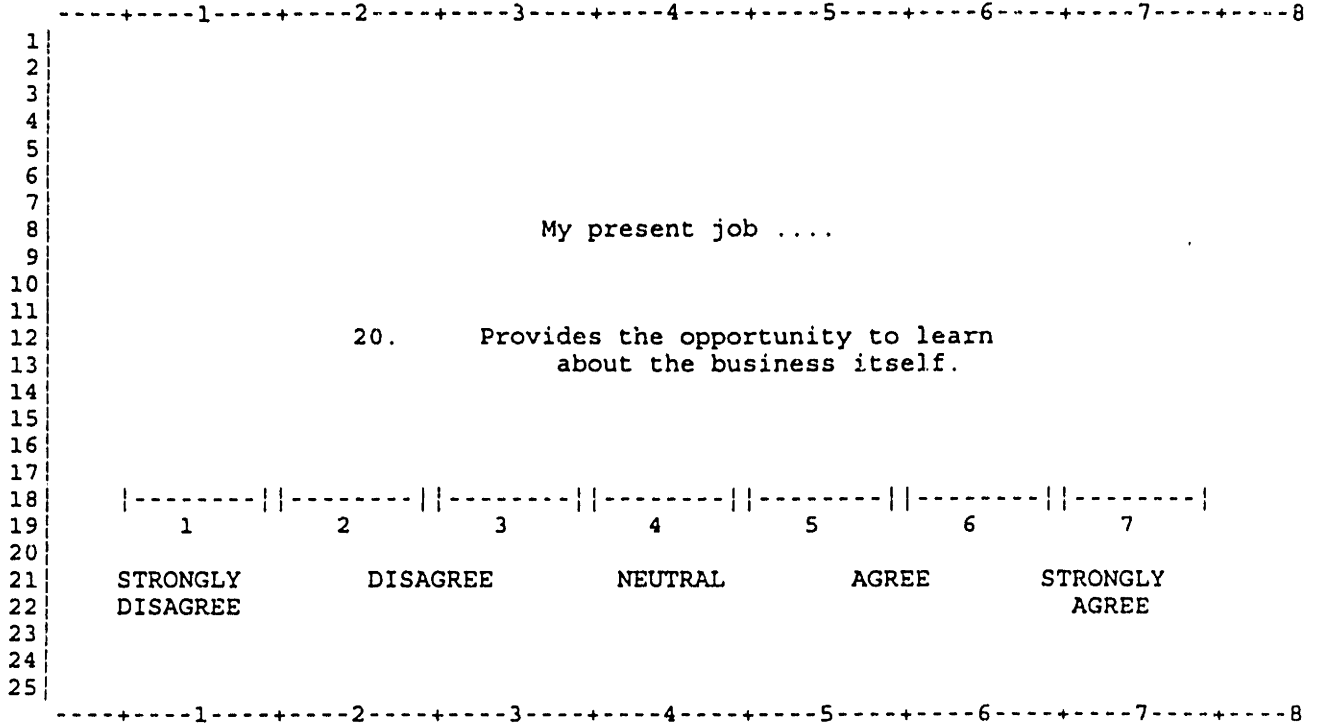
JCI-18



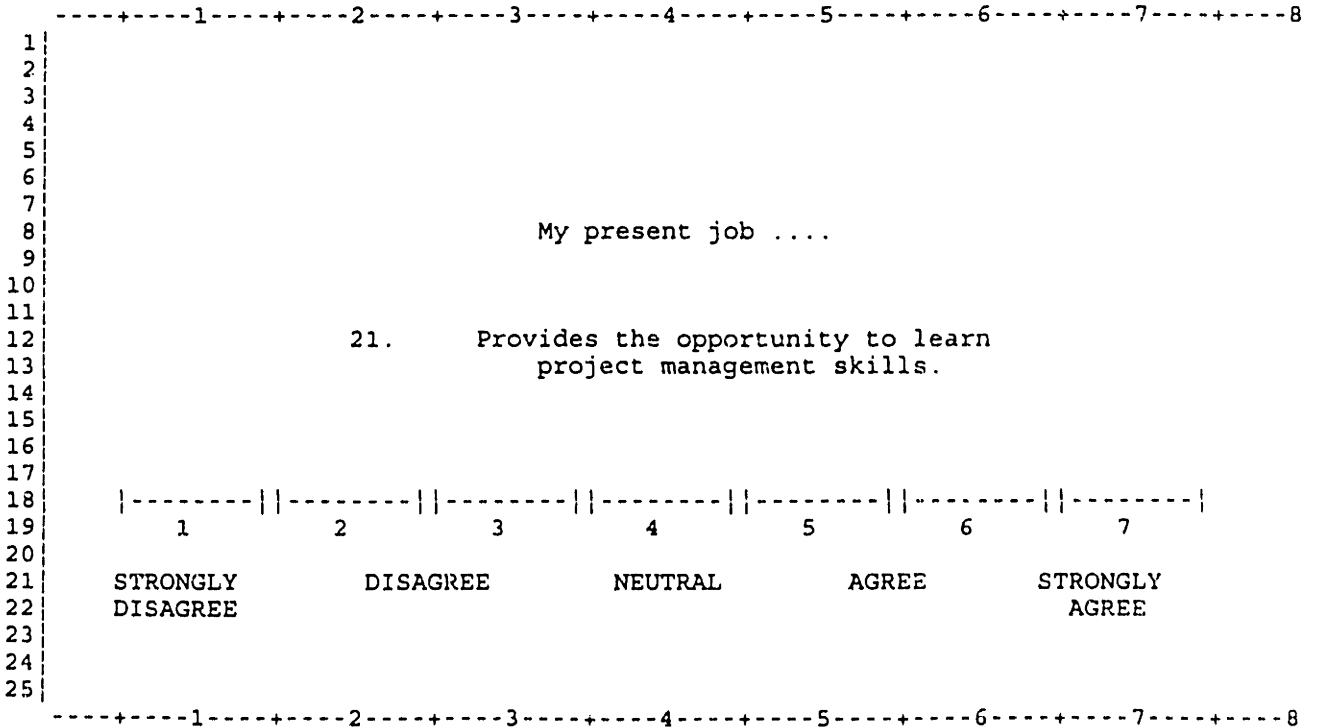
JCI-19



JCI-20



JCI-21



SKILL-00

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11 This set of questions will ask you to rate on a
12 scale from 1 (low) to 7 (high) how important certain
13 skills and abilities are for performing your job.
14
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16
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18 Press Any Key to Continue.
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SK-BK1

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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8 How important is the following skill or ability for performing your job?
9
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11
12 1. Knowledge of the business
13
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT NEUTRAL IMPORTANT IMPORTANT
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SK-AS10

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How important is the following skill or ability for performing your job?

2. Ability to trouble-shoot technical problem

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1 2 3 4 5 6 7

EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

-----1-----2-----3-----4-----5-----6-----7-----8

SK-CS13

-----1-----2-----3-----4-----5-----6-----7-----8

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How important is the following skill or ability for performing your job?

3. Verbal communication skills

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EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

-----1-----2-----3-----4-----5-----6-----7-----8

SK-AS11

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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How important is the following skill or ability for performing your job?

4. Designing user interfaces

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1 2 3 4 5 6 7

EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

SK-AS5

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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How important is the following skill or ability for performing your job?

5. Integrating new systems with old system

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1 2 3 4 5 6 7

EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
UNIMPORTANT IMPORTANT

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

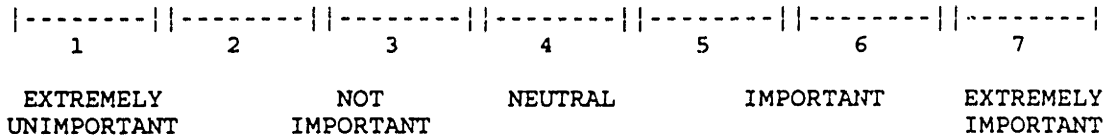
SK-CS15

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How important is the following skill or ability for performing your job?

6. Providing feedback to management



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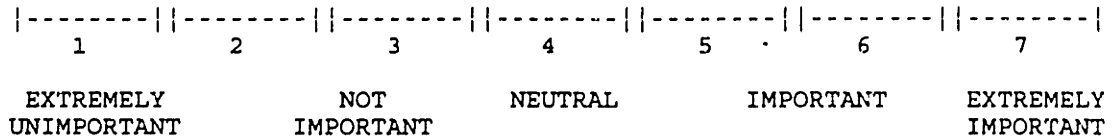
SK-AS4

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How important is the following skill or ability for performing your job?

7. Developing data and process models to represent business information.



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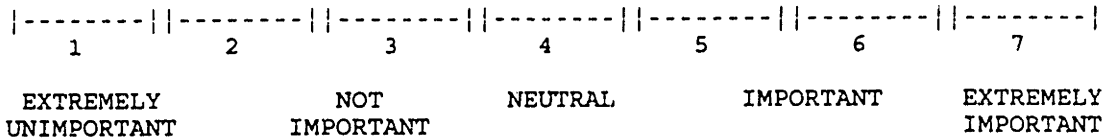
SK-BK2

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How important is the following skill or ability for performing your job?

8. Understanding the users' business objective



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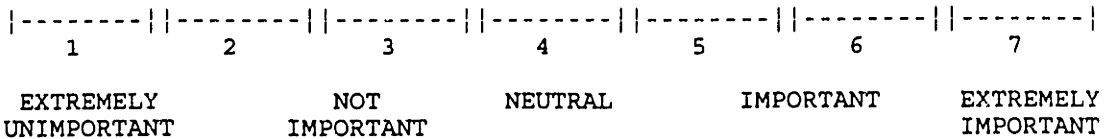
SK-AS9

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How important is the following skill or ability for performing your job?

9. Willingness to learn new technologie



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SK-BK3

-----1-----2-----3-----4-----5-----6-----7-----8

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8 How important is the following skill or ability for performing your job?
9
10
11
12 10. Developing strategic IS plans for the business
13
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
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21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT
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SK-AS12

-----1-----2-----3-----4-----5-----6-----7-----8

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8 How important is the following skill or ability for performing your job?
9
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11
12 11. Understanding the big picture of
13 how systems are integrated
14
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
20
21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT
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SK-AS7

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8 How important is the following skill or ability for performing your job?
9
10
11
12 12. Creativity in solving problem
13
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
20
21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT
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SK-AS6

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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8 How important is the following skill or ability for performing your job?
9
10
11
12 13. Writing and de-bugging computer code
13
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
20
21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT
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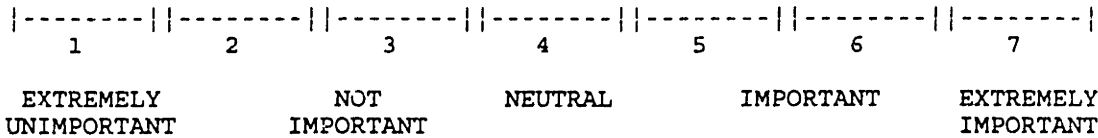
SK-GA19

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How important is the following skill or ability for performing your job?

14. Ability to work with minimal supervision



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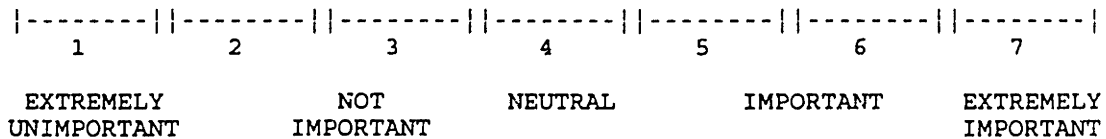
SK-CS16

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How important is the following skill or ability for performing your job?

15. Written communication skills



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SK-GA18

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8 How important is the following skill or ability for performing your job?
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12 16. Ability to organize work
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT IMPORTANT IMPORTANT IMPORTANT
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SK-GA21

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8 How important is the following skill or ability for performing your job?
9
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12 17. Adapting prior knowledge to new technologies
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT IMPORTANT IMPORTANT IMPORTANT
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25 -----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

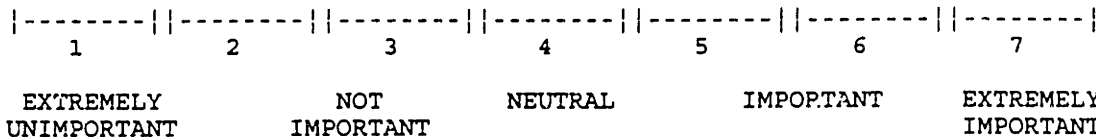
SK-GA8

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How important is the following skill or ability for performing your job?

18. General technical knowledge about computer



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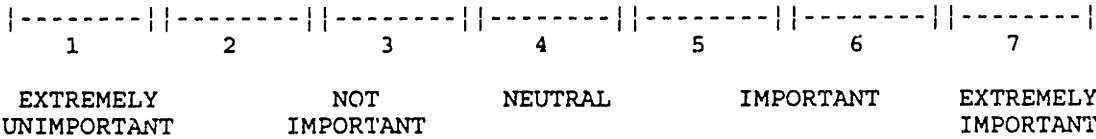
SK-GA20

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How important is the following skill or ability for performing your job?

19. Ability to train other worker



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SK-CS14

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8 How important is the following skill or ability for performing your job?
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12 20. Ability to lead and motivate others
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18 |-----|-----|-----|-----|-----|-----|-----|
19 1 2 3 4 5 6 7
20
21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT NEUTRAL IMPORTANT IMPORTANT
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SK-GA17

-----1-----2-----3-----4-----5-----6-----7-----8

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8 How important is the following skill or ability for performing your job?
9
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11
12 21. Ability to get along with people
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18 |-----|-----|-----|-----|-----|-----|-----|
19 1 2 3 4 5 6 7
20
21 EXTREMELY NOT NEUTRAL IMPORTANT EXTREMELY
22 UNIMPORTANT IMPORTANT NEUTRAL IMPORTANT IMPORTANT
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JDI-00

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The next set of questions will present a series of terms to describe your job. Please indicate how well each term describes the work you do, keeping in mind the new system development tools and approaches that you listed above.

Press any key to continue

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JDI-01

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The work I perform is . . .

1. fascinating

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

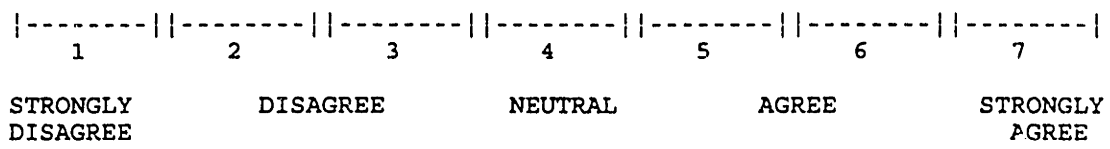
JDI-02

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The work I perform is . . .

2. satisfying



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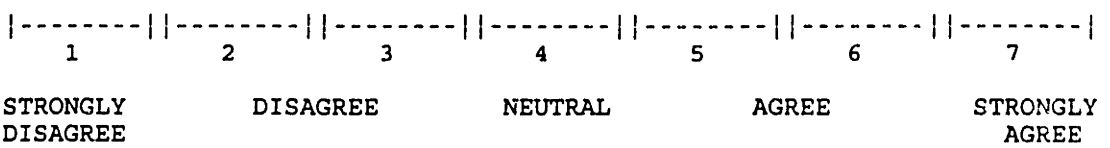
JDI-03

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The work I perform is . . .

3. boring



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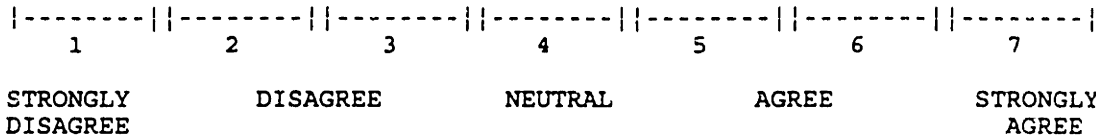
JDI-04

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The work I perform is . . .

4. creative



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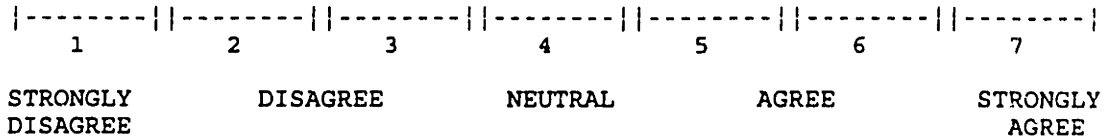
JDI-05

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The work I perform is . . .

5. respected



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JDI-06

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The work I perform is . . .

6. useful

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

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JDI-07

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The work I perform is . . .

7. tiring

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

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JDI-08

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The work I perform is . . .

8. challenging

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STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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JDI-09

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The work I perform . . .

9. there is too much to do

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1 2 3 4 5 6 7
STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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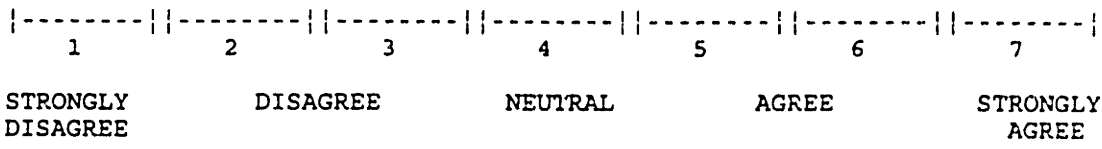
JDI-10

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The work I perform is . . .

10. frustrating



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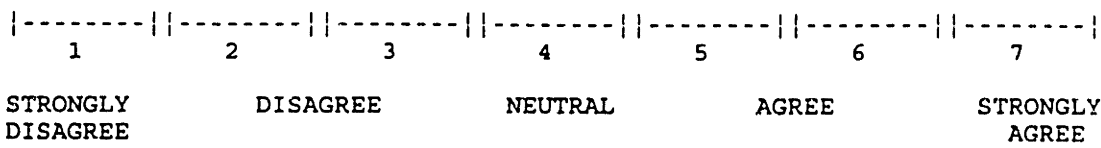
JDI-11

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The work I perform is . . .

11. repetitive



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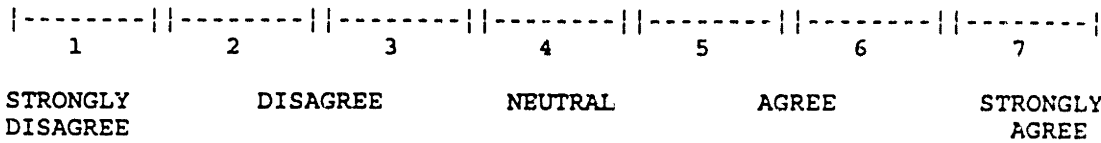
JDI-12

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The work I perform . . .

12. gives me a sense of accomplishment



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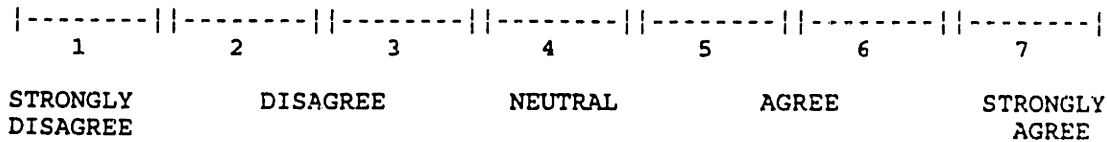
JDI-GEN

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The work I perform . . .

13. Overall, I like it very much



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KAI-00

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7
8       The next set of questions will ask you how well a
9
10      set of terms apply to you.  If you believe the item
11
12      applies to you, then move the cursor to AGREE or
13
14      STRONGLY AGREE and press ENTER.  If you think that the
15
16      item does not apply to you, then select DISAGREE or
17
18      STRONGLY DISAGREE and press ENTER.
19
20              Press any key to continue
21
22
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KAI-24-C

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-----1-----2-----3-----4-----5-----6-----7-----8
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7
8       I would describe myself as someone who ....
9
10
11
12      1.  prefers to work on one problem at a time.
13
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18      |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19      | 1       | 2       | 3       | 4       | 5       | 6       | 7       |
20
21      STRONGLY   DISAGREE   NEUTRAL   AGREE   STRONGLY
22      DISAGREE
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KAI-22-E

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8 I would describe myself as someone who
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10
11
12 2. masters all details painstakingly.
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
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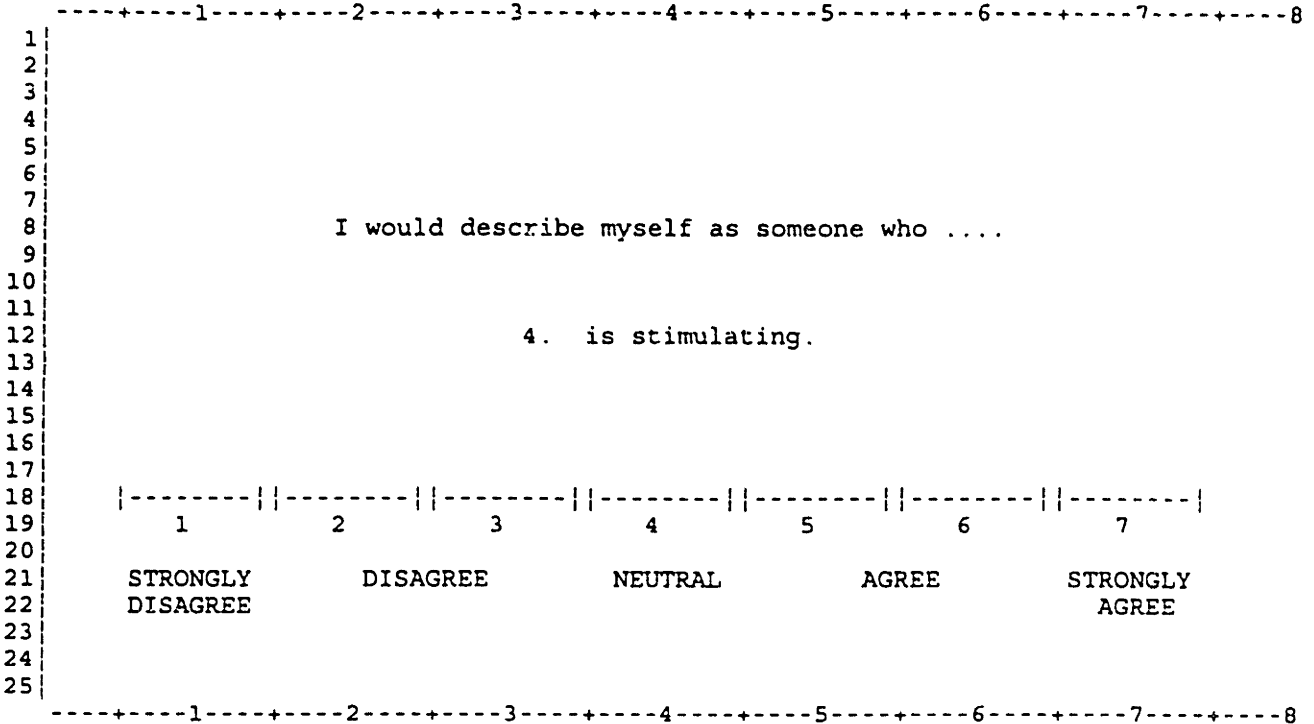
KAI-21-O

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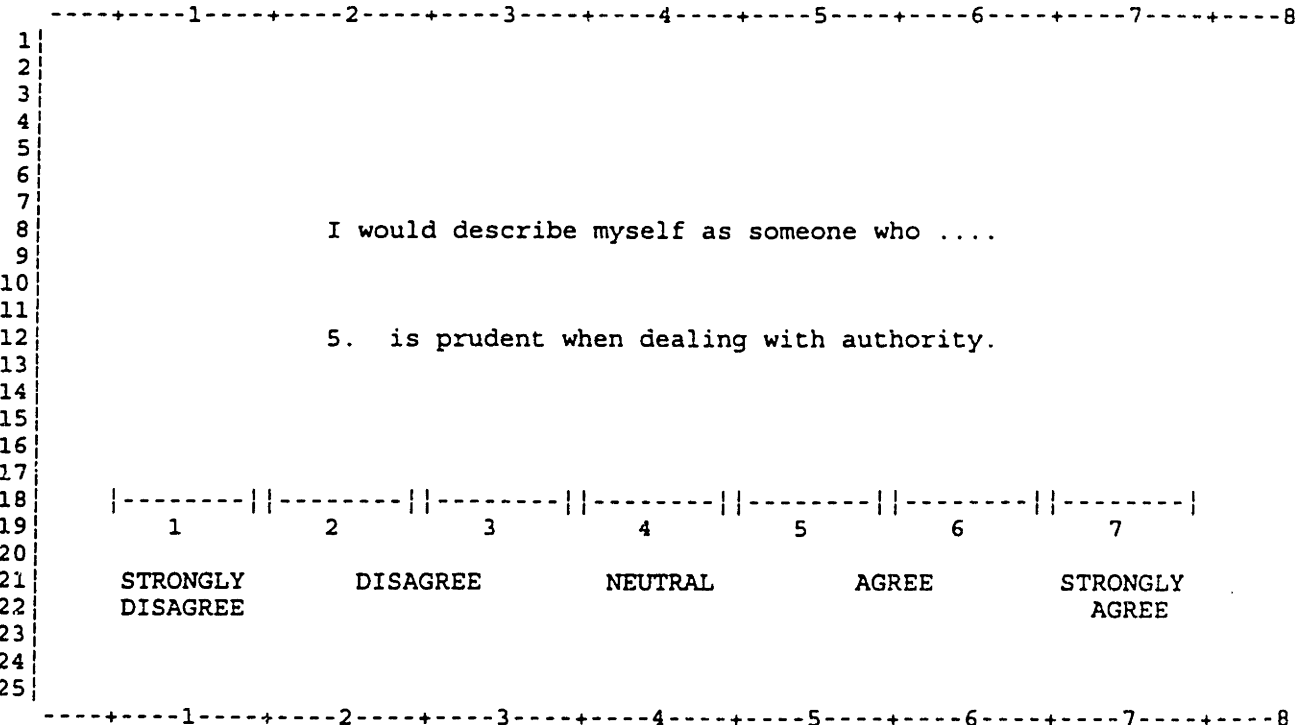
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7
8 I would describe myself as someone who
9
10
11
12 3. has original ideas.
13
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 1 2 3 4 5 6 7
20
21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
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KAI-19-O



KAI-06-R



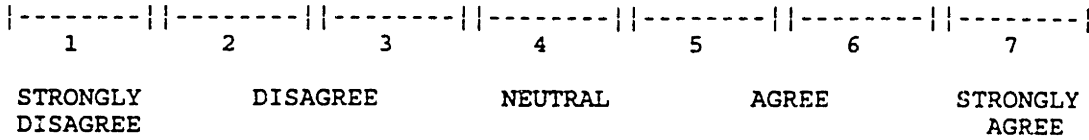
KAI-26-C

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I would describe myself as someone who

6. often risks doing things differently.



-----1-----2-----3-----4-----5-----6-----7-----8

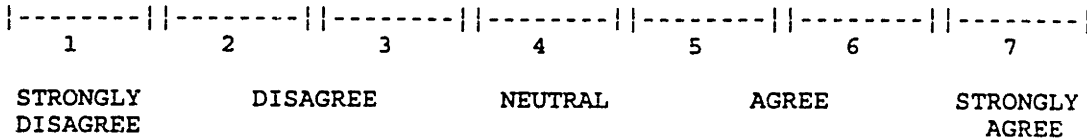
KAI-11-O

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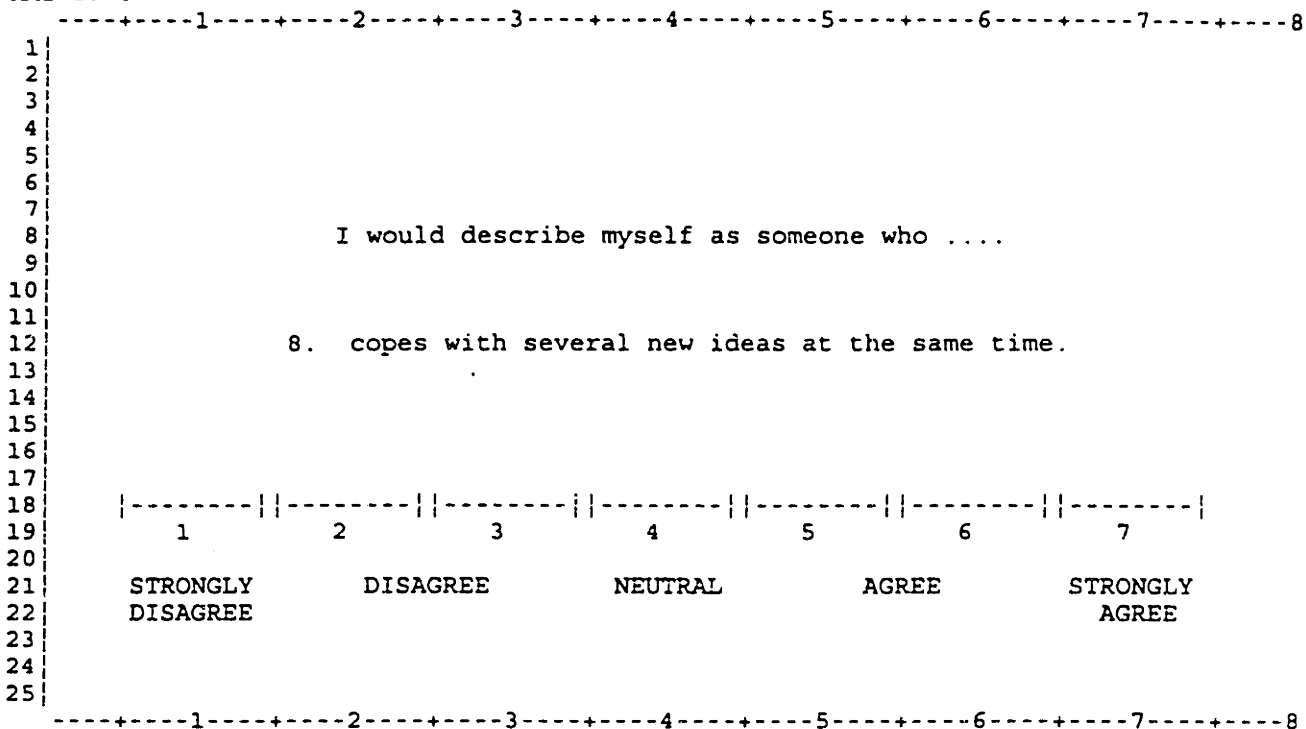
I would describe myself as someone who

7. has fresh perspectives on old problems.

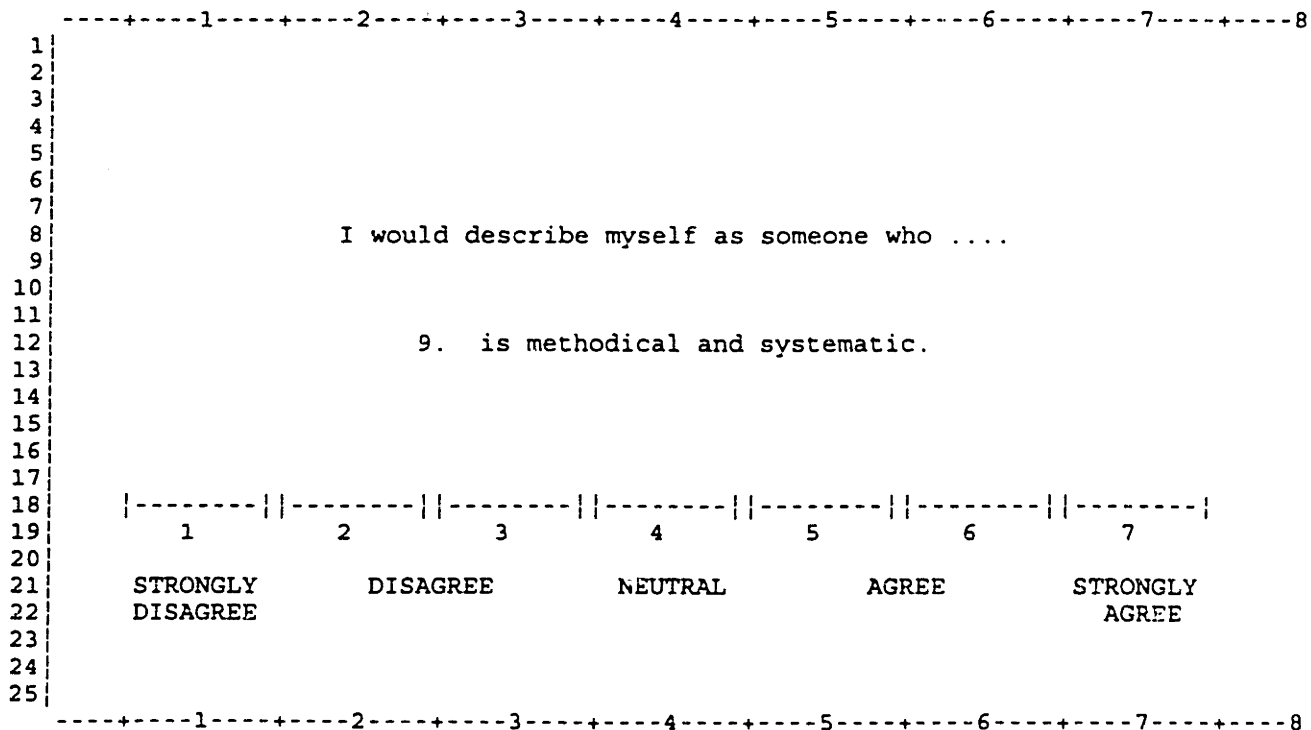


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KAI-16-0



KAI-25-E



KAI-07-R

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8 I would describe myself as someone who
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10
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12 10. never acts without proper authority.
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
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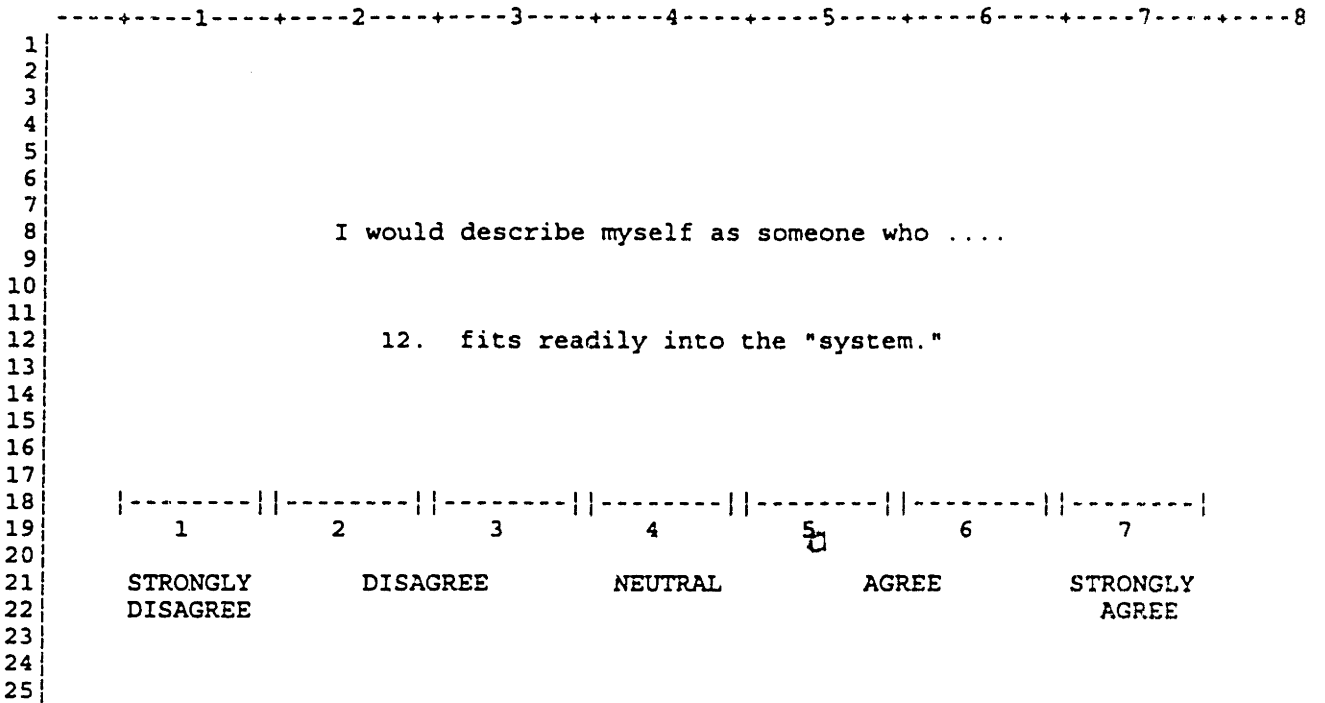
KAI-14-E

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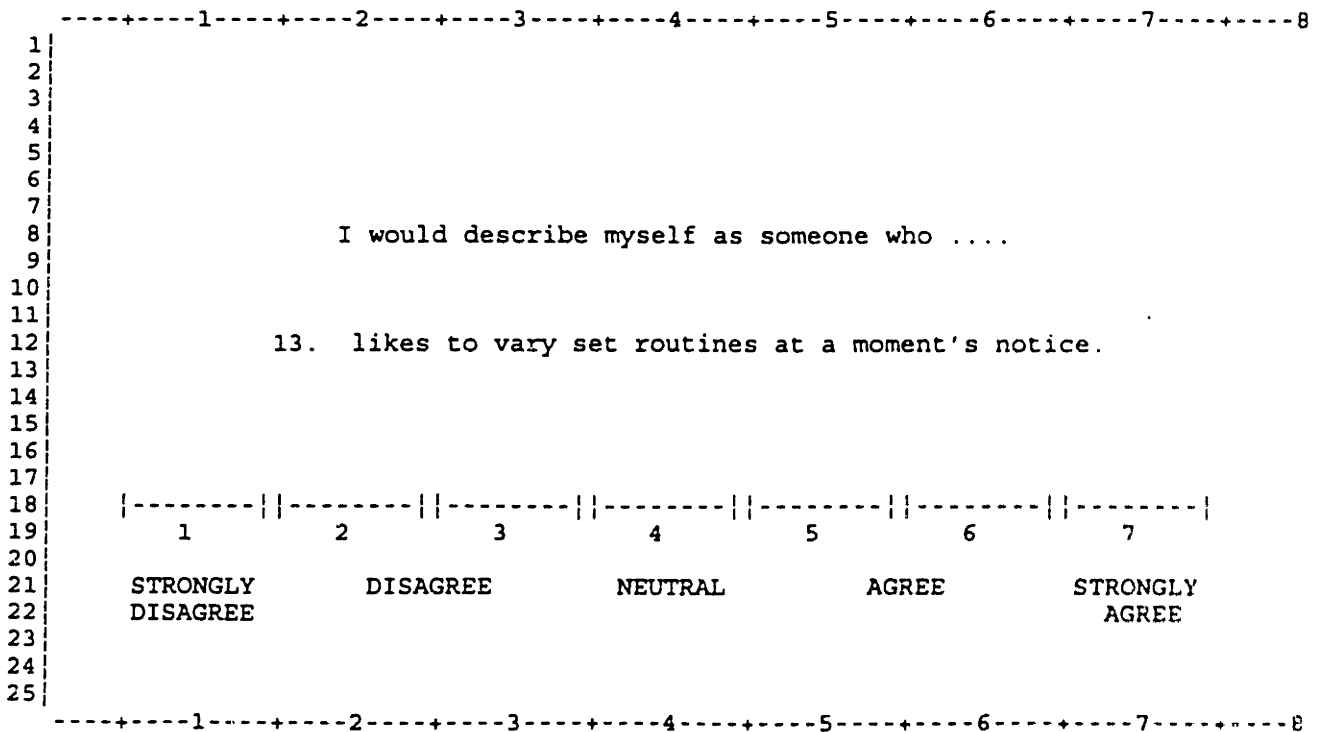
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8 I would describe myself as someone who
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12 11. is thorough.
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19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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22 DISAGREE AGREE
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KAI-30-R



KAI-12-C



KAI-18-0

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7
8 I would describe myself as someone who
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10
11
12 14. can stand out in disagreement against a group.
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19 1 2 3 4 5 6 7
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
23 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
24 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
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KAI-03-0

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7
8 I would describe myself as someone who
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10
11
12 15. will always think of something
13 when I am stuck on a problem.
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19 1 2 3 4 5 6 7
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
23 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
24 DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
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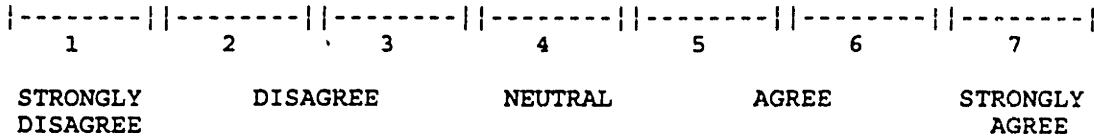
KAI-04-E

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I would describe myself as someone who

16. enjoys detailed work.



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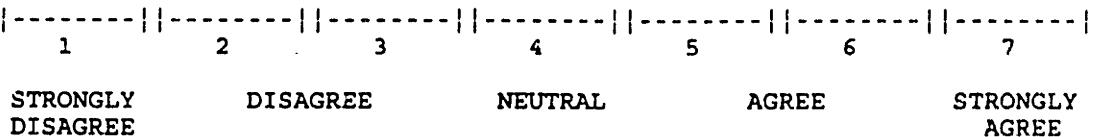
KAI-05-C

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I would describe myself as someone who

17. would rather create something new than
improve on what already exists.



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KAI-23-O

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I would describe myself as someone who

18. generates lots of ideas.

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

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KAI-02-R

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I would describe myself as someone who

19. conforms to the conventional way of doing things.

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

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KAI-13-C

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8 I would describe myself as someone who
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10
11
12 20. prefers changes to occur gradually.
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19 1 2 3 4 5 6 7
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
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KAI-08-R

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8 I would describe myself as someone who
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12 21. never seeks to bend or break the rules.
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21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
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AT-00

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This is Part 3 of the survey.
The next set of questions will ask you about your
general attitudes and beliefs on a range of topics.

Press Any Key to Continue

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AT-01

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1. I like to work on problems even if they
do not have clear-cut answers.

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

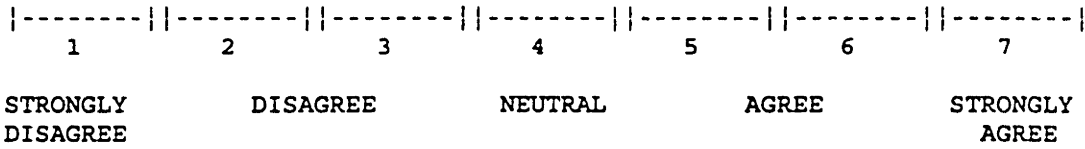
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AT-02

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2. A problem has little attraction for me
if I do not think it has a solution.



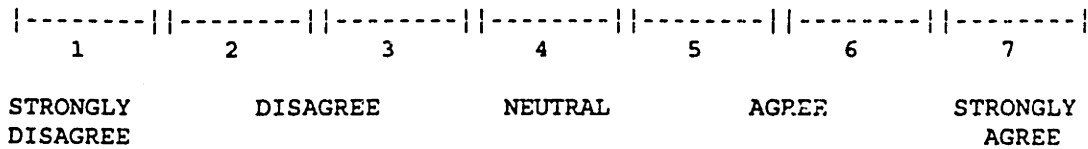
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AT-03

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3. Before an examination, I feel much less anxious
if I know how many questions there will be.



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AT-04

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4. I like to fool around with new ideas, even if
they turn out later to be a total waste of time.

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1 2 3 4 5 6 7

STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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AT-05

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5. There is a right way and a wrong way
to do almost everything.

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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AT-06

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6. I am uncomfortable with people unless I feel
that I can understand their behavior.

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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AT-07

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7. Practically every problem has a solution.

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STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
DISAGREE AGREE

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AT-08

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12		8.	It bothers me when I don't know how					
13			other people react to me.					
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19		1	2	3	4	5	6	7
20								
21		STRONGLY	DISAGREE	NEUTRAL	AGREE	STRONGLY		
22		DISAGREE				AGREE		
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The next 21 items are a reduced length version of the
Personal Resilience Questionnaire

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For Further Information, Please contact:

ODR, Inc.
2900 Chamblee-Tucker Road
Atlanta, GA.
(404) 455-7145

PRP-01

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9. I like myself.

1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

PRP-02

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10. I am comfortable in a variety of social situations.

1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

PRP-03

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11. Questions that don't have a right answer are really frustrating.

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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PRP-04

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12. My life has a clear direction and purpose.

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

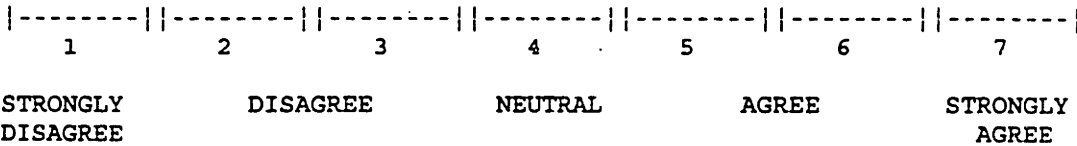
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PRP-05

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13. I am willing to take some risks to get what I want.



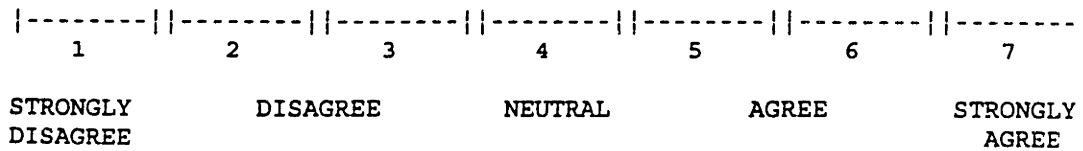
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PRP-06

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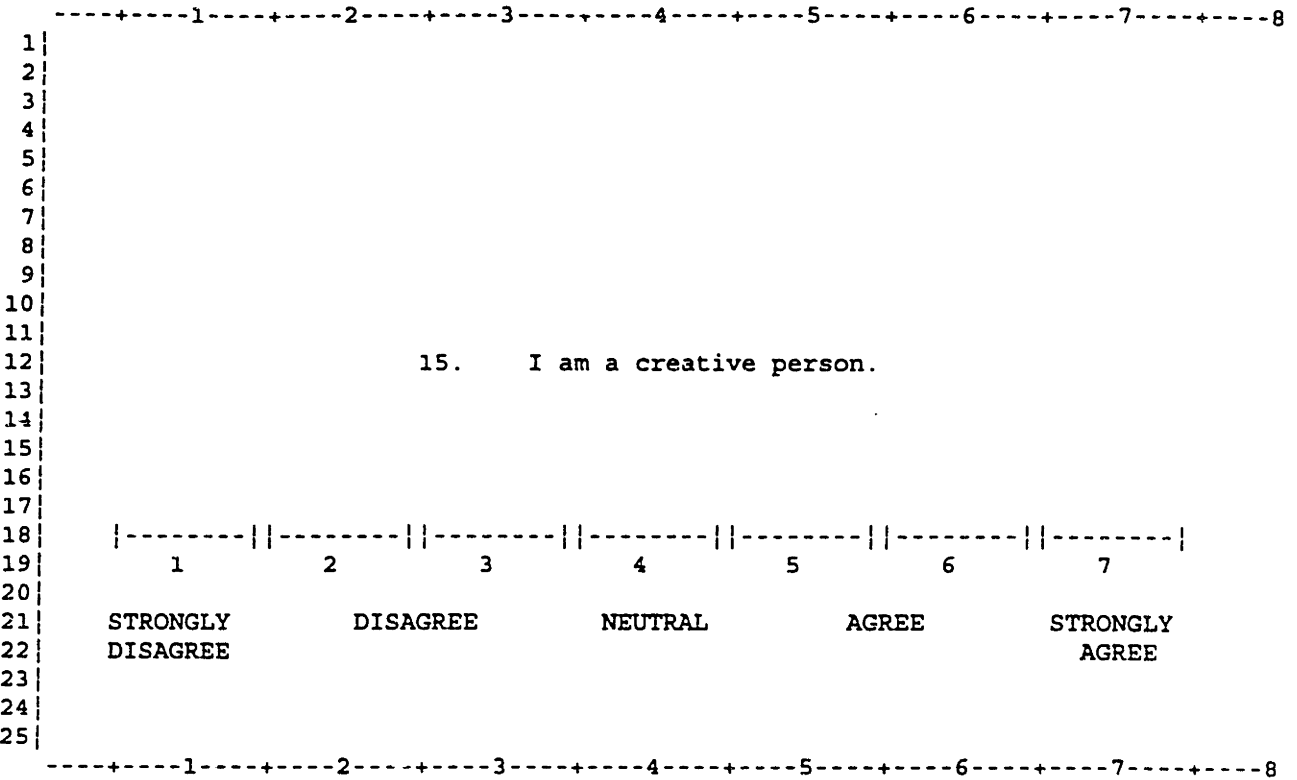
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14. I usually wake up in the morning excited about what the day will bring.

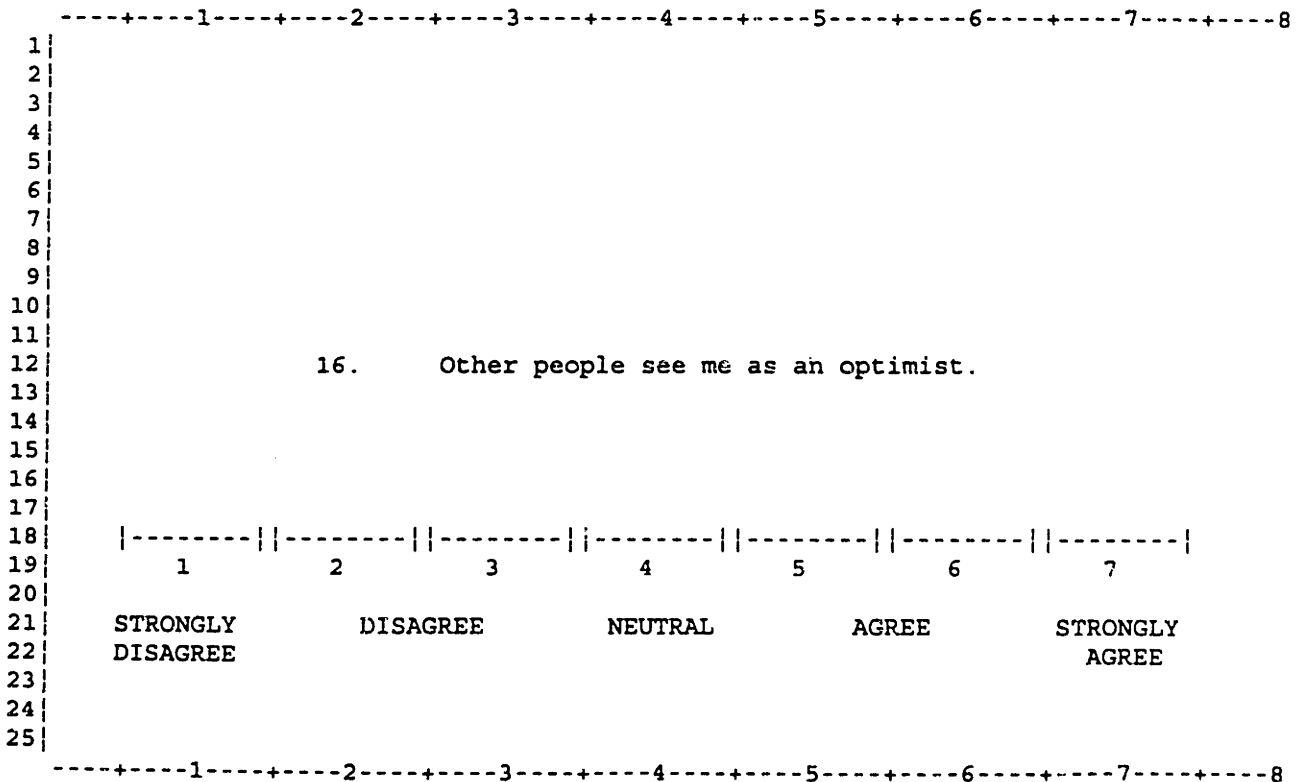


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PRP-07



PRP-08



PRP-09

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12 | 17. I am often reluctant to ask others for help
13 | in a difficult situation.
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19 | 1 2 3 4 5 6 7
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21 | STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
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-----1-----2-----3-----4-----5-----6-----7-----8

PRP-10

-----1-----2-----3-----4-----5-----6-----7-----8

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11 |
12 | 18. I am always trying to learn new things or
13 | find ways to improve myself.
14 |
15 |
16 |
17 |
18 | |-----| |-----| |-----| |-----| |-----| |-----| |
19 | 1 2 3 4 5 6 7
20 |
21 | STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
22 | DISAGREE AGREE
23 |
24 |
25 |

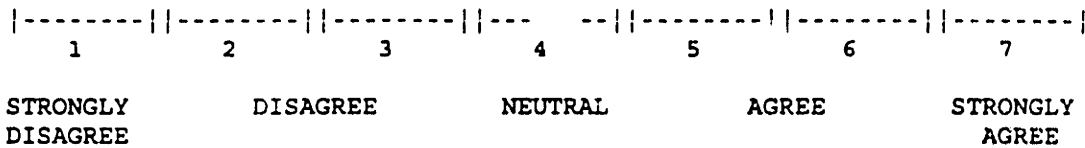
-----1-----2-----3-----4-----5-----6-----7-----8

PRP-11

-----1-----2-----3-----4-----5-----6-----7-----8

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19. It is easy for me to become depressed about things.



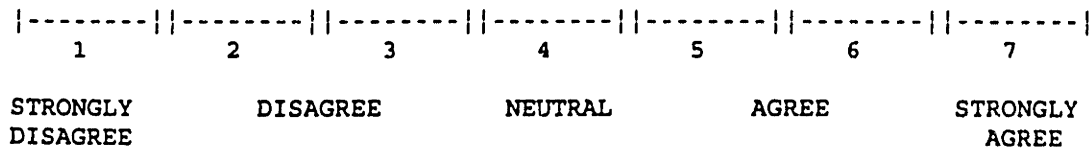
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PRP-12

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20. The things I am doing in my life right now are an expression of my personal goals and aims.



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PRP-13

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12 21. I feel good about the things I have done
13 with my life so far.
14
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18 |-----|-----|-----|-----|-----|-----|
19 1 2 3 4 5 6 7
20
21 STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
23
24
25 -----1-----2-----3-----4-----5-----6-----7-----8

PRP-14

-----1-----2-----3-----4-----5-----6-----7-----8

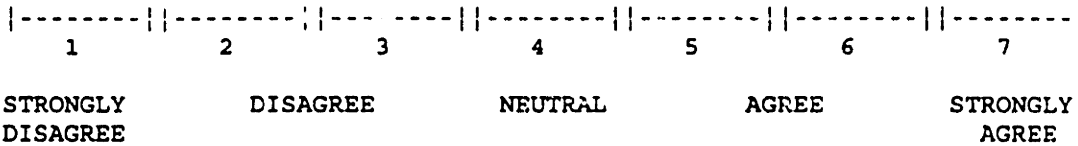
1
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11
12 22. I do NOT manage time well -- it is always
13 slipping away from me.
14
15
16
17
18 |-----|-----|-----|-----|-----|-----|
19 1 2 3 4 5 6 7
20
21 STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE AGREE
23
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25 -----1-----2-----3-----4-----5-----6-----7-----8

PRP-15

-----1-----2-----3-----4-----5-----6-----7-----8

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23. When a crisis occurs in my life, I can keep my focus and get myself back on track.



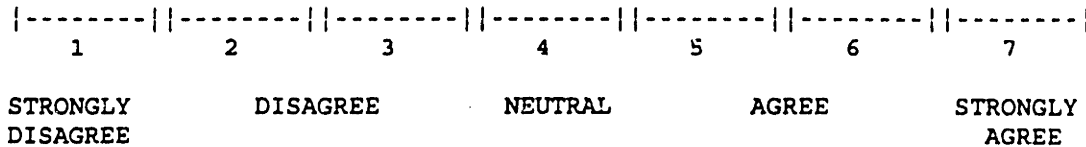
-----1-----2-----3-----4-----5-----6-----7-----8

PRP-16

-----1-----2-----3-----4-----5-----6-----7-----8

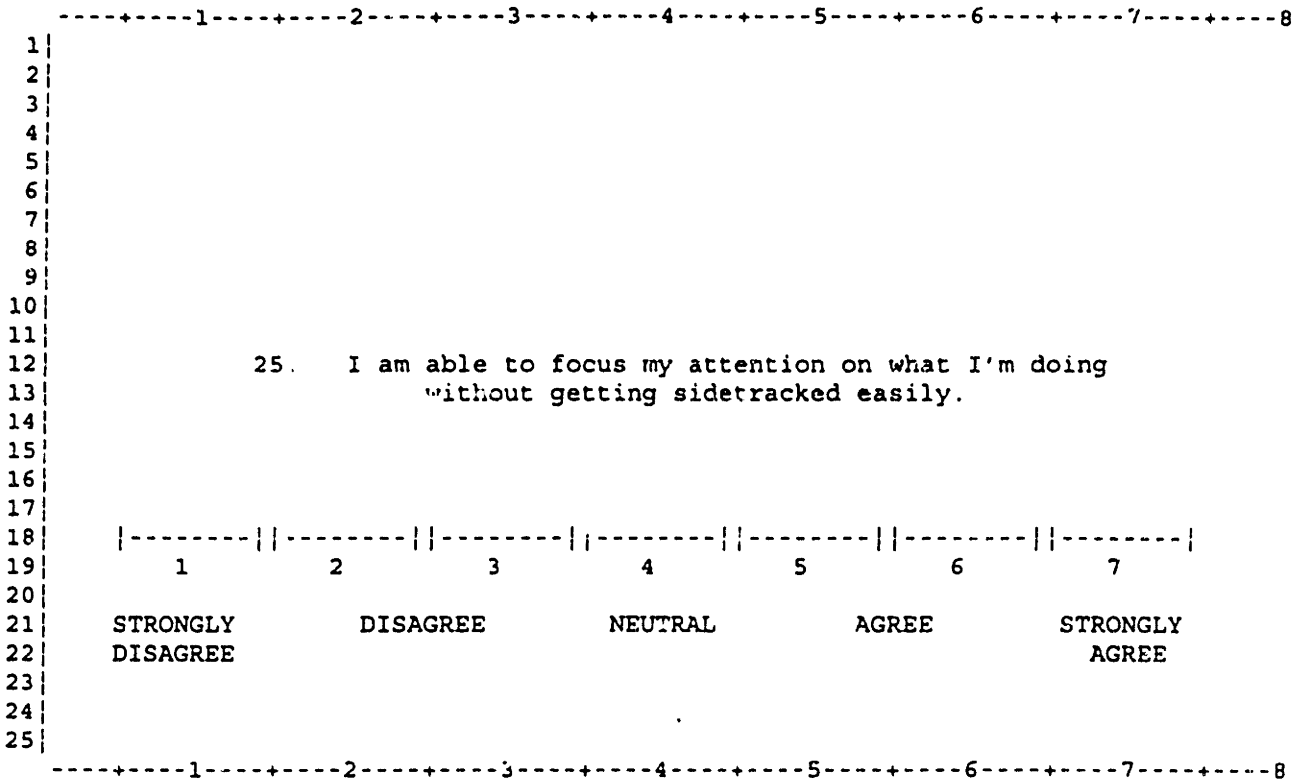
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24. I do NOT have a clear sense of what my skills and abilities are.

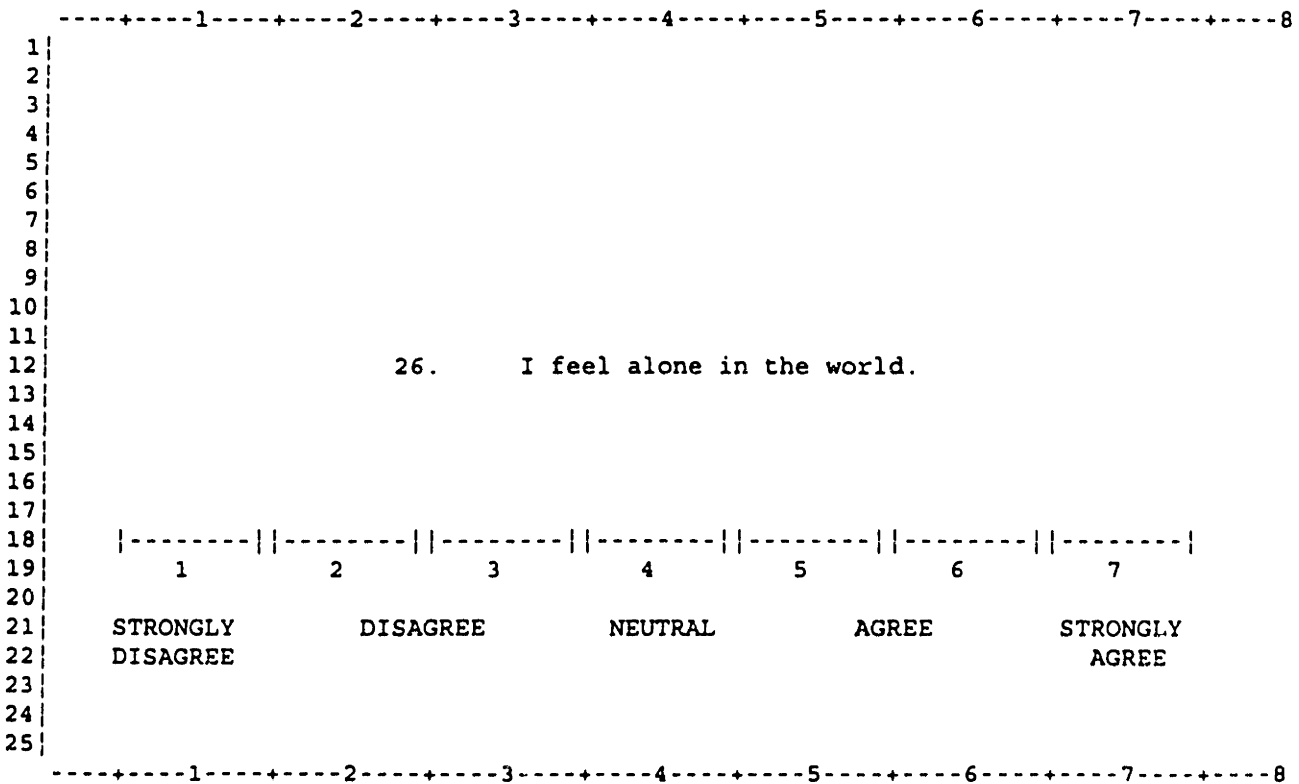


-----1-----2-----3-----4-----5-----6-----7-----8

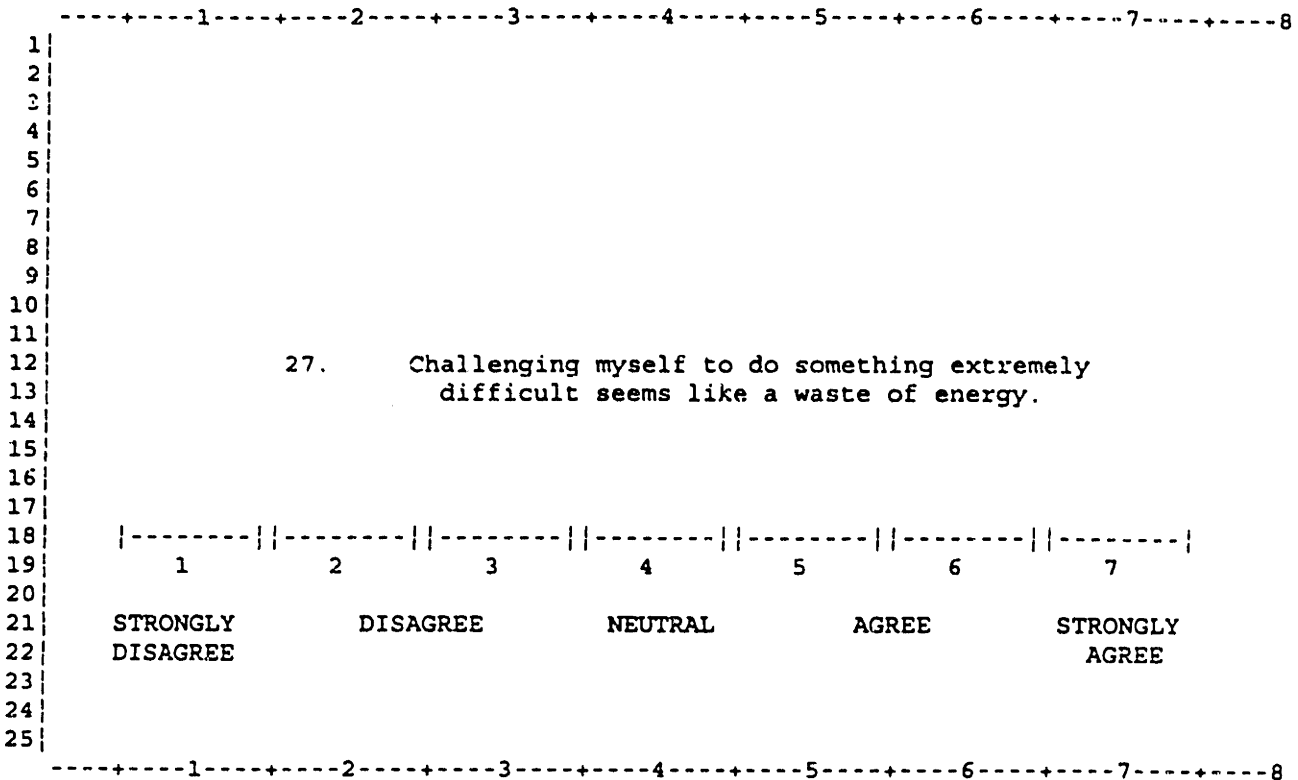
PRP-17



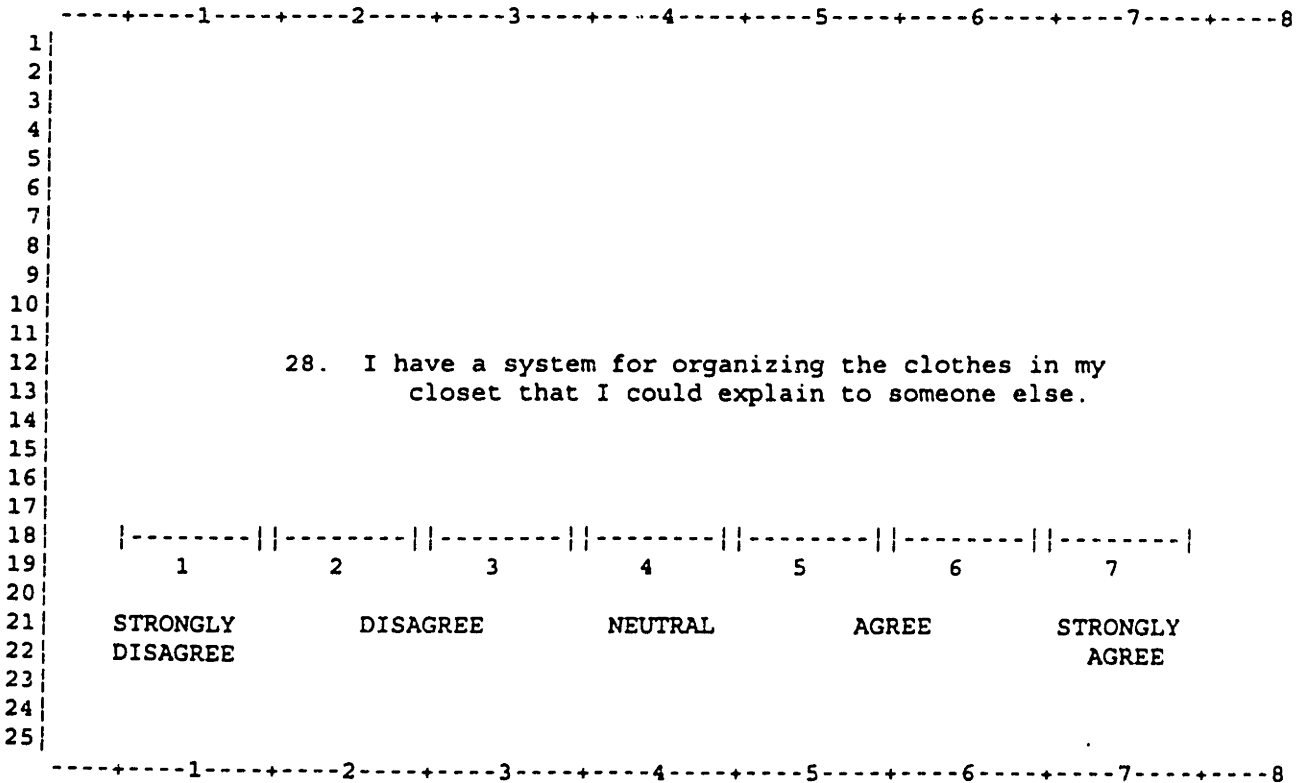
PRP-18



PRP-19



PRP-20



PRP-21

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29. Other people are better at thinking of creative ways to get things done than I am.

-----1-----2-----3-----4-----5-----6-----7-----8
1 2 3 4 5 6 7
STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY AGREE

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-00

-----1-----2-----3-----4-----5-----6-----7-----8

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The next set of questions will ask you to provide some general background information about yourself.

Press Any Key to Continue.

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DEM-01

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10 |
11 |           1.   How old are you?
12 |
13 |
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15 |
16 |           Please type your AGE and then press the ENTER key.
17 |
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-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-02

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-----1-----2-----3-----4-----5-----6-----7-----8
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9 |
10 |
11 |           2.   Please indicate your gender
12 |
13 |
14 |
15 |
16 |
17 |
18 |           1     Male
19 |           2     Female
20 |
21 |
22 |
23 |
24 |
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-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-03

-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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3. What is the highest level of education you completed?

- 1 high school graduate
- 2 technical or trade school
- 3 some college
- 4 junior college degree (A.A.)
- 5 bachelor's degree
- 6 bachelor's degree plus certificate program
- 7 some graduate school
- 8 received master's degree
- 9 some work toward doctoral degree
- 10 completed doctoral degree

Move the cursor to select the correct answer.
Press ENTER to continue.

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

DEM-04

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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4. When did you start working in your present company?

Please enter the 2-digit MONTH and 2-digit YEAR

For example, type 06/92 to represent June, 1992

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

DEM-05

-----1-----2-----3-----4-----5-----6-----7-----8

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5. When did you start working in your present position?

Please enter the 2-digit MONTH and 2-digit YEAR

For example, type 06/92 to represent June, 1992

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-06

-----1-----2-----3-----4-----5-----6-----7-----8

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6. How many total years have you worked in the field
of computers or information systems?

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DEM-07

-----1-----2-----3-----4-----5-----6-----7-----8

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7. What is your job title?

Please type your title below.
Press the ENTER key when you are finished.

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DEM-DEPT

-----1-----2-----3-----4-----5-----6-----7-----8

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8. Which of the following divisions do you work for?

- 1 Chemicals Division
- 2 Corporate Applications Services
- 3 Gases & Equipment Group (GEG)
- 4 European Division
- 5 Research & Engineering Services (RES)

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-09

-----1-----2-----3-----4-----5-----6-----7-----8

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9. Which of the following job areas best describes the work you perform?

- 1 Programmer/Analyst
- 2 Technical Services Support
- 3 Systems Operations Support
- 4 User or User Analyst
- 5 Technical Lead
- 6 Project Team Leader
- 7 Other

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-OPS

-----1-----2-----3-----4-----5-----6-----7-----8

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10. Please indicate the primary type of hardware that you support.

- 1 IBM mainframe
- 2 other mainframe
- 3 minicomputer (AS/400, DEC VAX, S/38)
- 4 UNIX workstations
- 5 client/server distributed systems
- 6 networked PCs and LANs
- 7 another platform

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-PA1

-----1-----2-----3-----4-----5-----6-----7-----8

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7 | 8. Please describe the primary platform
8 | for which you develop systems:
9 |
10 |
11 |
12 |
13 |
14 | 1 IBM mainframe
15 | 2 other mainframe
16 | 3 minicomputer (AS/400, DEC VAX, S/38)
17 | 4 UNIX workstations
18 | 5 client/server distributed systems
19 | 6 networked PCs and LANs
20 | 7 another platform
21 |
22 |
23 |
24 |
25 |

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-PA2

-----1-----2-----3-----4-----5-----6-----7-----8

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8 |
9 | 9. Please select each of the items below which corresponds to
10 | the tasks you perform in your job. Press F1 to view HELP.
11 |
12 |
13 |
14 |
15 |
16 | 1 System Analysis and Design
17 | 2 Application Programming
18 | 3 System Testing
19 | 4 Human Interface Design
20 | 5 Training Business Users
21 | 6 Supervise Other Staff
22 | 7 Other
23 | 8 Save Answers and Continue
24 |
25 |

-----1-----2-----3-----4-----5-----6-----7-----8

TI-00

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The next set of questions will ask you about your intentions to leave your present employer. Please remember that all your responses are confidential. Your responses will only be analyzed as part of a group along with other employees.

Press any key to continue

-----1-----2-----3-----4-----5-----6-----7-----8

TI-01

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-----1-----2-----3-----4-----5-----6-----7-----8

1. If I were offered another job in this area, I would take it.

1	2	3	4	5	6	7
STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

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TI-02

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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11 |
12 | 2. I am NOT in the market for another job.
13 |
14 |
15 |
16 |
17 |
18 | |-----|-----|-----|-----|-----|-----|-----|
19 | 1 2 3 4 5 6 7
20 |
21 | STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
22 | DISAGREE AGREE
23 |
24 |
25 |

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

TI-03

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

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11 |
12 | 3. I am thinking seriously of looking for another job.
13 |
14 |
15 |
16 |
17 |
18 | |-----|-----|-----|-----|-----|-----|-----|
19 | 1 2 3 4 5 6 7
20 |
21 | STRONGLY DISAGREE NEUTRAL AGREE STRONGLY
22 | DISAGREE AGREE
23 |
24 |
25 |

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

TI-04

-----1-----2-----3-----4-----5-----6-----7-----8

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12 4. I think often about quitting my job in this company.
13
14
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16
17
18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
20
21 STRONGLY DISAGREE DISAGREE NEUTRAL AGREE STRONGLY
22 DISAGREE DISAGREE AGREE AGREE
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-----1-----2-----3-----4-----5-----6-----7-----8

THANKYOU

-----1-----2-----3-----4-----5-----6-----7-----8

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7 Thank you for participating in this survey.
8
9 If you would like to provide any final comments or
10 feedback about the survey, select YES below.
11
12 Otherwise press NO to exit from the survey.
13
14 Thank you very much for your assistance!
15
16
17
18
19
20 1 YES - I have some comments
21
22 2 NO - No comments - Please exit the survey
23
24
25

-----1-----2-----3-----4-----5-----6-----7-----8

FEEDBACK

```
-----1-----2-----3-----4-----5-----6-----7-----8
1 |
2 |
3 |           You have the entire area in the box below to provide feedback.
4 |
5 |           Press ENTER twice when you are finished.
6 |
7 |
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-----1-----2-----3-----4-----5-----6-----7-----8
```

THANKFIN

```
-----1-----2-----3-----4-----5-----6-----7-----8
1 |
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6 |
7 |           Thank you again for participating in this survey.
8 |
9 |           Please seal the diskette in the attached mailer
10|
11|                and drop in any mailbox.  I will provide
12|
13|                you with a summary of the results when they
14|
15|                are available later in the summer.
16|
17|
18|
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-----1-----2-----3-----4-----5-----6-----7-----8
```

Appendix 6.2

Issues Related to Ci-3's Procedure for Counting Items

Ci-3 counts the survey items before compiling and saving the program, and it counts "items" in a highly idiosyncratic manner. This resulted in the fact, that a survey with substantially fewer than 100 questions would be counted as having excessive questions, in which case the program would fail to compile, and could not be used.

- Any instruction screens presented to respondents count as extra items if the required response is "Press Any Key to Continue," before the survey continues. In contrast, the instruction screen does not count as an item if it is programmed to display a fixed length of time (e.g., 5 seconds), before moving ahead. Since I avoided making assumptions about how quickly respondents would be able to read instruction screens, I chose the former option, and thus each instruction screen in the survey counted as an additional "item."

- Optional help screens do *not* count as survey items, since they only display when the subject presses the *F1* key.

- Any question which permits multiple responses is treated as if it consists of multiple questions. For example, if the item which asks: "Which of the following types of work tasks do you perform in your job?" is followed by eight options; this question counts as *one* item if the subject is only permitted one response, however, if the subject is allowed to choose two (or more) responses, then the question counts as *eight* items. For example, the item which asked respondents to identify the *three* most useful training or learning activities from a list of eight possible answers, counted as eight survey items. All the specifics of counting items is a detail, they became significant in this research, because the pricing structure of Sawtooth Technologies' products is based on the maximum number of "items" that can be compiled in a given survey. Exceeding the maximum item number associated with a specific license fee causes the procedure to compile the survey program to fail.

Appendix 6.3
Manager Survey Version
(64 pages)

INTRO

```
-----1-----2-----3-----4-----5-----6-----7-----8
1 |
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4 |
5 |           WELCOME IS Manager
6 |           [name of manager inserted above]
7 |
8 |           I am conducting this survey to learn about new software
9 |
10 |          development tools and approaches that are used in IS
11 |
12 |          departments, and how IS professionals learn to use them.
13 |
14 |          This survey will take approximately 20 minutes to complete.
15 |
16 |          Your answers will be saved automatically to the diskette.
17 |
18 |
19 |
20 |           Press Any Key to Continue
21 |
22 |
23 |
24 |
25 |
-----1-----2-----3-----4-----5-----6-----7-----8
```

INTRO-2

```
-----1-----2-----3-----4-----5-----6-----7-----8
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7 |
8 |           Several of the systems developers within the [name of department] have
9 |
10 |          already completed a survey similar to this one.  This survey version
11 |
12 |          is for IS team leaders, project managers, and department heads.
13 |
14 |
15 |
16 |
17 |
18 |           Press Any Key to Continue.
19 |
20 |
21 |
22 |
23 |
24 |
25 |
-----1-----2-----3-----4-----5-----6-----7-----8
```

INTRO-3

-----1-----2-----3-----4-----5-----6-----7-----8

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The information that you provide will be confidential. Your responses will not be shared with anyone from your company. The only people who will have access to your responses are me and my advisors at MIT. The answers you provide will be combined with responses from other managers and employees and used in a company-wide analysis. In exchange for your participation in the research, you will receive a copy of the results.

Press Any Key to Continue

-----1-----2-----3-----4-----5-----6-----7-----8

INTRO-3A

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You can press the F1 to view HELP information for each question. There are customized help screens available for each question type throughout the survey. Press F1 now to view the help screen.

Press Any Key to Continue

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CHECKCOL

-----1-----2-----3-----4-----5-----6-----7-----8

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If this screen appears in color, press C.
If it does not appear in color, or if you know you
are using a monochrome monitor, press any other key.

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DEM-JHFS

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1. Which of the following divisions do you work for?

Use the DOWN arrow key to move the cursor, and then press ENTER.

- 1 Corporate Sector Systems
- 2 Financial Information Systems
- 3 Investment & Pension Systems
- 4 Retail Information Systems
- 5 Other

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-GEN1

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-----1-----2-----3-----4-----5-----6-----7-----8
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9 |
10 |      2.  What types of business applications does your group
11 |           develop information systems for?
12 |           (e.g. accounting, logistics, manufacturing, etc.)
13 |
14 |
15 |           This is an open ended question.
16 |
17 |           Press the ENTER key twice when you are finished.
18 |
19 |
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-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-09

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9 |
10 |      3.  Which of the following titles best describes
11 |           the work that you perform?
12 |
13 |
14 |      Use the DOWN arrow key to move the cursor, and then press ENTER.
15 |
16 |           1   Programmer/Analyst
17 |           2   Technical Services Support
18 |           3   Systems Operations Support
19 |           4   User or User Analyst
20 |           5   Technical Lead
21 |           6   Project Team Leader
22 |           7   Other
23 |           8   Department Manager
24 |
25 |
-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-10

-----1-----2-----3-----4-----5-----6-----7-----8

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4. Which of the following job areas best describes
the work performed by THE STAFF YOU SUPERVISE?

Use the DOWN arrow key to move the cursor, and then press ENTER.

- 1 Programmer/Analyst
- 2 Technical Services Support
- 3 Systems Operations Support
- 4 User or User Analyst
- 5 Technical Lead
- 6 Project Team Leader
- 7 Other

-----1-----2-----3-----4-----5-----6-----7-----8

DEM-OPS

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5. Please indicate the primary type of hardware
that your staff supports.

Use the DOWN arrow key to move the cursor, and then press ENTER.

- 1 IBM mainframe
- 2 other mainframe
- 3 minicomputer (AS/400, DEC VAX, S/38)
- 4 UNIX workstations
- 5 client/server distributed systems
- 6 networked PCs and LANs
- 7 another platform

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DEM-PA1

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5. Please describe the primary platform on which
your staff develop application software:

Use the DOWN arrow key to move the cursor, and then press ENTER.

- 1 IBM mainframe
- 2 other mainframe
- 3 minicomputer (AS/400, DEC VAX, S/38)
- 4 UNIX workstations
- 5 client/server distributed systems
- 6 networked PCs and LANs
- 7 another platform

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DEM-PA2

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6. Please select each of the items below which corresponds to
the tasks that your staff perform in their jobs.
Press F1 to view HELP.

Use the UP and DOWN arrow key to move the cursor, or type the number
corresponding to the appropriate answers. Select as many responses as
necessary. Then select the last response when finished.

- 1 System Analysis and Design
- 2 Application Programming
- 3 System Testing
- 4 Human Interface Design
- 5 Training Business Users
- 6 Supervise Other Staff
- 7 Other
- 8 CONTINUE WITH NEXT QUESTION

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SKILL-00

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This next set of questions will focus on the knowledge and skills that your staff use to perform their jobs. First, you are asked to rate the importance of 21 different skills, in terms of how important they are for your staff in performing their jobs. To answer the questions, move the cursor to the correct position on the 7-point scale, either by using the MOUSE, or by using the LEFT and RIGHT arrow keys and then pressing enter.

Press Any Key to Continue.

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SK-TEST

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This is just a sample question. For example:
How important is the following skill or ability
for your IS staff in performing their jobs?

0. Writing Programs in COBOL

If Writing COBOL programs is NOT a task your team members perform, then move the cursor to the 1 or 2 position.

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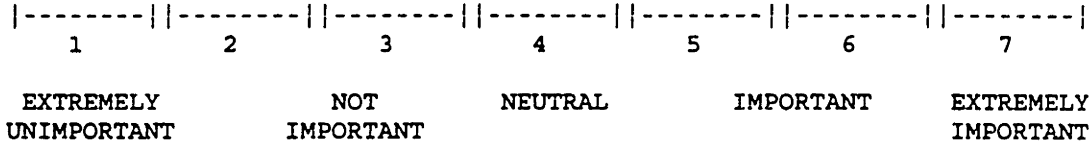
SK-BK1

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How important is the following skill or ability
for your IS staff in performing their jobs?

1. Knowledge of the business



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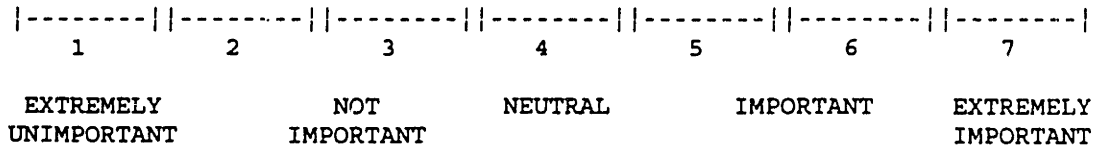
SK-AS10

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How important is the following skill or ability
for your IS staff in performing their jobs?

2. Ability to trouble-shoot technical problem



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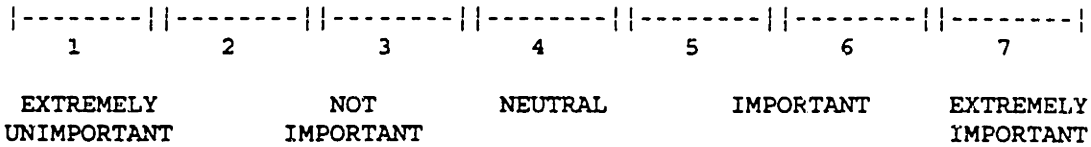
SK-CS13

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How important is the following skill or ability
for your IS staff in performing their jobs?

3. Verbal communication skills



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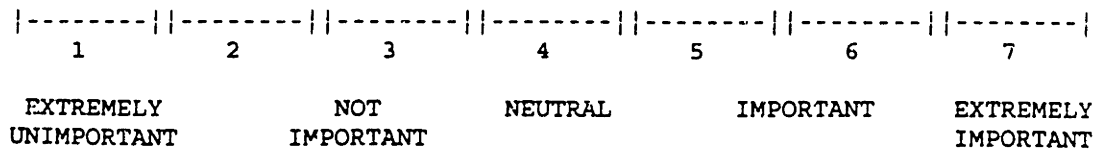
SK-AS11

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How important is the following skill or ability
for your IS staff in performing their jobs?

4. Designing user interfaces



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SK-AS5

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How important is the following skill or ability
for your IS staff in performing their jobs?

5. Integrating new systems with old system

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SK-CS15

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How important is the following skill or ability
for your IS staff in performing their jobs?

6. Providing feedback to managemen

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SK-AS4

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How important is the following skill or ability
for your IS staff in performing their jobs?

7. Developing data and process models
to represent business information

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EXTREMELY UNIMPORTANT	NOT IMPORTANT	NEUTRAL	IMPORTANT	EXTREMELY IMPORTANT		

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SK-BK2

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How important is the following skill or ability
for your IS staff in performing their jobs?

8. Understanding the users' business objective

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SK-AS9

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How important is the following skill or ability
for your IS staff in performing their jobs?

9. Willingness to learn new technologie

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EXTREMELY UNIMPORTANT NOT IMPORTANT NEUTRAL IMPORTANT EXTREMELY IMPORTANT

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SK-BK3

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How important is the following skill or ability
for your IS staff in performing their jobs?

10. Developing strategic IS plans for the business

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EXTREMELY UNIMPORTANT NOT IMPORTANT NEUTRAL IMPORTANT EXTREMELY IMPORTANT

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SK-AS12

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How important is the following skill or ability
for your IS staff in performing their jobs?

11. Understanding the big picture of
how systems are integrated

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SK-AS7

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How important is the following skill or ability
for your IS staff in performing their jobs?

12. Creativity in solving problem

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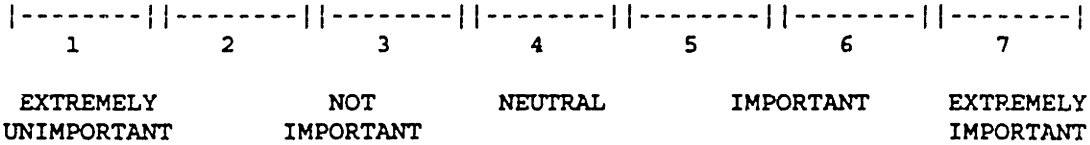
SK-AS6

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How important is the following skill or ability
for your IS staff in performing their jobs?

13. Writing and de-bugging computer code



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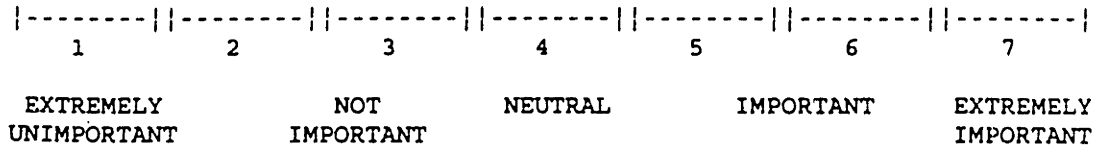
SK-GA19

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How important is the following skill or ability
for your IS staff in performing their jobs?

14. Ability to work with minimal supervision



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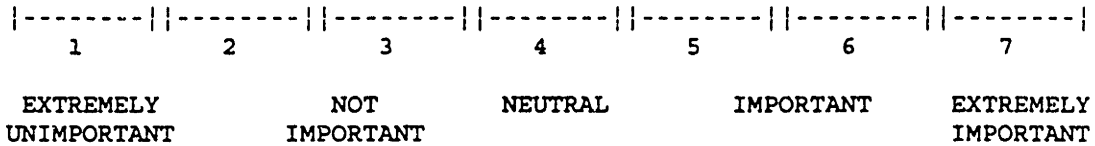
SK-CS16

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How important is the following skill or ability
for your IS staff in performing their jobs?

15. Written communication skills



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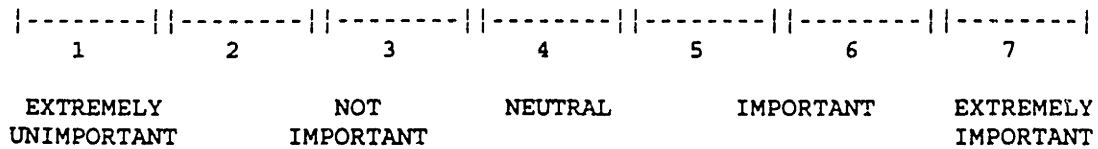
SK-GA18

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How important is the following skill or ability
for your IS staff in performing their jobs?

16. Ability to organize work



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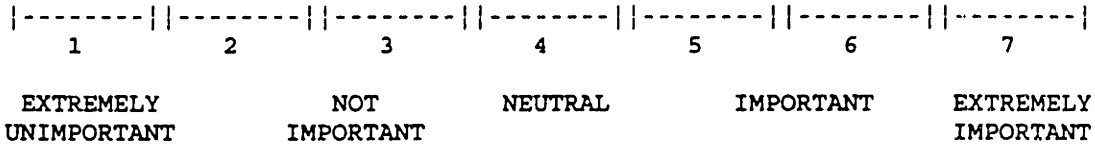
SK-GA21

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How important is the following skill or ability
for your IS staff in performing their jobs?

17. Adapting prior knowledge to new technologies



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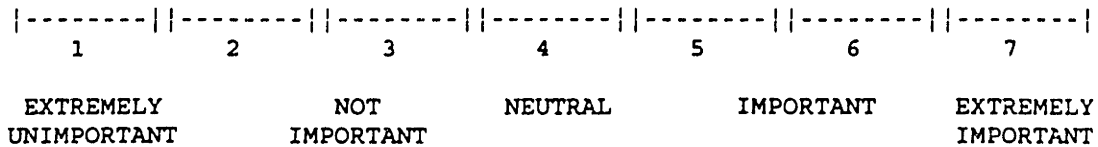
SK-GA8

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How important is the following skill or ability
for your IS staff in performing their jobs?

18. General technical knowledge about computer



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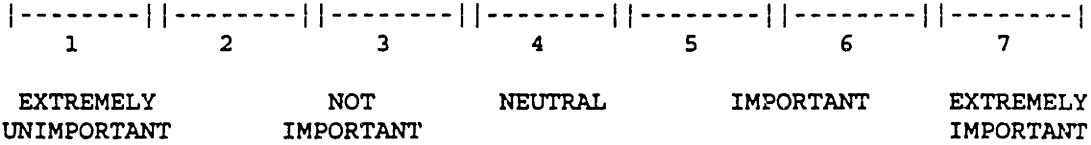
SK-GA20

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How important is the following skill or ability
for your IS staff in performing their jobs?

19. Ability to train other worker



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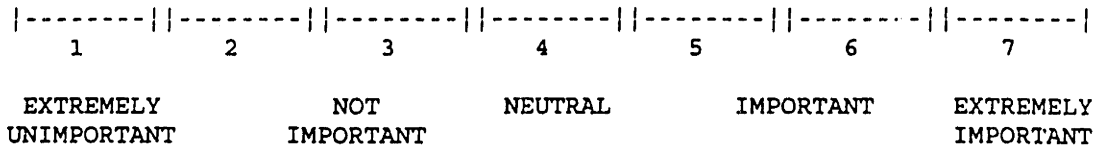
SK-CS14

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How important is the following skill or ability
for your IS staff in performing their jobs?

20. Ability to lead and motivate others



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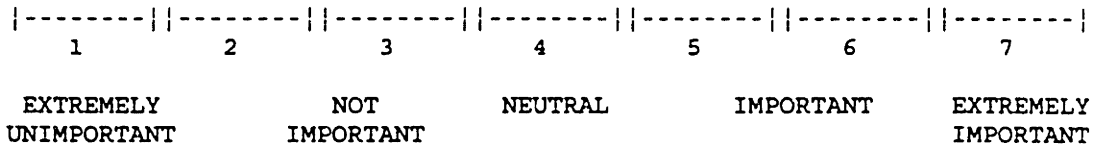
SK-GA17

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How important is the following skill or ability
for your IS staff in performing their jobs?

21. Ability to get along with people



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EVAL-00

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This next set of questions will ask you to rate the job
performance of some of your IS team members along
these skill and knowledge dimensions. First you will
be asked to rate one team member on all skill dimensions,
then the next team member, etc.

Press Any Key to Continue.

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NAME-EVL

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This set of questions will ask you to rate the job
performance of
along these skill and knowledge dimensions.

Press the F1 for Help if you have any questions.

Press Any Key to Continue.

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BK1-EVL

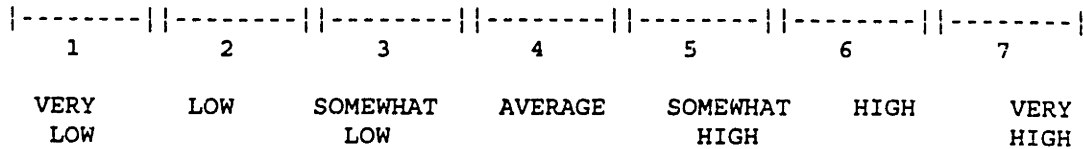
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How would you rate the performance of your team member

on the following skill or ability dimension?

1. Knowledge of the business



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AS10-EVL

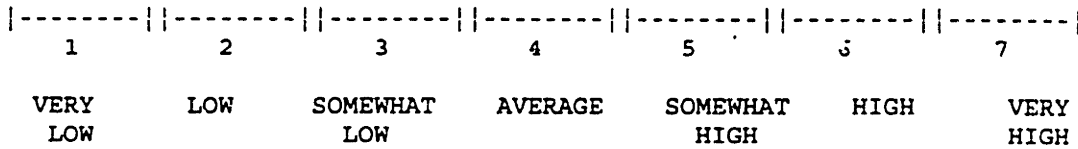
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How would you rate the performance of your team member

on the following skill or ability dimension?

2. Ability to trouble-shoot technical problem

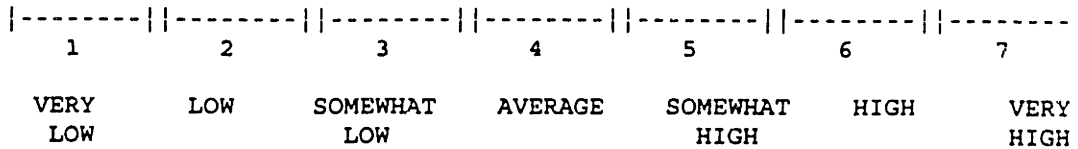


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CS13-EVL

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AS11-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?

4. Designing user interfaces

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AS5-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?

5. Integrating new systems with old system

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CS15-EVL

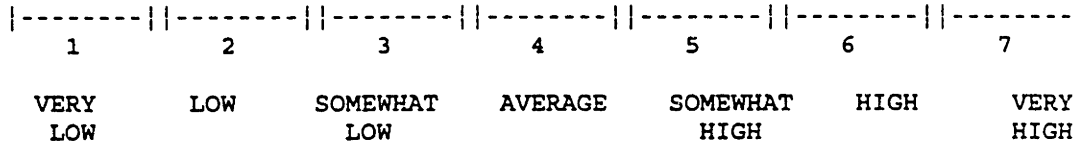
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How would you rate the performance of your team member

on the following skill or ability dimension?

6. Providing feedback to managemen



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AS4-EVL

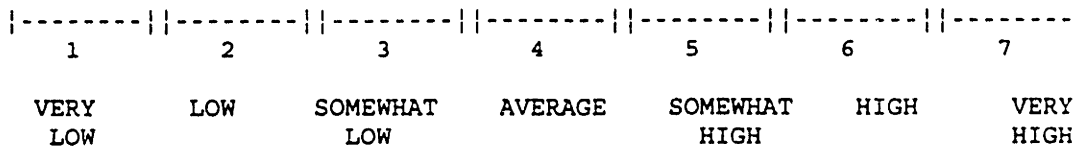
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How would you rate the performance of your team member

on the following skill or ability dimension?

7. Developing data and process models to represent business information



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BK2-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?

8. Understanding the users' business objective

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VERY LOW	LOW	SOMEWHAT LOW	AVERAGE	SOMEWHAT HIGH	HIGH	VERY HIGH

-----1-----2-----3-----4-----5-----6-----7-----8

AS9-EVL

-----1-----2-----3-----4-----5-----6-----7-----8

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How would you rate the performance of your team member

on the following skill or ability dimension?

9. Willingness to learn new technologie

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VERY LOW	LOW	SOMEWHAT LOW	AVERAGE	SOMEWHAT HIGH	HIGH	VERY HIGH

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BK3-EVL

-----1-----2-----3-----4-----5-----6-----7-----8

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3 How would you rate the performance of your team member
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10 on the following skill or ability dimension?
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14 10. Developing strategic IS plans for the business
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18 |-----| |-----| |-----| |-----| |-----| |-----| |-----|
19 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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22 LOW LOW LOW HIGH HIGH HIGH
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AS12-EVL

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3 How would you rate the performance of your team member
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10 on the following skill or ability dimension?
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13 11. Understanding the big picture of
14 how systems are integrated
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AS7-EVL

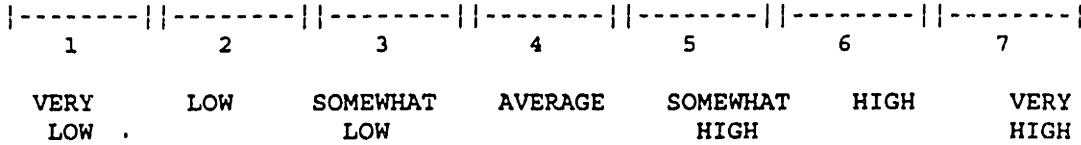
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How would you rate the performance of your team member

on the following skill or ability dimension?

12. Creativity in solving problem



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AS6-EVL

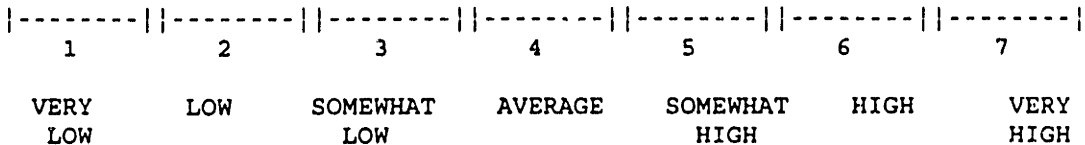
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How would you rate the performance of your team member

on the following skill or ability dimension?

13. Writing and de-bugging computer code



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GA19-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?

14. Ability to work with minimal supervision

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VERY LOW	LOW	SOMEWHAT LOW	AVERAGE	SOMEWHAT HIGH	HIGH	VERY HIGH

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CS16-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?

15. Written communication skills

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GA18-EVL

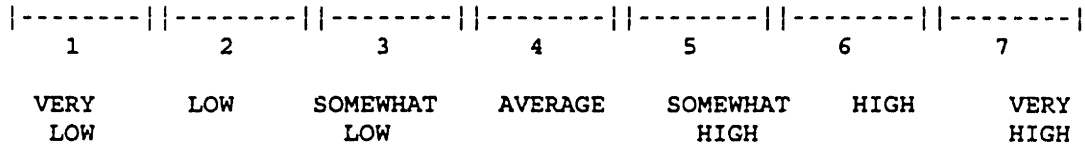
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How would you rate the performance of your team member

on the following skill or ability dimension?

16. Ability to organize work



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GA21-EVL

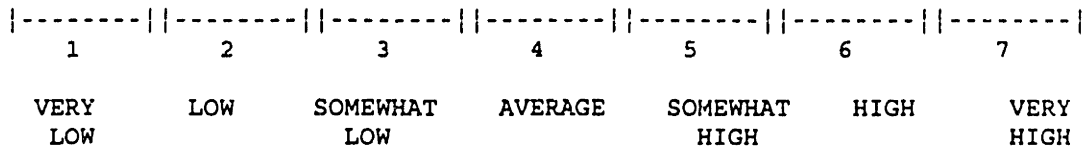
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How would you rate the performance of your team member

on the following skill or ability dimension?

17. Adapting prior knowledge to new technologies



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GAB-EVL

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3 | How would you rate the performance of your team member
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9 |
10 | on the following skill or ability dimension?
11 |
12 |
13 |
14 | 18. General technical knowledge about computer
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22 | LOW LOW HIGH HIGH
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GA20-EVL

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10 | on the following skill or ability dimension?
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14 | 19. Ability to train other worker
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CS14-EVL

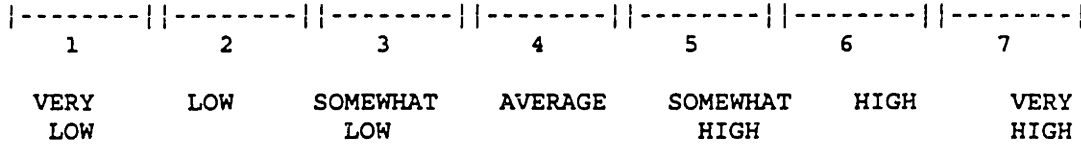
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How would you rate the performance of your team member

on the following skill or ability dimension?

20. Ability to lead and motivate others



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GA17-EVL

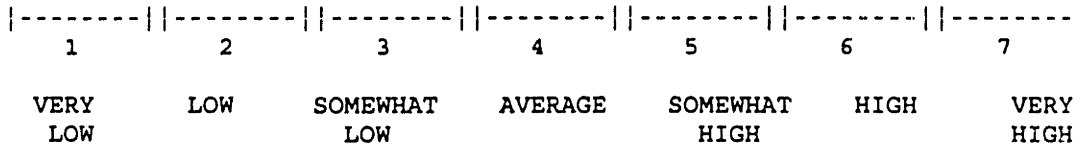
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How would you rate the performance of your team member

on the following skill or ability dimension?

21. Ability to get along with people



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AT1-EVL

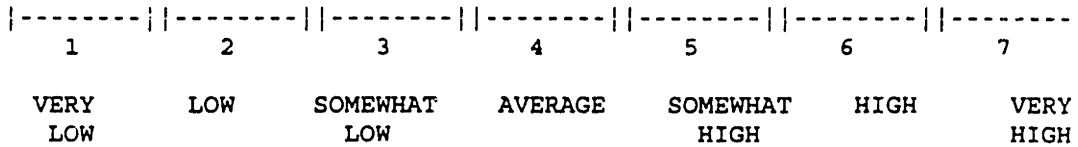
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How would you rate the performance of your team member

on the following skill or ability dimension?

22. Effort put forth on the job



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AT2-EVL

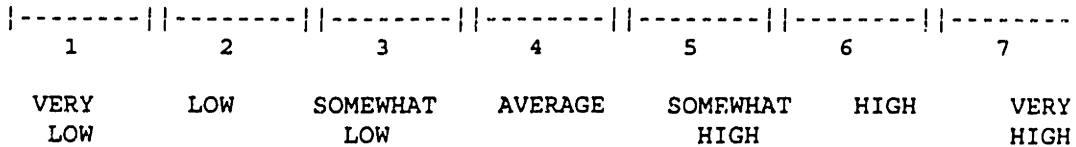
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How would you rate the performance of your team member

on the following skill or ability dimension?

23. Level of dedication to the job



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AT3-EVL

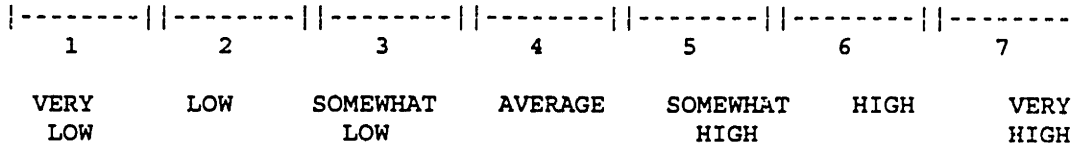
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How would you rate the performance of your team member

on the following skill or ability dimension?

24. Attitude toward the job



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OV1-EVL

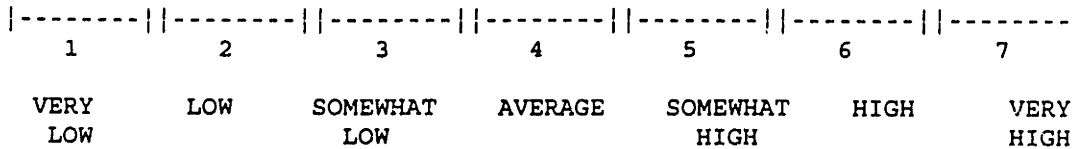
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How would you rate the performance of your team member

on the following skill or ability dimension?

25. Quality of work produced



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OV2-EVL

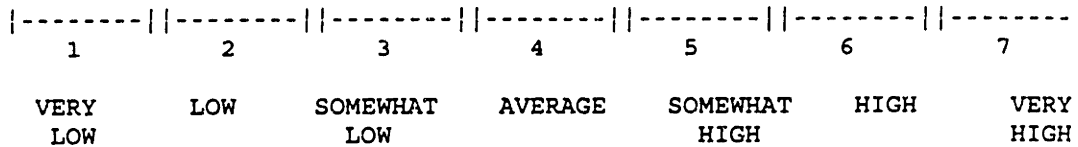
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How would you rate the performance of your team member

on the following skill or ability dimension?

26. Quantity or volume of work produced



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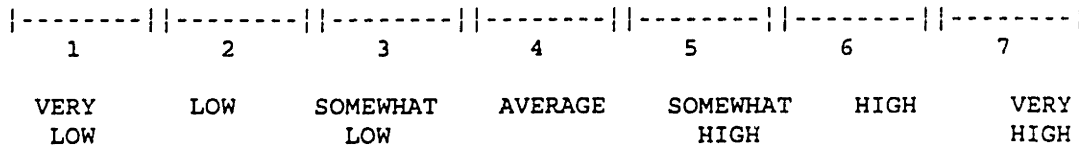
OV3-EVL

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How would you rate the performance of your team member

on the following skill or ability dimension?



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THANKYOU

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Thank you for participating in this survey.

This is the end of Part 1 of the survey.

You can insert the Part 2 diskette and type START.

Press any key to end this part.

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INTRO

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This is Part 2 of the survey for managers and team leaders.

Part 2 will cover the new software development techniques
that were introduced into your workgroup, how your staff
learned these techniques, and your perceptions of the changes.

Press Any Key to Continue

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CHECKCOL

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If this screen appears in color, press C.
If it does not appear in color, or if you know you
are using a monochrome monitor, press any other key.

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SPI-00

-----1-----2-----3-----4-----5-----6-----7-----8

1 |
2 |
3 | Changes in System Development Activities
4 |
5 | The following section will ask you questions about how the system
6 | development activities within your department have changed during
7 | the recent past. Please consider changes that have occurred over
8 | approximately the past 18 months, since early 1994.
9 | The following questions will ask you whether there have been any
10 | changes in the system development tools and approaches you use.
11 | Please answer these questions with regard to your project team or
12 | workgroup. If the feature described in the question has not changed,
13 | simply select the NO response.
14 |
15 | Press Any Key to Continue
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SPI-01

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2 |
3 | During the period from early 1994 until now,
4 | have the members of your workgroup begun using ...
5 |
6 |
7 | 1. a new programming language?
8 |
9 |
10 |
11 | 1 YES
12 | 2 NO
13 |
14 | If you answer YES, name the new programming language below.
15 |
16 |
17 |
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spi-01a

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9
10      What was the previous programming language
11      that you were using before this?
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14
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18      Press the ENTER key twice when you are finished.
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SPI-02

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7      During the period from early 1994 until now,
8      have the members of your workgroup begun using ...
9
10
11
12      2.      a new application development tool?
13
14
15
16      (for example, a CASE tool or GUI development tool such as PowerBuilder)
17      1      YES
18      2      NO
19
20      If you answer YES, please name the new tool or tools below.
21
22
23
24
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spi-02a

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9 |
10 |      What was the previous application development tool
11 |          that you were using before this?
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18 |      Press the ENTER key twice when you are finished.
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SPI-03

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7 |      During the period from early 1994 until now,
8 |      have the members of your workgroup begun using ...
9 |
10 |
11 |
12 |
13 |      3.      a new hardware platform for development?
14 |
15 |
16 |
17 |          1      YES
18 |          2      NO
19 |
20 |      If you answer YES, please name the new hardware platform below.
21 |
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spi-03a

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10 |
11 |           What was the previous hardware platform
12 |             that you were using before this?
13 |
14 |
15 |
16 |
17 |
18 |           Press the ENTER key twice when you are finished.
19 |
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SPI-04

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7 |           During the period from early 1994 until now,
8 |             have the members of your workgroup begun using ...
9 |
10 |
11 |
12 |
13 |           4. a new approach for defining system requirements?
14 |
15 |
16 |
17 |                 1     YES
18 |                 2     NO
19 |
20 |           If YES, please name the new requirements definition approach below.
21 |
22 |
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spi-04a

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What was the previous approach for capturing system requirements that you were using before this?

Press ENTER twice when you are finished.

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SPI-05

-----1-----2-----3-----4-----5-----6-----7-----8

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During the period from early 1994 until now, have the members of your workgroup begun using ...

5. a new methodology for system design?

- 1 YES
- 2 NO

If you answer YES, please name the new design methodology below.

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spi-05a

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What was the previous system design methodology
that you were using before this?

Press the ENTER key twice when you are finished.

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SPI-06

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During the period from early 1994 until now,
have the members of your workgroup begun using ...

6. new approaches for involving business users?

- 1 YES
- 2 NO

If you answer YES, please name the new approach for users below.

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spi-06a

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What was the previous approach for involving users
that you were using before this?

Press ENTER twice when you are finished.

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SPI-07

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During the period from early 1994 until now, have there been ...

7. any other changes in system development work?

- 1 YES
- 2 NO

If you answer YES, please type your answer below, then press ENTER twice.

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SPI-08

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11 |      8.  Please identify below the one change that has made
12 |          the greatest difference to your group's work process.
13 |          First press the ENTER key, then list the biggest change.
14 |
15 |
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19 |          PRESS ENTER KEY
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SPI-09

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11 |      9.  You said that your team uses
12 |          for system development work.  Please answer the following
13 |          questions with regard to this specific innovation.
14 |
15 |          Press Any Key to Continue
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SPI-DATE

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10. When did your team begin using

Please enter the 2-digit MONTH and 2-digit YEAR

For example, type 06/92 to represent June, 1992

-----1-----2-----3-----4-----5-----6-----7-----8

SPI-PROJ

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11. On how many system development projects has
your team used

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SPI-PROD

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12. How many of those systems are now in production?

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ATT-00

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The next set of questions will ask you for your
perceptions of the new software development tools,
methodologies, and other changes that you listed above.

Press Any Key to Continue

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ATT-01

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You said that your team now uses
for system development work. Please answer the following
questions with regard to this specific innovation.

Press Any Key to Continue

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AT-EOU-1

-----1-----2-----3-----4-----5-----6-----7-----8

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In my opinion,

1. is easy to learn

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----2-----3-----4-----5-----6-----7-----8

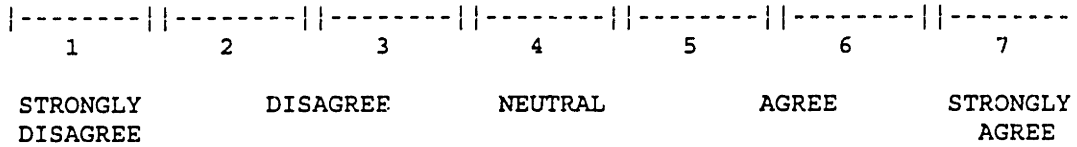
AT-RA-1

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In my opinion, using

2. makes it easier to develop systems



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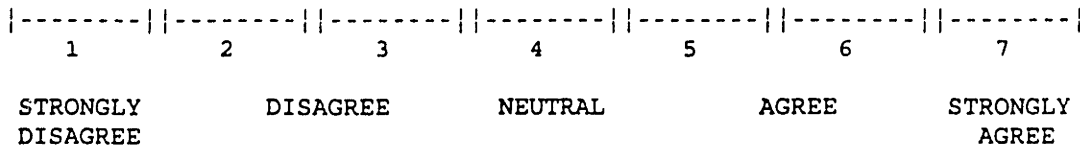
AT-EOU-2

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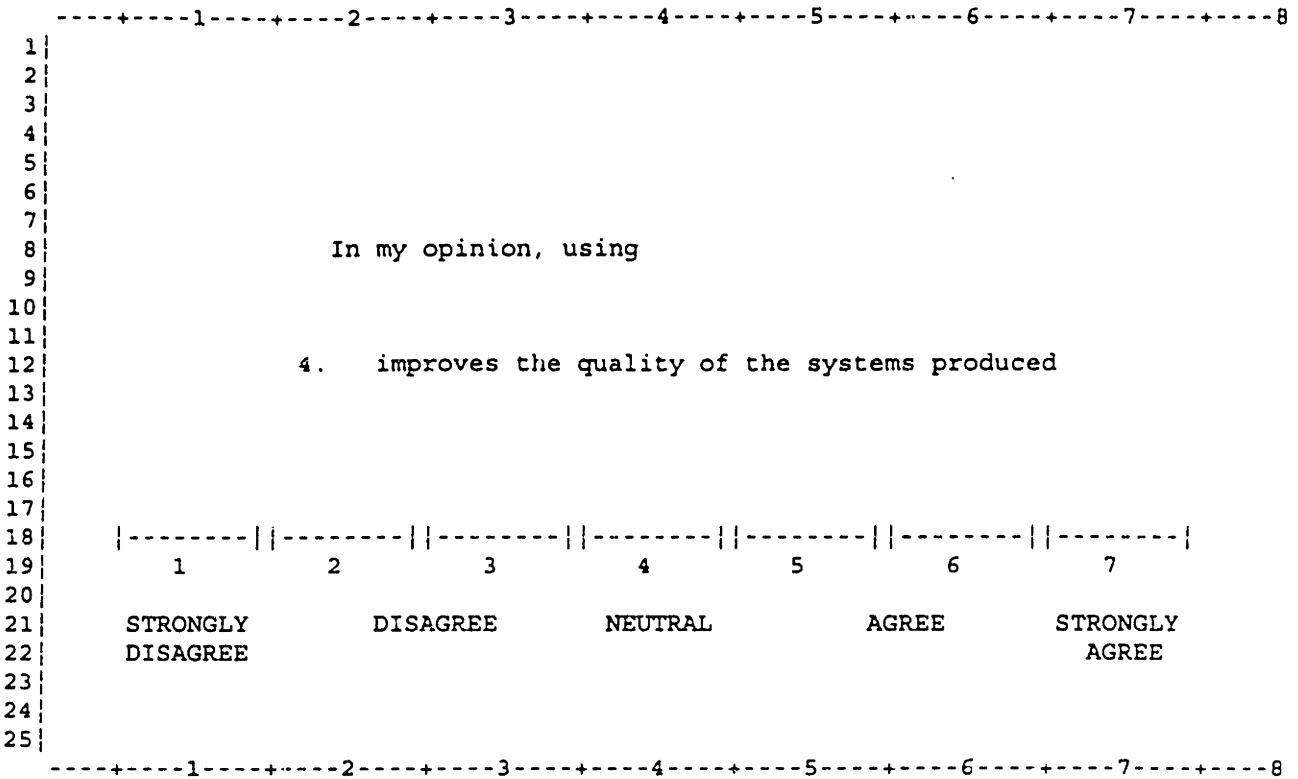
In my opinion, using

3. requires a lot of mental effort

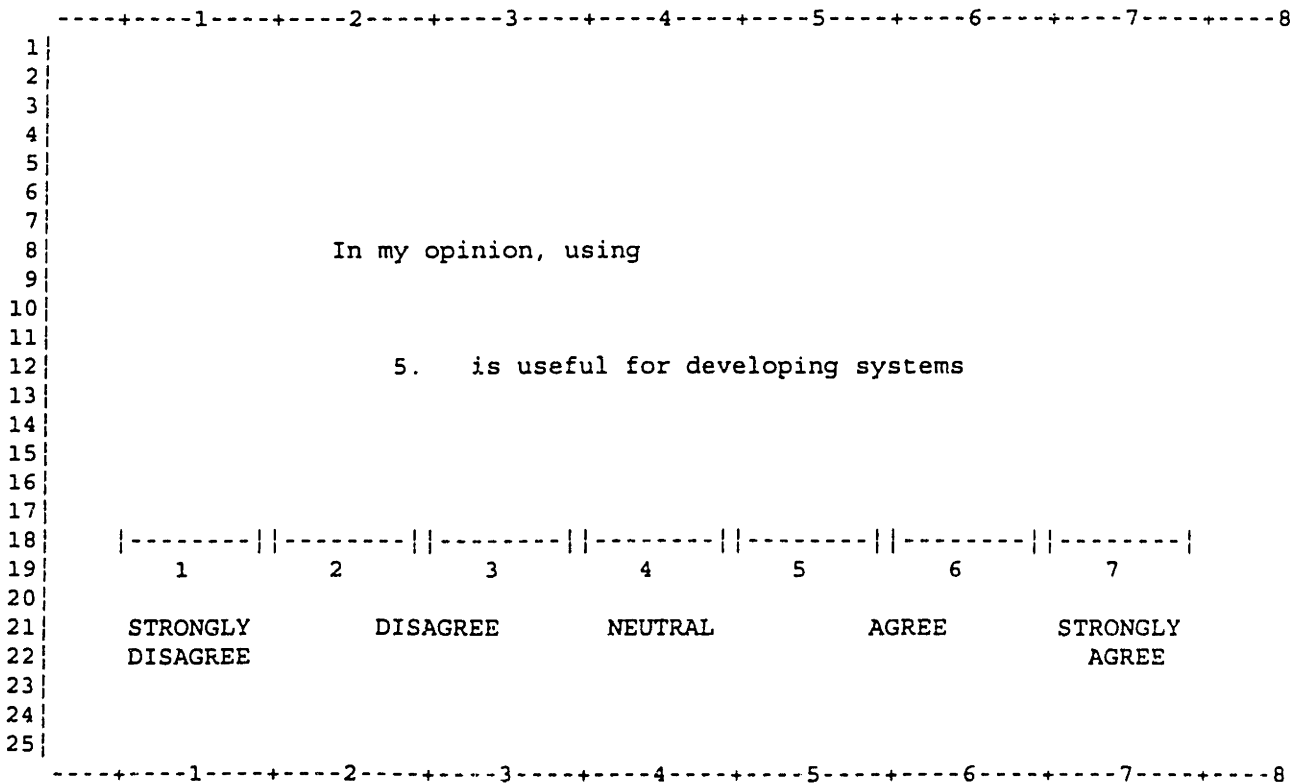


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AT-RA-2



AT-RA-3



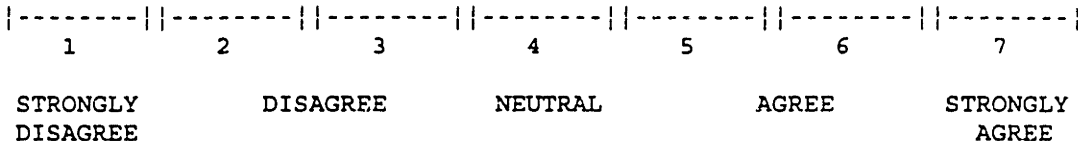
AT-GEN-1

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In my opinion,

6. overall I like using



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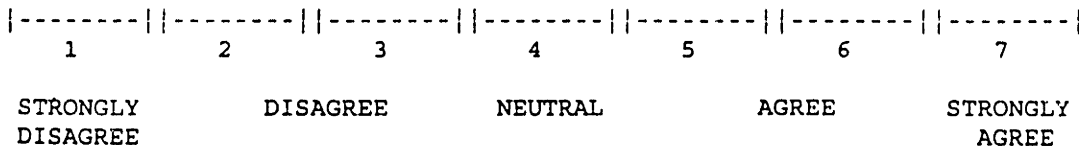
AT-CPT-1

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In my opinion, using

7. is compatible with all aspects of our work



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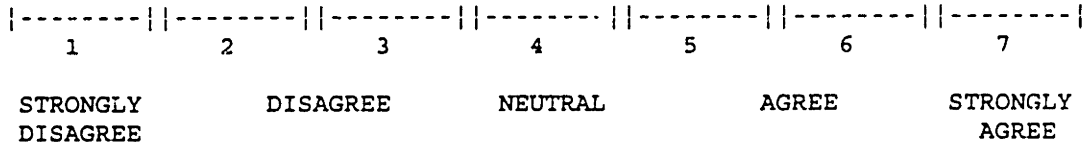
AT-EF-2

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In my opinion, using

8. enhances the effectiveness of my IS staff on the job



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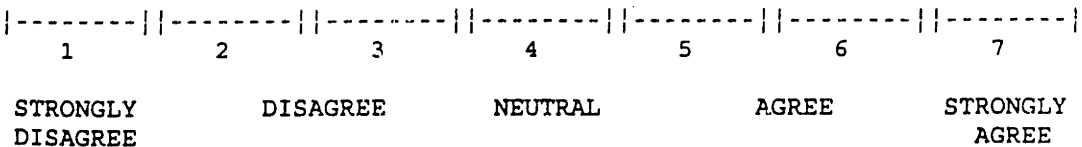
AT-EOU-3

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In my opinion,

9. it is easy to become skillful at using



-----1-----2-----3-----4-----5-----6-----7-----8

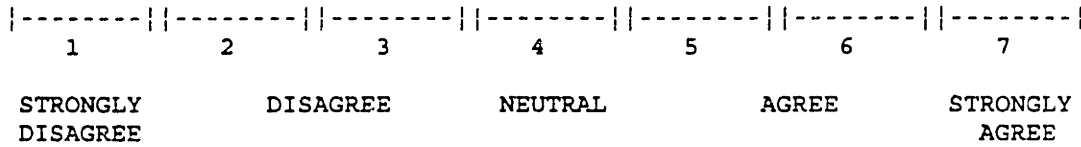
AT-RA-4

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In my opinion, using

10. increases the productivity of my IS staff



-----1-----2-----3-----4-----5-----6-----7-----8

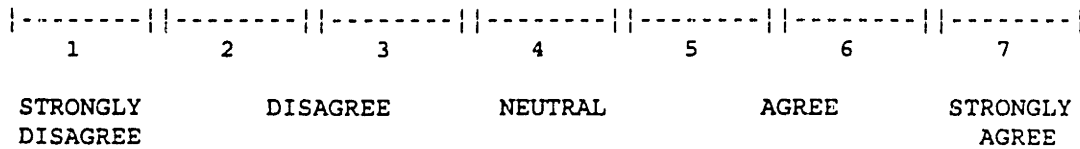
AT-EF-1

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In my opinion, using

11. improves the job performance of my IS staff



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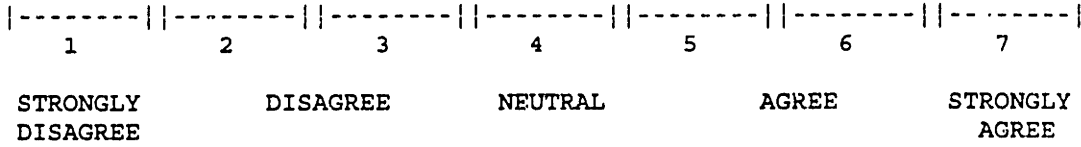
AT-EOU-4

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In my opinion,

12. is easy to use



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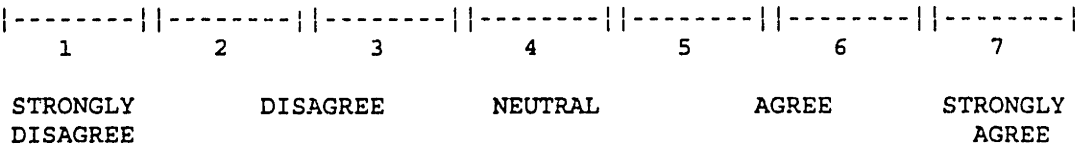
AT-EOU-5

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In my opinion,

13. is often frustrating to use



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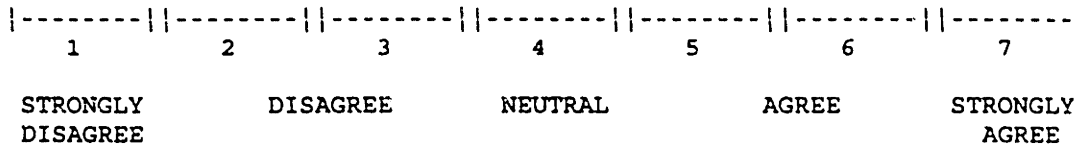
AT-CPT-2

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In my opinion, using

14. fits with the way we like to work here



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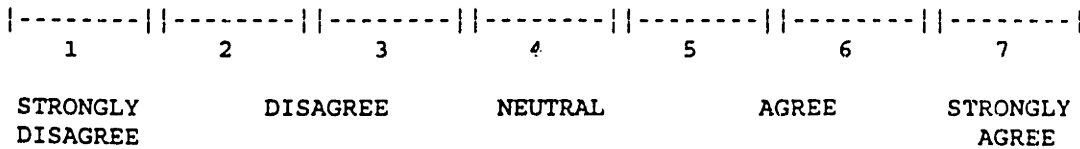
AT-RA-5

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In my opinion, using

15. allows my IS staff to perform tasks more quickly



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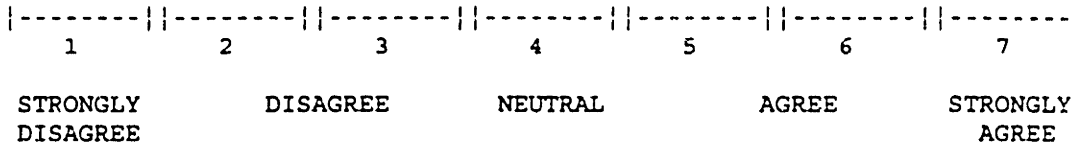
AT-EOU-6

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In my opinion, when using

16. it is easy to get it to do what you want to do



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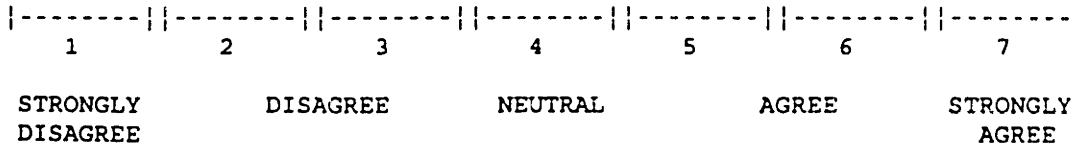
AT-CPT-3

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In my opinion, using

17. is a significant change from the way we traditionally developed systems here



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AT-NEW-1

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In my opinion, using

18. constrains our creativity in developing systems

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STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE		

-----1-----2-----3-----4-----5-----6-----7-----8

LEARN-00

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Learning Processes and Activities

The following set of questions will ask for information about the training and other activities that your IS staff used to learn the new system development approaches that you described above.

Press Any Key to Continue

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LEARN-01

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1 |
2 |
3 |   Please reflect on how your staff actually learned the new tools
4 |   and methods listed above.  Then rank order the top THREE items
5 |   from the following list, based on how useful they have been in
6 |   helping your staff to acquire new skills.  First, identify the
7 |   MOST useful activity, then the SECOND most useful, then the THIRD.
8 |
9 |   You can select the answers either:
10 |      - by typing the numbers corresponding to the answers, or
11 |      - by using the UP and DOWN arrow keys to move the cursor,
12 |        and pressing ENTER.
13 |
14 |   Select #9 when you are finished (SAVE ANSWERS and CONTINUE).
15 |      1.  classroom-based training led by an instructor
16 |      2.  college extension classes
17 |      3.  reading computer manuals
18 |      4.  reading computer trade magazines
19 |      5.  reading books (other than computer manuals)
20 |      6.  working informally with a mentor one-on-one
21 |      7.  discussions during project meetings
22 |      8.  trial-and-error learning from hands-on practice
23 |      9.  SAVE ANSWERS AND CONTINUE TO NEXT QUESTION
24 |
25 |
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LEARN-02

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8 |
9 |   Are there any OTHER learning activities that you and your
10 |   staff engaged in to learn and reinforce these new skills?
11 |   Please provide any comments you have about the learning process.
12 |
13 |       This is an open ended question.
14 |       Your answer can be as long as the white box below.
15 |
16 |
17 |       Press the ENTER key twice when you are finished.
18 |
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LEARN-03

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8 |           3.   Did your IS staff take any training classes to learn
9 |               the new tools and approaches you listed above?
10|
11|
12|
13|
14|           Move the cursor by using DOWN arrow key and then pressing Enter,
15|           OR by typing the numbers corresponding to the answers below.
16|
17|               1.  No, they did not take any classes
18|               2.  Yes, they took daytime training or classes
19|               3.  Yes, they took part-time evening classes
20|               4.  Save answer and go to next question
21|
22|
23|
24|
25|-----1-----2-----3-----4-----5-----6-----7-----8
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LEARN-3A

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8 |
9 |           How many total hours of actual classroom time
10|              did their day-time training include?
11|
12|           Please take a moment to calculate how many hours
13|              of classroom training your IS staff attended.
14|
15|
16|           Press F1 for additional information.
17|
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25|-----1-----2-----3-----4-----5-----6-----7-----8
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LEARN-3b

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9 |
10 |          How many total hours of actual classroom time
11 |             did these evening classes include?
12 |
13 |          Please take a moment to calculate how many hours
14 |             of evening classes your IS staff attended.
15 |
16 |          Press F1 for additional information.
17 |
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-----1-----2-----3-----4-----5-----6-----7-----8
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LEARN-04

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11 |
12 |          Did you appoint someone as a "mentor" to your developers
13 |             to oversee and guide and guide their learning processes?
14 |
15 |
16 |
17 |             1      YES
18 |             2      NO
19 |
20 |
21 |
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25 |
-----1-----2-----3-----4-----5-----6-----7-----8
```

LEARN-05

-----1-----2-----3-----4-----5-----6-----7-----8

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Please provide some additional detail about using mentors.

For example, please describe how many mentors you had,
whether they were employees or external consultants,
and how you selected and evaluated the mentors, or
any other details you wish to add.

Press Enter Twice to Save your answer.

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DEM-00

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This final set of questions will ask you to provide some
general background information about yourself.

Press Any Key to Continue.

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DEM-01

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11 |           1.   How old are you?
12 |
13 |
14 |
15 |
16 |           Please type your AGE and then press the ENTER key.
17 |
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DEM-02

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9 |
10 |
11 |           2.   Please indicate your gender
12 |
13 |
14 |
15 |
16 |
17 |
18 |           1     Male
19 |           2     Female
20 |
21 |
22 |
23 |
24 |
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-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-03

```
-----1-----2-----3-----4-----5-----6-----7-----8
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6 |           3.  What is the highest level of education you completed?
7 |
8 |
9 |
10|
11|           1   high school graduate
12|           2   technical or trade school
13|           3   some college
14|           4   junior college degree (A.A.)
15|           5   bachelor's degree
16|           6   bachelor's degree plus certificate program
17|           7   some graduate school
18|           8   received master's degree
19|           9   some work toward doctoral degree
20|          10   completed doctoral degree
21|
22|           Use the DOWN arrow key to move the cursor.
23|              Then press ENTER to continue.
24|
25|-----1-----2-----3-----4-----5-----6-----7-----8
```

DEM-04

```
-----1-----2-----3-----4-----5-----6-----7-----8
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8 |
9 |           4.  When did you start working at [Company Name]?
10|
11|           Please enter the 2-digit MONTH and 2-digit YEAR
12|
13|
14|
15|
16|           For example, type 06/92 to represent June, 1992
17|
18|
19|
20|
21|
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25|-----1-----2-----3-----4-----5-----6-----7-----8
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DEM-05

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5. When did you start working in your present position?

Please enter the 2-digit MONTH and 2-digit YEAR

For example, type 06/92 to represent June, 1992

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DEM-06

-----1-----2-----3-----4-----5-----6-----7-----8

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6. How many total years have you worked in the
field of computers or information systems?

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DEM-07

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11 |           7.  What is your job title?
12 |
13 |
14 |
15 |
16 |           Please type your title below.
17 |
18 |           Press the ENTER key when you are finished.
19 |
20 |
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THANKYOU

```
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6 |
7 |           Thank you for participating in this survey.
8 |
9 |           If you would like to provide any final comments or
10 |              feedback about the survey, select YES below.
11 |
12 |           Otherwise press NO to exit from the survey.
13 |
14 |
15 |           Thank you very much for your assistance!
16 |
17 |
18 |
19 |
20 |           1      YES - I have some comments
21 |
22 |           2      NO  - No comments - Please exit the survey
23 |
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FEEDBACK

```
-----1-----2-----3-----4-----5-----6-----7-----8
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3       You have the entire area in the box below to provide feedback.
4
5       Press ENTER twice when you are finished.
6
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THANKFIN

```
-----1-----2-----3-----4-----5-----6-----7-----8
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6
7       Thank you again for participating in this survey.
8
9       Please seal the diskette in the attached mailer
10
11          and drop in any mailbox.  I will provide
12
13          you with a summary of the results when they
14
15          are available later in the summer.
16
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-----1-----2-----3-----4-----5-----6-----7-----8
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CI3INFO

-----1-----2-----3-----4-----5-----6-----7-----8

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In case you are curious, the questionnaire was created
with the software program called "Ci3" from Sawtooth Software
of Evanston, IL. (708) 866-0870. This is a specialized
software program for producing survey questionnaires.

Press Any Key to Exit the Survey.

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Appendix 7.1 Activities for Learning Client/Server Development

Respondents were asked to select the three *most useful* types of learning activities, from the list below.²³ Three different criteria for evaluating the priority order of the learning activities are shown below, however, these different criteria produced similar rank order results. Classroom training was identified as the most useful learning activity. Based on the second scoring method, where *all* of the respondents' choices are included, however, led to a tie between classroom training and hands-on, trial-and-error learning (76.5% of respondents ranked each of these activities among their top three choices). Finally, using a weighting scheme which assigns a specific number of points to each ordered choice (using the weights 5, 3, and 1 points to their first three choices, respectively), led to a measure of the average number of points assigned to each option per respondent. Here again, classroom training and hands-on, trial-and-error learning each were each ranked highly and very closely by respondents (3.2 - 3.3 points awarded, on average, per respondent).

Rank Order Results	Learning Activities	% First Choice	% Top Three	Average Points per Respondent
1.	Classroom-based training led by an instructor	39.5	76.5	3.30
2.	Trial-and-error learning from hands-on practice	31.1	76.5	3.22
3.	Working informally with a mentor one-on-one	15.1	53.8	2.18
4.	Reading computer manuals	6.0	44.5	1.70
5.	Discussions during project team meetings	4.2	27.0	1.02
6.	Reading books (other than computer manuals or trade magazines)	2.5	15.1	0.58
7.	Evening classes (e.g., college extension courses)	1.7	5.0	0.21
8.	Reading computer trade magazines	0.0	1.7	0.08

Differences between employees' preferences for learning activities in the two firms are not presented, however when statistically analyzed (using Chi-squared analysis), there were no differences between Chemco and Insureco respondents' choices for the learning activities identified as most useful.

²³ These results do not show the initial order of the choices that were presented in the question. Since respondents had the option to select three responses, it is possible that there was some order bias — whereby respondents tended to first select the options near the top of the list. (Classroom training was at the top of the list.)

For all other training methods, there was no differences between firms in terms of the preferences expressed for various learning methods.²⁴

QUESTIONS ABOUT HOURS OF TRAINING

(respondents answered these questions if they attended *any* training)

NUMBER OF DAYTIME TRAINING CLASS HOURS

	Number of Cases	Mean	Standard Dev.	Difference between Group Means	
				T-Test	p value
ChemCo	43	48.14	32.26		
InsureCo	38	41.80	29.88		
Total	81	45.26	31.13	+0.920	0.363

NUMBER OF EVENING TRAINING CLASS HOURS

	Number of Cases	Mean	Standard Dev.	Difference between Group Means	
				T-Test	p value
ChemCo	3	41.33	36.295		
InsureCo	5	28.00	20.748		
Total	8	33.00	25.88	+0.68	0.60

²⁴ An additional analysis provided an interesting result: respondents who said that they took *some* training classes were no more likely to rank training in their top three most useful learning methods when compared to those who did not attend training classes. That is, respondents could respond that they took no training classes, but then say that training classes were the most useful learning method. No validation was included in the survey's software code to detect such contradictions. Since this suggests an inconsistent pattern of responses, the learning preference data should be interpreted with caution.

Data for Relationship between Need for Technical Challenge and Job Satisfaction

Company	Need for Technical Challenge		
	(score on the JPI items which load on this factor)		
	0-23	0-24	0-25
	LOW	MEDIUM	HIGH
ChemCo	4.82	5.06	5.19
InsureCo	4.72	4.91	4.36

Need for Technical Challenge v. Job Satisfaction

