Corporate IT Skill Needs: a Case Study of BigCo.

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ABSTRACT

This paper reports on a case study of the IT skills and needs at one site. The data is organized by assessing the members of BigCo's Corporate IT group regarding their present IT skill levels and the perception of skill needs both now and three years in the future. This work relies on a categorization drawn from both academic and professional literature regarding skill needs for IT professionals. In doing this work we draw on surveys, interviews, focus groups and archival documents to build a rich and detailed perspective on skill needs for the IT professionals at BigCo's Corporate IT group. Findings show that there is an implicit set of conceptual IT skills that IT professionals are expected to have. Further, the non-IT skill needs are presently very important and are expected to become even more important. Finally, there are important department-level, experience, and gender variations in the responses suggesting that IT roles are growing both more numerous and more specialized.

Keywords

IT skills, distributed computing, IT staffing.

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What skills must information technology (IT) workers possess to successfully contribute to their organization's performance? This question unites both the professionals who practice using IT in organizations and the academics who study and teach about that use – even if these two groups often disagree on what these skills should be (Trauth et al., 1993). By IT skills, we mean the set of techniques, methods, and basic knowledge that shape the work of IT professionals. Reflecting on this question, this paper reports on a case study of the IT skills and needs of the Corporate IT group of BigCo (a psuedonym) – a Fortune 200 company with a diversified set of products – whose IT group is consistently rated by the trade magazine *Computerworld* as one of the best places for IT people to work.

We selected a case study approach for two reasons. First, it complements the research approaches used in existing studies (Yin, 1989). Most of these studies rely on either Delphi-based/ key-informant methods (Brancheau and Wetherbe, 1987) or self-administered surveys (Trauth et al., 1993; Leitheiser, 1992; Nelson 1991). The second reason is that the case study approach allows for more in-depth assessments than do broad-based survey or key-informant approaches. While this may highlight issues particular to the site, the case approach also allows a deeper probing of issues relevant across many sites (Eisenbardt, 1989).

The paper consists of five parts. In the first part we set out the conceptual bases for this study and review pertinent literature. In the second part we outline the context of the study, the BigCo corporate IT environment. In the third part we outline how we conducted the study. In the fourth part we present our discussion of the findings. In the fifth part we conclude by presenting implications of this data for Corporate IT groups in general, for IT professionals, and for research on IT skills.

TRENDS SHAPING THE WORK OF IT PROFESSIONALS

The work at BigCo reflects trends emerging from the increased use of IT in organizations. The first trend is that IT is becoming more integrally involved in work (Wigand et al., 1997; Sproull and Kiesler, 1991). This is reflected at BigCo where senior leadership has publicly declared the importance of IT to its future and is investing approximately $50 million to implement new computing infrastructures in the coming years. A second trend is that organizations expect those doing this work to have the needed skills

and competencies to use IT to its full potential (Bridges, 1994; Aronowitz and DiFazio, 1995). This also means that the organization's workers increasingly rely on the skills and competencies of the technologists forming their IT staff to insure that the various ITs on which they rely work when needed.

A third trend is that the various ITs being used in organizations are also changing. Two of the most important technological changes are: (1) the move from mainframe to distributed computing and (2) the increasing reliance on external vendors, both to build the information systems and to help implement them (Sawyer and Southwick, 1997; Sawyer and Southwick, 1996). Both of these are reflected in BigCo's current IT operations.

The first IT change, movement to distributed computing, is exemplified by the implementation of client/server-based systems. The technical architecture of client/server computing is substantially different from that of mainframe computing (Hall, 1994). A fundamental premise of client-server computing is that the total capacity of the distributed servers and workstations exceeds that of the mainframes they replace. This new computing architecture moves software applications, and the associated processing of data closer to the user (via the client software). This allows for faster, more efficient, and more effective computer processing and improves the quality of service. The pervasive distribution of IT hardware and software at BigCo requires their IT professionals to be more integrated into work processes.

The second IT change is the movement from developing new systems internally to using those that are built by third-party IT vendors. This movement from building to buying information systems, coupled with the desire to make these systems work together seamlessly, encourages organizations to purchase enterprise wide distributed computing systems such as those developed and marketed by SAP, Peoplesoft and others (Sawyer and Southwick, 1996). These large systems require extensive implementation efforts. For example, BigCo's IT staff is augmented by significant number of both the product vendors and consultants.

Taken together, these three trends create a rapidly evolving environment that is both expanding -- as choices about the uses of and roles of IT are changing -- and still unclear -- as all the new products, vendors, and systems do not yet provide a stable market

for the organizations who desire their services (Sawyer and Southwick, 1996). This also suggests that IT professionals need more than technical skills. Technologies are changing quickly and many of them are changing in ways that render prior technology competencies obsolete (i.e., there is little advantage in learning Netware's network operating system scripting commands having first learned IBM's job control language for mainframe operating systems). Further, as the IT leadership at BigCo pointed out, many of the current cadre of IT professionals (including consultants) are not yet sufficiently skilled with the new ITs to meet the current demands of pervasive, network centric, PC-based, vendor developed, systems.

This tumultuous environment also means IT professionals have little skill stability. That is, there is little to suggest that an IT professional can learn a set of core skills which will carry him or her through their career. This lack of skill stability differs from traditional professional careers such as accounting or engineering where certain laws or generally agreed-upon principles govern the profession and change slowly. For IT professionals trying to make sense of their future skill needs, the available literature sends mixed messages. The next two sub-sections highlight the current literature regarding IT skills.

IT Skills According to the Professional Press

Current professional literature[1] highlights specific technical skill needs. For example, a debate may center on which IT package or product is most important to learn. This approach focuses on packages and not on skill (Radding, 1997; Jacobson, 1996). The question regarding IT skill needs is posed as: is it better to know Oracle or Sybase, JAVA or COBOL, Novell or NT? (Wilson, 1997; Wilson 1996)

The professional press also suggests that most implementation and change management efforts are best left to consultants. This is done in two ways. The first way is to rely on consultants to address all change management issues (Fenn, 1996, Ball, 1980). The second way is to hire consultants to lead implementation. Finally, the articles in the professional press are surrounded by ads touting the latest computer-based management tools, an overt claim that IT management is easy if one buys the correct tool. This suggests that Brooks' (1987) silver bullet mentality seems to prevail in more areas than software development.

IT Skills According to the Academic Press

Current academic literature[2] typically approaches the skills issue from a management perspective. That is, what skills do managers see as most important for IT professionals? This work advocates the importance of non-IT skills along with general IT skill sets. The literature categorizes the skills IT professionals need into a combination of general business skills, technology management skills, inter-personal skills and IT skills (see Table 1). For example, Todd, McKeen and Gallupe (1995) identify three areas of IT skills: technical, business, and systems. Trauth, Farwell and Lee (1993) categorize IT work into task specific (IT Tasks), technical skills, and abilities. More recently, Lee, Trauth and Farwell, (1995) organize IT professional's skill needs into business functional, technology management, interpersonal and management, and technology specializations. Heckman (1998) categorizes these needs as: core technology skills, social skills, marketplace skills and conceptual skills.

These depictions reflect the growing range of specific IT skills that are needed. Three of the categorizations make explicit the need for business or marketplace skills. Three also highlight the need for social or client/user interaction skills. All four acknowledge the need for analytic or problem-solving skills. However, this management perspective provides the individual worker with little guidance. For example, the work of Brancheau, Janz and Wetherbe, (1987), Neiderman, Brancheau and Wetherbe, (1991), Brancheau and Wetherbe, (1987); Dickson, et al, (1984) and Ball and Harris, (1980) highlights key IT issues about every five years.

Categories	Todd, McKeen & Gallupe, 1991	Trauth, Farwell & Lee, 1993	Lee, Trauth & Farwell, 1995	Heckman (in press)
Business Functional Skills	Business		Business	Marketplace
Interpersonal Skills		Abilities	Interpersonal	Social
Technology Management Skills	Systems	Technical	Tech. Mgt.	Conceptual
Information Technology Skills	Technical	Task Specific	Tech. Spec.	Technology

Table 1: Categorizing IT Professional's Skills in the Academic Press

The Four Aspects of IT Skill Needs

Our approach to the skills needed by IT professionals builds on both the professional and academic literature. We draw on the academic literature to frame the needed IT skills and include the four aspects used by Lee, Trauth and Farwell (1995): technology management, business functional, interpersonal, and IT skills. Technology management skills include the ability to relate IT use to corporate strategy, the link between IT and operations, the ability to conduct product analyses, manage both projects and

vendors, and conduct change management. Business functional skills include a grasp of general business issues and an understanding of the environment in which the business exists. Interpersonal management includes the ability to develop a personal social network, the ability to support clients, influence others, and an understanding of group processes. Technical skills encompass knowledge of computing infrastructures, distributed technologies, programming languages, systems integration, networks (both basics and protocols), Internet/ intranet development and support, desktop support, database, and systems analysis. We draw on the professional literature to help assess specific products and packages in the context of the need at BigCo's Central IT group.

OVERVIEW OF THE SITE

BigCo is a Fortune 200 company that manufactures a wide range of products for both commercial and retail customers. These products are grouped into two large, global, operating divisions. A third division, charged with product innovation, supports the other two divisions. Headquarters for these three divisions is located in a small city in the Northeastern US. The company's IT group is nationally recognized as one of the best places for IT professionals to work.

Following an extensive business process re-engineering in the early 1990's, BigCo recently initiated a company-wide migration to distributed computing relying on vendor-provided software. This distribution effort is expected to lead to a computing infrastructure in which corporate systems such as payroll, human resources, office computing suites (such as word processing and spread sheets), communications (such as voice and electronic mail), and financial management will be maintained and supported by corporate IT staff. Division, operating unit, or local manufacturing plants will maintain all other systems, such as process planning, manufacturing processing, and others.

The migration effort requires re-skilling BigCo's corporate IT (CIT) staff to support both the vendor developed, distributed, client-server based software implementation and integration, and addressing more advanced end-user support issues. Currently, CIT staff consists of 150 professionals and 20 administrative support staff. This group is augmented with a nearly equal number of consultants (from one large consulting firm) and a variable number of contract programmers and technicians. Following

successful migration, CIT senior leadership expect to rely on their staff to service the IT needs of BigCo and to minimize the number of both contract vendors and specialty consultants needed.

BigCo's senior IT leadership has chosen to take a work group approach for the management and implementation of the distributed computing migration. This means that over the past two years both the roles and working relationships among both the IT group and their users has changed. This reliance on heterogeneous groups requires further re-skilling in group management and interpersonal skills. And, the global nature of BigCo's manufacturing processes demands additional skill development in the areas of multi-cultural management. Amidst all this change, however, the CIT staff have changed little. That is, the people who ran the tightly centralized mainframe IT world of four years ago are the same people who are now responsible for implementing and supporting a client/server computing infrastructure.

Issues Facing BigCo's CIT Group

BigCo's movement to distributed computing represents the continued integration of computing into work. Their commitment to this effort reflects the belief held by senior leadership that BigCo's workforce is capable of taking advantage of these newly implemented computing tools. The implementation of these systems also reflects the two IT changes. The new system is vendor-built (in fact, BigCo is partnering with the vendor to write several key functions), and, it is a client/ server-based product.

In order for CIT's senior leadership to make decisions regarding the skills needed to support the new IT, they first needed to assess the present state of IT skills. This IT skills assessment could be used by CIT leadership to help plan both project team membership (by drawing together personnel with the right mix of skills) and to guide future hiring practices.

RESEARCH APPROACH

This project began in February, 1997 and concluded in June, 1997. Four data collection methods were used to assess BigCo CIT's current and future IT skill needs: focus groups, interviews, a survey and archival records. Use of multiple methods allowed the researchers to collect different kinds of data which provided different viewpoints and informed different parts of the research

question (Jick, 1979; Brewer, 1989). In addition, the use of multiple methods allows for the triangulation of data (1988).

A review of contemporary literature, from both academic and professional sources on IT skills assessment was used to create a list. This list was shared with CIT's human resource (HR) personnel in order to get feedback about the relevancy of the chosen IT skills. The HR personnel helped further narrow the list of IT skill needs by eliminating those that were not relevant at that site. They also helped "translate" the skill categories into terms more familiar to the sites' IT professionals. This provided a means to tailor the specific IT skills to address both the site's needs and to adopt phrases that were familiar to the people at that site who would be completing the instrument.

Based on the contents of the list, the project team developed the instruments to support the interviews, the conduct of the focus groups, and the survey provided to the IT professionals at this site. The final contents of the survey [3] draw on the both the academic and professional literature and findings drawn from focus groups, interviews, and briefings with CIT leadership.

The study team organized the IT skills survey to include five parts: business functional skills, technology management skills, interpersonal skills, IT skills, and demographics. Each of the four skills parts have from two to eleven elements. Each element has from three to 15 questions. For each element additional space was provided to comment on other issues not explicitly covered by the questions.

For each question, respondents were asked to evaluate their current level of knowledge regarding the skill, their current need for this skill, and their expectation regarding their need for this skill in three years' time. A five point scale was used in the survey to record perceptions of current skill level, skill level needed now, skill level needed in three years. End points on this survey were "no knowledge" and "thorough knowledge." The resulting survey was pretested at the site in a series of focus groups and additional modifications were made based on feedback from these meetings.

Data Collection

Data were collected from several sources over a four month period. It began with a set of background documents provied by the CIT study team liaison. Additional documents were gathered throughout the data collection period. Interviewees consisted of CIT employees from a range of job classifications, Corporate IT customers, and CIT consultants. Interviews lasted from 45-60 minutes, and focused on the participant's perception of CIT's future skill needs. Each interview was taped and these transcripts were subjected to key-word analysis. In this approach, the interview and focus group notes are searched for certain key words and the surrounding text is used to develop meaning of these keywords.

Focus groups drew on CIT employees from a range of job classifications. These included user support, technology support, development and design, team leaders, managers, and customers of CIT. Focus groups lasted for 90 minutes and emphasized the participant's perception of CIT's future skill needs. These sessions also provided a way to speak with multiple CIT employees during a short period of time and encouraged them to feel as though they were a part of the process (Baronas and Louis, 1986). Notes taken during each focus group were both subjected to key-word analysis and used to improve the survey.

The skills assessment survey included almost 600 items and took each person about 60 minutes to complete.[3] The survey was administered to the 140 IT professionals at CIT, with a 100% response rate. The high response rate was due in part to extensive participation by CIT members during the focus groups and interviews prior to administering the survey. Extensive support from CIT senior leadership and human resource personnel was also instrumental since they expected to use this data to help plan for both training the existing personnel and future hires. The ten most senior CIT managers, the 20 clerical staff, and CIT's consultants and vendors were not included in the sample.

Interview and Focus Group Findings

Table 2 presents findings drawn from the eight focus groups, thirteen formal interviews and numerous informal meetings with BigCo CIT employees, contractors, customers and consultants. The field notes and transcripts of these various sources were analyzed for common themes. Supporting evidence for these themes was assembled using explanatory matrices (Miles and

Huberman, 1990).

Finding	Explanation
Core Set of IT Skills	General agreement about what these are. However it is difficult for people to make explicit.
Need for Interpersonal Skills	Recognized as important to job in current work environment. Respondents had mixed feeling about this. Some liked, others did not, this relatively new emphasis on interdependence and social interaction.
Need for Project Management Skills	Most respondents felt that there is shortage of people who can manage resources and schedules. Since, almost everything CIT people do is project based, this is a critical shortage.
IT Skills Useful in Organization	Value of any IT skill measured by it's use to help the organization. Perception is that the company will set a technical direction and tell people what to learn. This is interpreted by people that there is no reason to explore new ITs on their own.
Combination of Skills to be a Problem Solver	Current work requires both communication and technical problem solving skills to be effective.

Table 2: Findings from Interview and Focus Groups

Participants in both interviews and focus groups were more interested in discussing the non-technical IT skill needs. Typically, it was difficult to focus on the technical issues. However, a consensus emerged regarding technical IT skill needs. Data from the BigCo interviews and focus groups suggests that there are five technical competencies that IT workers should know:

- both local and server operating systems
- network operations (e.g.,cabling, protocols)
- database use
- programming, and
- the systems development lifecycle.

In discussing these core IT skills, respondents espoused the belief that skills in a particular package or product were less important than a conceptual understanding of the underlying technology. However, participants pointed out that it is often difficult to assess this conceptual understanding and easier to assess knowledge of the features of a particular product or package.

Survey Data Analysis

Analysis of the survey data is first presented at the aggregate level. This combines all 140 responses for a given section into one average. For each part or element all indicators for that part/element are also aggregated and the mean is used. Analysis using aggregated demographic data is based on both gender and experience. Both of these were self-reported and confirmed by the site's HR personnel.

Table 3 presents the demographic data. The duties and responsibilities reflect the CIT group's orientation towards service of the organization's computing infrastructure focused on support. The designers and developers are typically involved in very specialized projects (such as intranet development) or are retained to support existing legacy systems that are being phased out as part of the client/server implementation progresses. The demographic data suggests that the IT group membership is quite stable. However, the data regarding years in (current IT) job suggest that the work roles of these people are changing. The educational level and field of study data suggest a broader diversity of backgrounds. This may be due to the extensive experience of some members (The longest tenure in CIT is 37 years and 15% have more than 20 years of IT experience). Men outnumber women by two-to-one.

Duties and Responsibilities	(#)	Demographic	Mean (s.d)	Educational Level (%)		Field of Study (%)	
User Support	21	Years at BigCo.	10.7 (6.1)	High School	7.2	Math/CS	40.0
Technical Support	49	Years in IT field	11.1 (4.7)	Military Training	1.4	Bus/Econ.	28.6
Design/Development	20	Years in job	0.9 (1.5)	Vo/Tech Training	1.4	Engineering	12.9
Database Support	21			Some College	13.8	Liberal Arts	7.9
Network Support	12	Gender (#)		AA/AS Degree	16.7	Science	3.6
Department Management	9	Men	94	BA/BS Degree	44.9	Music/Drama	1.4
Other	8	Women	46	MA/MS Degree	13.0	Education	1.4

Table 3: Demographic Data

Analysis of the survey data is based on descriptive techniques and both means and standard deviations are provided (Pedhauzer and Schmelkin, 1991). Means are rounded to one decimal. Since there is no statistical test to reflect differences across the three responses for each indicator we interpreted the data using the following conventions:

- A 0.5 point spread between present level have, present level needed, and future level needed is noteworthy.
- A 0.5 difference from the population mean (exhibited by a department, say) is noteworthy. In several cases, 0.4+ differences are also highlighted.

- Responses above 4.0 and below 1.0 are considered compelling. Since there is a psychometric tendency to *not* respond with end-point values, these responses are powerful messages.

Aggregated Findings

Aggregating the business, technology management, interpersonal and IT skills parts leads to three findings (see Table 4). The first finding is the high levels of importance, both now and in the future, that respondents place on business functional, technology management and interpersonal skills. All are high now, current need is even higher, and need expected in three years is higher still. The second finding is the relatively low level of IT skills when compared to the first three. These results fit well with those from the interviews and focus groups. That is, IT skills, *in general*, are not the most pressing needs. The elements of each of these parts are presented and discussed in the following sub-sections.

	Current Level of Understanding	Level I Think I Need to Have Now	Level I Think I Will Need in Three Years
Business Functional Skills	3.3 (.71)	3.9 (.71)	4.2 (.86)
Technology Management Skills	3.1 (.74)	3.7 (.72)	3.8 (.67)
Interpersonal Management Skills	3.7 (.58)	4.2 (.60)	4.4 (.58)
IT Skills	2.0 (.53)	2.3 (.65)	2.3 (.85)

Table 4: Aggregation Summary of Survey Parts

The aggregated data lead to a third finding. The level of IT skills that respondents presently perceive they have, need, and will need are consistently low. Given the rapid changes in the IT profession and the rapid changes in information technologies the perception that a generally low level of competence is fine now and in the future should be challenged. Note, however, the high levels of the other skill category responses. The respondents may be indicating some confusion over their roles, the expectations of skills they must possess, and the rewards and incentives they see. For example, when asked about rewards for self-training, many respondents could not say if there were any (other than personal) or why it would be valuable to do such a thing. This may reflect confidence that they can learn technical skills, but not the other skills that are much harder for IT professionals to assimilate.

Business Function Skills Table 5 presents the two elements of this part. Both elements are currently highly rated. For both

parts, respondent believe they need to know more now and more in three years.

Technology Management Skills Table 6 presents the element aggregations for Technology Management Skills. The table shows the high levels of interest in current and future needs. Key drivers of the high ratings seem to be strategic management and self-management. However, almost every category rises at least .5 across the three responses.

	Current Level of Understanding	Level I Think I Need to Have Now	Level I Think I Will Need in Three Years
General Business Skills	3.6 (.94)	4.1 (.99)	4.3 (1.07)
Organizational/ Environmental Understanding	3.1 (.93)	3.9 (.77)	4.1 (.93)

Table 5: Business Functional Skills

	Current Level of Understanding	Level I Think I Need to Have Now	Level I Think I Will Need in Three Years
Operating Management	2.9 (.80)	3.2 (.83)	3.3 (1.00)
Strategic Management	3.2 (.75)	3.9 (.79)	4.1 (.93)
Product Analysis	3.3 (1.10)	3.8 (1.10)	3.9 (1.30)
Project Management	3.0 (.93)	3.6 (.94)	3.8 (1.10)
Vendor Management	2.8 (1.10)	3.3 (1.20)	3.6 (1.50)
Self Management	3.6 (.64)	4.2 (.63)	4.4 (.70)

Table 6: Technology Management Skills

Interpersonal Management Skills Table 7 presents the element-level aggregation of this part. The table shows that current levels are high and both current and future needs are very important. These results are some of the most compelling of the study since they are so highly rated.

	Current Level of Understanding	Level I Think I Need to Have Now	Level I Think I Will Need in Three Years
Personal Network Development	3.8 (.75)	4.3 (.68)	4.5 (.71)
Client Support	3.6 (.68)	4.1 (.78)	4.3 (.60)
Influencing	3.7 (.64)	4.3 (.68)	4.5 (.68)
Group Processes	3.7 (.71)	4.3 (.68)	4.5 (.64)

Table 7: Interpersonal Management Skills

Information Technology Skills Table 8 contains data on the element-level analysis of the IT skills. This provides some insight into the low ratings of the eleven IT skill elements. The relatively wide dispersion of these elements suggest that the aggregated data may be obscuring diverse, but narrow, perspectives among the respondents. That is, people may rate several areas high and the rest low. If this is a consistent pattern across a diverse group, the highly-rated skills will be blanketed by the larger population that provides a low response to the same indicators. This is explored, below.

	Current Level of Understanding	Level I Think I Need to Have Now	Level I Think I Will Need in Three Years
Infrastructure	2.4 (1.10)	3.2 (.89)	2.8 (1.40)
Distributed Technology	2.2 (1.10)	2.5 (.89)	2.5 (1.40)
Programming Lang.	1.8 (.78)	1.8 (.97)	1.7 (1.10)
Systems Integration	2.6 (.63)	2.8 (.87)	2.8 (1.00)
Network Fundamentals	1.6 (1.30)	1.8 (1.50)	1.9 (1.60)
Network Protocols	1.8 (.74)	2.0 (.95)	2.0 (1.10)
Internet/Intranet Tech.	1.4 (.79)	1.8 (1.00)	2.0 (1.10)
Desktop Support	2.7 (.60)	3.0 (.87)	3.0 (1.20)
Operating Systems	2.3 (1.10)	2.3 (1.00)	2.2 (1.30)
Database	1.7 (.68)	1.8 (.85)	1.7 (1.00)
Systems Analysis	2.2 (.92)	2.5 (1.20)	2.6 (1.40)

Table 8: Information Technology Skills

Department-Level Variations in IT Skill Needs Since the overall levels of IT skill needs were low, relative to both the five point scale used in the survey and to the responses for the other sections, the means of the eleven sub-section elements of the IT Skills part were calculated for each of CIT's 14 departments.[4] These department-level means varied. For example, the mean of the Customer Support department differs substantially from the mean of all other departments with regard to Desktop Support.

This variation in responses at the department level leads to two findings. The first finding is that the three IT skills needed by most departments are: (1) systems integration, (2) desktop support and (3) systems analysis. All three of these skills are noteworthy because they represent conceptual uses of IT -- not point skills such as a particular package or function. In this way these skills demand deeper conceptual knowledge about a range of technologies and about how to work with people in an organizational setting. The second finding is that the most needy departments are the ones most involved in client/server-based,

computing: the Database Management, Applications Support, and Server Infrastructure.

Gender Issues

Responses varied between the 94 male and 46 female respondents. For example, women provided most of the responses in the "Other" section for each part, rating these higher than anything males provided. Further, on almost every response, men reported:

- having higher levels of current knowledge
- needing more knowledge now, and
- needing more knowledge in the future.

Experience Issues

Responses also varied by both level of IT experience and level of IT experience at BigCo. To conduct this analysis, the responses were split into two groups: those with more and those with less than average time as an IT professional at BigCo . This means that the lesser-experienced group had less than 11 years of IT experience at BigCo and the more experienced group had 11 or more years of experience. The analysis showed that, on almost every response, the less-experienced set reported:

- having higher levels of current knowledge
- needing more knowledge now, and
- needing more knowledge in the future.

This is particularly true for Infrastructure, Network Fundamentals and Internet/Intranet skills.

Finally, when comparing years of IT experience to total years at BigCo, data show that those with more than 11 years of BigCo IT experience had fewer years in the IT profession than they did years at BigCo. The difference is as much as three years for the most senior respondents. However, those with less than 11 years of BigCo IT experience had more years in the IT profession than they did years as a BigCo employee. The difference is as much as two years for the least senior respondents.

ISSUES WITH IT SKILLS AT BIGCO

Data show that BigCo Corporate IT skill levels now and in the future are affected by both respondent age and level of IT experience. This trend is typical of most corporate IT departments and reflects two underlying trends: the steady change in technology and the increasing diversity of the IT workforce. Implications for this trend, however, are not as clear. Certainly the age/skill difference will continue as the pace of IT change makes long-term skill retention problematic. Gender-based differences in IT skill needs demand additional attention (Nissenbaum, 1994; Kling and Dunlop, 1995; Kling, 1993).

Data also show that the current IT professionals are not fully skilled to support distributed computing . For example, the areas with the highest skill needs are also the areas most crucial to distributed computing success – servers, application/desktop support, and integration and implementation of the vendor-supplied packages. The high need levels in all non-IT specific skills suggests that the current IT professionals, while cognizant of their need, are not properly skilled to serve as a IT facilitators. That is, they recognize the need, but are not sure how to work effectively in teams, span vendor and user boundaries, and/or be effective technical problem-solvers (Kreiner, 1989; Gundry and Rousseau, 1994; Grote and Baitsch, 1991).

Implications for Central IT Groups

We believe that BigCo's situation is representative, not unique. The contemporary work place is faced with a shortage of IT professionals (ITAA, 1997) and massive IT-enabled implementation efforts are increasingly common (for example, SAP and Peoplesoft systems are being implemented in more than 13000 sites worldwide). Thus, the massive changes in IT are being absorbed by the current IT staffs. Even when corporate IT managers are aware that IT workers need up-to-date IT skills it is difficult to re-skill their staffs (Crossman, 1986; Jian and Klein, 1995). For example, at BigCo, training is seen as critical and money is available to support this training. Still, they have an under-skilled staff.

Moreover, just having specific IT skills is not enough. Much of the future IT workers jobs will involve social/ interpersonal skills that enable them to work together with users, vendors, and even other IT workers employed by local or line organizations (Becker, Insley and Endres, 1997; Crossman, 1986). If the BigCo IT staff are an indicator, both workers and managers have trouble

identifying how to best gain these skills and how to balance their time between learning critically-needed technical skills and critically-needed interpersonal skills (Jian and Klein, 1995).

The department-level analysis differences underscore the increasing diversity of the IT professional's career (e.g., as a vendor, consultant, corporate IT, or distributed IT, employee). This is perhaps the most profound change to IT skill needs. The specialization of IT means that the all-encompassing perspectives on what is IT and what skills IT professionals need must now account for variations in the types of work in which these people will engage. That is, the skills needed to be a successful contributor in a central IT group may be much different than those needed in a distributed IT group (Eschenfelder et al., 1998).

Implications for IT Professionals

These findings suggest that the nature of IT work is changing in two ways. The first is that, increasingly, IT workers will be working in teams and this will demand excellent interpersonal and group process skills. The second change is the continual, and rapid, flux in the technologies which professionals in the field must comprehend, and sometimes master. Given the flux in these technologies, IT professionals must work to keep themselves skilled and not rely on corporate guidance.

A third implication is the expanding number of roles available to IT professionals. For example, until recently, most IT workers were employed in CIT groups much like that at BigCo. Now, however, there are outsourcing firms such as EDS and Keane, consulting firms such as Anderson, contractor firms such as Manpower, and vendor firms such as SAP or Microsoft. In addition, there are now distributed IT groups inside large organizations. Given ITs pervasive nature, even small companies are hiring IT jacks-of-all-trades to support their computing needs. Each of these venues provides new opportunities for IT professionals. However, they often require a different set of skills than did the traditional IT worker in the large central IT shop.

Implications for Continued Research on Corporate IT Skill Needs

We end this paper by positing two issues for continued research in understanding the skill needs of IT professionals. The first issue is that, while it seems ever more obvious that IT work increasingly involves more than IT skills, this may mask the importance of a greater need for IT professionals to have a strong conceptual understanding of technology. This means moving past a discussion of packages and products or IT and non-IT skills to a discussion of the skills needed to understand and communicate about technical problems in heterogeneous technical environments. This skill seems to be in short supply and knowledge about the components of this skill seems to be even more scarce (Drucker, 1994; Crepeau et al., 1992).

The second issue is, in an era in which IT professionals have a broader array of roles and specializations than ever before, more attention needs to be paid to what is demanded of IT professionals and how best to characterize both the work they do and the way this work fits into the work of organizations. In this light, the question of IT skills becomes: what will be the defining aspects that delineates a modern, IT-using, worker from the technologist who has the job of supporting that worker and the IT infrastructure? The line is very blurred at the moment.

NOTES:

1: The professional press is defined as magazines and publications that focus on managing and using IT to support organizational work. These include such outlets as *CIO*, *Datamation*, *Fortune*, *Business Week*, and *Computerworld*. Conversely, the trade press focuses on the technology and examples of these outlets include *PC Week*, *Macweek*, *Personal Computing* and *Byte*.

2: The academic press include outlets that publish scholarly discussions of the role of IT in organizations. Examples of these outlets include *Information Systems Research*, *MIS Quarterly*, *Journal of MIS*, and *Information Technology & People*. Bridge journals/ magazines, designed to appeal to both audiences, such as *Harvard Business Review*, *Sloan Management Review*, *Communications of the ACM*, and *IEEE Software* are included.

3: For a copy of the survey instrument, contact the lead author.

4: In doing this, we included together any one, two, or three person departments to protect their confidentiality.

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