Center for
Technology in Government

New York State
IT Workforce Skills Assessment

Statewide Survey Results

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This report is the result of an extraordinary partnership. Government leaders and executives, employee unions, university researchers, and the State's information technology professionals all made essential contributions to this first-of-its-kind statewide IT workforce skills assessment. Each participant brought unique skills and perspectives and a willingness to combine them into a comprehensive effort that will help New York make sound future IT workforce investments.

Table of Contents

List of Figures and Tables

Executive Summary

The goal of this information technology (IT) workforce skills assessment is to gather information to help New York State (NYS) better meet the training and development needs of its IT professionals, and to identify future needs for IT skills. The project included two voluntary on line surveys. The first was directed to IT employees and the second to Chief Information Officers (CIOs) in state agencies. The two surveys together produced a comprehensive current profile of self-reported demographics, skill proficiencies, and training needs of the current state IT workforce, as well as a comprehensive set of agency level IT forecasts for the next three years. This report, prepared by the Center for Technology in Government (CTG), is the first step in a longer term effort. In the next phase, the State CIO Council Human Resources Committee and its subgroups will use these results to generate recommendations for next steps and action plans that enhance professional development and skill proficiency for the entire IT workforce. In addition, CTG will produce agency level reports to be provided to participating agency CIOs for similar future planning.

The data show that New York has a strong foundation for moving into the future. The IT workforce has strong and pervasive management skills, and strong proficiency in fundamental IT topics. IT employees are well-educated and very experienced in state government and in the missions of agencies. The workforce is stable and highly motivated for training in both traditional and new areas. On average, employees reported a need for some level of training (from basic to advanced) in 42 of the 126 skills in the survey. Many commented that frequent and varied training is necessary because the field changes continually and because its components are so interdependent. The retirement picture is mixed. Non-managerial IT professionals indicate they may retire in only modest numbers in the near future, but a growing wave of impending retirements, especially after 2009 and among management staff is a concern. As a counterpoint to this picture, most employees are interested in working for the State part time after retirement.

Strong proficiency exists in foundational IT technical areas such as system design and development, programming, and technical support services which are all important for current and future IT effectiveness. Equally important, however, the study showed a substantial gap between the current proficiency profile of the IT workforce and the skill needs forecasted for growth in the near future. Infrastructure (including security), web computing, and work associated with information content appear to present major challenges. Most agency CIOs forecast growing need for skills in these competency areas, but current proficiency levels are low in all three. Fortunately, strong convergence is evident across employees, CIOs, and state IT leaders on the types of skills that are necessary to achieve and sustain an effective IT enterprise across state government in the future. These skills were identified by comparing low current proficiency ratings, high future need, high employee training demand, and strategic importance. These skills represent the most fruitful areas for investments in workforce skill development.

Training professionals can use the data from this study to construct comprehensive programs and coherent curricula that address the needs of workers in a variety of job specialties and in core competencies that pertain to all IT professionals. In addition, similarities in key needs across all types of agencies present opportunities for partnerships and economies of scale in training and professional development investments.

Finally, the study results suggest areas for future investigation and leadership attention. These pertain to three topics: workforce development, training program design, and organizational and enterprise IT planning.

Workforce profile

The demographic data collected through the surveys highlight areas of strength in the NYS workforce as well as some concerns with respect to future workforce development.

The State IT workforce is well-educated and very experienced. More than 90 percent have some college education and much of that education is concentrated in technical fields (more than one-third hold degrees in computer science, information science, or management information systems). In addition, about 16 percent of IT professionals hold current certifications. The workforce is also very experienced in both state government and agency missions, with long tenures in state service, mostly concentrated in one or two agencies.

Retirements among non-managerial IT professionals may be modest in number for the next three years, although nearly a quarter of IT managers and about one-third of the CIOs expect to retire within that time period. Retirement projections increase substantially for all three groups after 2009. The overall workforce profile indicates a substantial proportion will be eligible to retire in the next three years (especially among managers and executives) although the proportion of non-managerial IT professionals who actually plan to retire is rather modest (about 11 percent) between 2006 and 2009. The pace of retirement intentions for non-managerial IT professionals between 2006 and 2012 ranges from 1.7 percent planning to retire in 2006 to 3.9 percent in 2012, by which time more than 22 percent of today's IT workers expect to have retired. Three-quarters of IT professionals and managers reported an interest in continuing to work for the State part-time after retirement.

Current skill proficiencies

The skill proficiency data is based on self-assessments by New York State IT employees. They reported their personal level of proficiency on 126 skills associated with IT work in state government.

Higher overall proficiency ratings are concentrated in management, system design and development, technical support, and legacy technologies. Among the top 25 skills, ten are general management skills such as written and oral communication and supervisory skills.

Lower overall proficiency ratings are associated with networking, web-based services, security, and information analysis and use. No skills in these areas appeared in the top 25.

As a broad pattern, younger employees have somewhat higher proficiency ratings in newer technical skills, while older workers have higher proficiency ratings in management and legacy technologies.

The most striking differences in proficiency rating patterns are associated with job specialties. Within each specialty area, (such as programming, data administration, or IT management) high proficiency ratings exist in a number of skills appropriate to the specialty.

Training demand

In addition to reporting their personal levels of proficiency, employees also reported their need for training in each skill.

On average, IT employees said they need some level of training in 42 skills. The level needed ranged from basic to advanced and generally employees chose the level that is one step above their current proficiency. Many commented that they need ongoing training in their particular specialties plus general familiarity with a variety of other areas in order to keep up with constant changes in technology, to understand the broader context of their assignments, and to do a good job of contributing their particular expertise to larger efforts that combine skills and technologies from several specialty areas.

Overall, the greatest demand for training occurs among management skills, followed by skills associated with the web and with security functions. Strong demand is also present for skills associated with system design and development and networking. Lesser demand is present for information analysis skills followed by operations support and mainframe-oriented technologies. Among the top 25 skills for training demand, eleven are general management skills, eight pertain to security functions and infrastructure, and six are associated with the web.

Competency areas

Broad competency areas were constructed to organize the full set of 126 skills into logical clusters. Collectively, these competency areas encompass the entire IT function of state government.

Seven competencies provide an organizing framework for skills development. The competency areas encompass a full range of capabilities for both IT professionals and IT organizations. Collectively, they represent a competency framework that is useful for considering both agency effectiveness and individual proficiency across the full spectrum of IT activities. While no single person or agency could be expected to be expert in every specific skill, IT employees and IT organizations should generally possess some level of familiarity or proficiency in each of the seven broader competency areas.

Higher proficiency ratings are evident in the competency areas we call management, systems and databases, technical support services, and legacy technologies.

Lower proficiency ratings are evident in the competency areas of infrastructure, web computing, and management and use of information as an asset.

Training demand is higher in management, web computing and infrastructure competencies, and lower in systems and databases, management and use of information as an asset, technical support services, and legacy technologies.

Three-year IT forecasts

CIOs assigned a forecast to each of the 126 skills for three years into the future.

Most growth is forecast for infrastructure and web computing skills. The majority of CIOs chose a growth forecast for more skills in the infrastructure and web computing competency areas than in

the others (eleven and nine skills respectively). The majority also chose growth forecasts for three management skills, four system and database skills and four skills in the competency area of management and use of information as an asset. No skills in technical support services or legacy technologies received a majority growth forecast.

Some differences are evident across agencies with different numbers of IT staff, but at least half of the CIOs in agencies with small, medium, and large staff chose a growth forecast for the same fourteen skills, with most emphasis on the infrastructure and web computing competency areas. These 14 skills include website design and development, website management, system security applications, and identity management and directory services, as well as systems integration, project management, and records management.

Gap analysis

The data from both surveys was combined with information from the State's strategic statement of enterprise architecture principles in order to triangulate on the greatest differences between needed skills and existing proficiency.

At the statewide level, the skills that represent strong convergence among low proficiency ratings, high training demand, forecasted growth, and strategic importance fall almost entirely in the competency areas of infrastructure, web computing, and management and use of information as an asset. Two management skills, business continuity planning and IT risk assessment, also emerged. No appreciable gap was evident for the competency areas with higher proficiency ratings such as systems and databases, technical support services, or legacy technologies.

When the gap analysis was performed for individual job specialties, the same strong competency-based patterns were evident, although each specialty included a somewhat different set of additional skills relevant to its work content.

Workforce development considerations

Training demand is strongly motivated by current work responsibilities and desire for more challenging work. Nearly all employees reported that training is needed to improve their ability to do their existing work. Similarly, more than four out of five said that training would prepare them for more demanding work and a greater variety of assignments.

Both employees and CIOs prefer off-site classroom programs. Overwhelmingly, both employees and CIOs prefer off-site classroom programs for learning all types of skills. Many comments suggested that this is the only method that assures a student will be able to devote uninterrupted time and attention to learning. However, open-ended comments included a variety of suggestions for combining training methods into complementary sets of approaches.

According to employee comments, many approaches (and combinations of approaches) to improving skill proficiency are possible and desirable. These include on- and off-site classes, mentoring, reference books, e-learning, and hands-on practice. Comments suggested that results can be improved by sequencing or combining multiple learning methods, better matching the timing of training with the need and opportunity to use new knowledge, better targeting of training

intensity to needed levels of expertise, explicitly allocating work hours to professional development, and valuing learning more highly in the management culture of agencies.

CIOs favor professional certification for a number of skill types. Three-quarters of the CIOs reported that professional certifications would or might be helpful in accomplishing their agencies' missions over the next three years. They were most positive about certifications in project management, information systems security, network security, and databases. Currently, only 1-2 percent of employees hold certifications in these areas.

Future considerations

Given the importance and nature of workforce development, the report is the first step in a longer term effort. In the next phase, the State CIO Council Human Resources Committee and its subgroups will use these results to help generate recommendations for next steps and action plans that enhance professional development and skill proficiency for the entire IT workforce. The study results suggest several areas for future investigation and leadership attention.

Skill proficiency affects many aspects of IT workforce development. These aspects include assessing the relationship between job advancement and technical proficiency as well as the roles education and skills assessments could play in recruitment. Other topics include the usefulness of a skills orientation to IT succession planning and better understanding of the relationships among training, employee satisfaction, and retention.

Training and other professional development programs would benefit from further evaluation. Future considerations for the design of learning opportunities include determining the effectiveness of formal education compared to skill-oriented training, as well as understanding the effectiveness of various methods and combinations of methods for achieving different competency goals. Another consideration is the possibility of identifying core competencies and ideal specialization profiles to help set priorities for future skill investments. In addition, consideration could be given to policies and methods for coordinated purchasing of professional development programs.

An important relationship exists between skills and the effectiveness of the IT enterprise. Future exploration in this area might include better understanding of how organizational culture and policies affect proficiency levels, consideration of current and needed skills in the process of selecting agency and statewide IT standards, and explicitly incorporating skills considerations into organizational strategies for moving to higher levels of IT effectiveness.

Introduction

For the past twenty years, several trends have converged to strongly influence the workforce dynamics of business and government. First, nearly every aspect of work has been affected by the introduction of information technology (IT) into our society, economy, and workplaces. Second, relentless demands for efficiency, and continuous improvements in information technologies have combined to reshape both business models and modes of operation, as well as relationships with customers and citizens. As one consequence, government increasingly relies on information technologies to deliver all kinds of programs and services. At the same time, powerful demographic trends associated with the aging of the baby boom generation have created serious concerns about recruitment, retention, and succession planning for the government IT workforce. Over the last ten years, both federal and state governments have become concerned about the effects of losing institutional knowledge and critical skill sets to retirement. These concerns are exacerbated by the burgeoning growth of IT use in the private sector which poses strong competition for skilled IT professionals.

IT workforce issues have been a concern in New York State since the 1980s and were designated high priority areas in the 2004 and 2005 New York State Enterprise Information Technology Strategic Plans and statement of Enterprise Architecture Principles. Since 2003, the New York State CIO Council, Office of the CIO, the Office for Technology (OFT), and oversight agencies such as the Division of the Budget and Department of Civil Service have been working to develop a unified IT strategic plan that includes workforce needs. The CIO Council, made up of senior executives from more than 70 state agencies, authorities, and other organizations is responsible for initiation and oversight of IT policies and strategies for the State. The Council strives to achieve four overarching goals geared toward state government as an enterprise. The goals include optimizing technology investments and value through improved coordination of enterprise IT procurements; fostering architecture methodologies, standardization frameworks, and investments toward better information sharing and security; achieving integrated government through coordination, collaboration and recognizing information as a public asset; and ensuring that a skilled technology workforce is available, trained, and effectively employed.

The CIO Council carries out its work through seven standing committees on leadership, fiscal/procurement topics, security, strategic planning, technology, intergovernmental communications, and human resources. Each committee develops initiatives that translate high-level goals into operational improvements. For the Human Resources (HR) Committee, one key initiative is an effort to document current employee proficiency in IT-related skill sets, identify the training needs of employees, and assess the future direction of IT deployment in NYS. With the assistance of the Center for Technology in Government at the University at Albany/SUNY, and endorsement and financial support from the Governor's Office of Employee Relations, this initiative took the form of a statewide IT skills assessment. The assessment was also supported by the Public Employees Federation (PEF) and the Civil Service Employee Association (CSEA), the two major unions that represent IT employees.

Purpose of the assessment

The goal of this IT workforce skills assessment is to gather information to help the State better meet the training and development needs of its IT professionals, and to identify future needs for IT skills. The assessment included the design, administration, and analysis of two voluntary on line surveys. The first was directed to IT employees in New York State and the second to Chief Information Officers (CIOs) in state agencies. The two surveys together identify current skill levels as well as the future skills and training needed to meet the State's technology objectives. The results of the assessment will be used by the HR Committee to better target staff development funds and programs to the needs of employees and the future uses of IT in state government.

Participants and their roles

In early 2005, the CIO Council HR Committee organized a partnership of state agencies, labor unions, and the Center for Technology in Government (CTG) to help design and administer two surveys. The partnership took advantage of the strengths of each participating organization as follows:

- *Office of the CIO (OCIO)* – served as executive sponsor and provided a strategic overview of statewide IT needs and coordination among executive agencies and agency CIOs.
- *CIO Council HR Committee* – with expertise in IT, human resources management, and training, Committee members provided project leadership, expert advice, communication, and outreach.
- *Governor's Office of Employee Relations (GOER)* – as the State's labor-management agency, GOER provided funding for the assessment as well as policy advice and links to employee unions.
- *Office for Technology (OFT)* – provided project support, policy advisement, and training expertise.
- *Agency Liaisons* – validated employee lists, acted as contacts for employee questions, and trouble-shooters for technical difficulties.
- *State Employee Unions* – the Public Employees Federation (PEF) provided input on the employee survey and encouraged members to respond. The Civil Service Employees Association (CSEA) also endorsed the study.
- *Center for Technology in Government (CTG)* – provided expertise in research design, project planning and management, and analysis. CTG is an applied research center at the University at Albany/SUNY. Since 1993, it has worked in close cooperation with NYS government agencies to analyze issues and explore new approaches to government information strategies and IT and organizational innovation.

Overview of the assessment methodology

The CIO Council HR Committee named a Skills Inventory Subcommittee in 2005 to determine the most effective way to gather information about employee skill sets, training needs, and future skill needs. After evaluating several alternatives and best practices for obtaining good quality workforce information, the HR Committee recommended that the Office of the CIO and CIO Council use a survey instrument developed by the US Federal Chief Information Officers Council (CIOC), in partnership with the US Office of Personnel Management (OPM). The HR Committee established a project team to implement the skills assessment project and took advantage of this federal instrument and experience to design, administer, and analyze two voluntary on line surveys. The

surveys were based on the federal model but extensively customized to the needs of New York State. The first survey was designed for IT employees, and the second for Chief Information Officers (CIOs) in state agencies.

The employee and CIO surveys were conducted during March and April 2006, and involved nearly 5000 IT professionals employed in state agencies, authorities, and boards, including all executive agencies. The employee survey population consisted of all state employees who held one of a specified set of technical job titles as well as other employees in non-technical titles who were identified by their employing agencies as doing agency-level technology work. The CIO survey was sent to the CIOs of each participating state agency.

The on line surveys collected data on 126 skills, ranging from programming and security to system design and development, to IT management, and general management skills. The employee survey asked respondents to rate their current level of proficiency as well as their need for training in each skill. Demographic questions collected data on length of service, retirement intentions, and education. Employees also answered questions about their preferences for training methods and supplied comments and additional information in an open-ended question. The CIO survey covered the same 126 skills but asked these agency IT leaders to forecast the need their individual organizations would have for these skills three years into the future. Similar demographic, training and open-ended questions were also included.

The project team jointly developed a comprehensive communication plan that included a project website, newsletter articles, personal letters to key stakeholders and participants, posters, and outreach meetings. In addition, each agency designated a staff liaison.

A total of 4,882 employees were invited to complete the online skills assessment survey. An overall response rate of 58 percent was achieved with very good representation of respondents by agency size, grade level, job specialty, and age. The CIO survey response rate was 100 percent. The data from the two surveys were analyzed separately and then compared to produce statewide skill profiles, technology forecasts, and a gap analysis.

A more detailed discussion of the methodology and analysis are provided in Appendix A.

New York State IT Workforce and Leadership Profiles

Overview

The survey results highlight areas of strength in the NYS workforce as well as some concerns. The state IT workforce is well-educated and much of that education is concentrated in technical fields. The workforce is also very experienced in both state government and agency missions, with long tenures in state service, mostly concentrated in one or two agencies. The workforce age profile indicates a substantial proportion will be eligible to retire in the next three years (especially among managers and executives). The proportion of non-managerial IT professionals who actually plan to retire in the next three years is rather modest but the retirement wave will double by 2012. Minor differences in demographic characteristics are evident across age groups, job specialties, and agency size.

Overall demographic findings

The demographic profiles presented in Table 1 show a highly educated and experienced IT workforce with long tenure and experience in New York State government. Nearly all employees have had some college level education, with more than half having baccalaureate degrees and approximately one-third having degrees in technical fields (computer science, information science, or management information systems). Overall, the respondents' mean age is 46.

The details of the demographic profile are presented separately for CIOs (executives who represent their agencies on the CIO Council), IT managers (as identified by job title and specialty area) and non-managerial IT professionals.

Non-managerial IT professionals, on average, have 15 years of experience working for New York State government, with 11 years in public sector IT positions. Half have worked for only one agency and another quarter have worked for two agencies. About half have had private sector IT work experience, with four years of experience on average. In addition, 16 percent of IT professionals hold current certifications in managerial or technical areas.

IT managers average 23 years of experience in New York State government, with an average of 21 years in public sector IT. Thirty-six percent have worked for only one agency and 29 percent have worked for two agencies. About 40 percent have private sector IT experience with an average of two years of experience. Thirteen percent hold certifications. CIOs have also had long tenures in state government and many years of public sector IT experience concentrated in one or two agencies.

The retirement picture across the three groups is mixed. About 20 percent of non-managerial IT professionals will be eligible to retire between 2006 and 2009. However the number who actually plan to retire is more modest (11 percent). By contrast, 22 percent of IT managers and 32 percent of CIOs expect to retire within that time period. Retirement projections increase steadily for all three groups after 2009. The pace of intended retirements for non-managerial IT professionals between 2006 and 2012 ranges from an annual low of 1.7 percent in 2006 to a high of 3.9 percent planning

to retire in 2012, by which time more than 22 percent of today's professional employees expect to have retired. For managers and CIOs, the figures are substantially higher. More than 40 percent of IT managers and 55 percent of CIOs expect to have retired by 2012. As a counterpoint to the retirement picture, employees at all levels reported that they are very interested in working for New York State part-time after they retire. Fully three-quarters expressed an interest in post-retirement work.

Table 1. Demographic profiles of the New York State IT workforce

Characteristics	IT Professionals (n=2466)*	IT Managers (n=271)*	Agency CIOs (n=57)**
Mean age	45	49	51
Age range	20 – 74	30 – 64	33 - 68
Percent with any college education	96 %	98 %	96 %
Percent with bachelor's degree or higher	58 %	72 %	84 %
Percent with degree in a technical field (CS, IS, MIS)	39 %	44 %	30 %
Percent with certifications	16 %	13 %	n/a
Mean years of experience in NYS government	15	23	21
Mean years of public sector IT experience	11	21	16
Mean years of experience in current agency	11	15	13
Percent with all NYS experience in a single agency	50 %	36 %	43 %
Percent with all NYS experience in two agencies	28 %	29 %	19 %
Percent with private sector IT experience	48 %	41 %	55 %
Mean years of private sector IT experience	4	2	4
Percent eligible to retire within 3 years (2006 through 2009)	19 %	36 %	50 %
Percent planning to retire within 3 years (2006 through 2009)	11 %	22 %	32%
Percent eligible to retire within 6 years (2006 through 2012)	31 %	54 %	68 %
Percent planning to retire within 6 years (2006 through 2012)	22 %	41 %	55 %
Percent interested in working for NYS after retirement	75 %	77 %	76 %

** Excludes a total of 96 cases with missing job titles.*

***The employee survey covered employees in 54 agencies. The CIO survey covered CIOs in 57 agencies, including three small agencies which have an IT leadership position but whose IT services are provided by the staff of larger agencies.*

Job specialty categories

Survey respondents held a wide variety of job titles. With the advice of the HR Committee members, we were able to group more than 180 New York State Civil Service titles into seven job specialties. The resulting definitions and distribution of job specialties is shown in Table 2. These categories are a useful way to look at the workforce, but they do have some limitations due to the nature of Civil Service titles. While most titles pertain directly to the jobs performed, some are more broadly defined than others and may include a wider range of capabilities. In addition, individuals holding a variety of non-technical titles who are performing some aspect of an agency's IT function were also included in the survey population. Most of these titles were grouped in the Business Specialist category. Consequently, these groupings do not fully represent the work that people are actually doing, although they do approximate the broad job specialties in state government. Much of our subsequent analysis makes use of these job specialty categories in order

to understand better how people doing different types of work perceive their proficiency and skill development needs.

Table 2. Definitions of job specialties

Job Specialty	N*	Percent	Description
Programmer	1400	51	Titles within this group perform computer systems analysis, design, and programming activities for agency programs and may include web page development.
Other technical specialist	357	13	Generally entry and journey level positions in an IT organization, typically working in help desk, LAN administration, and user support or installation services functions. Resolve user problems by communicating with end-users and by translating technical problems from end-users to technical support staff. Install hardware, software and peripherals; runs diagnostic software; and utilize mainframe or client server software to provide system security access.
Technology manager	271	10	Titles within this group are responsible for planning/directing/ coordinating/supervising a combination of IT specialties for an agency including data base, data communications, operations and systems programming.
Business specialist	242	9	Titles within this group serve as technical specialists with technical knowledge and expertise related to their program(s)' specific automated system. They may work closely with IT staff in evaluating, reviewing, and analyzing business needs and supporting technology-related solutions within their assigned program areas.
Data communication/ telecommunications specialist	177	7	Titles within this group are responsible for voice and data communications network design, analysis, capacity planning, installation, monitoring, performance evaluation, and maintenance. Install and maintain data and voice communications network hardware/software. Maintain and update local and statewide communications networks and systems.
Database administrator/ analyst	119	4	Titles within this group are responsible for all activities associated with the design, development, installation, and performance of agency databases. May include advanced database programming, implementation, monitoring, and management of database environments.
Systems specialist	107	4	Titles within this group are responsible for systems programming and for implementing, maintaining, and managing an agency's systems software environment or major component. May be responsible for advanced systems programming, architecting, implementing and maintaining/managing an agency's advanced systems software environment or major component.
Operations specialist	64	3	Titles within this group are responsible for planning/directing/ coordinating the computer operations activities of large computer systems including all data processing hardware and peripheral equipment. Supervise computer operators engaged in carrying out computer operations activities.

** Excludes a total of 96 cases with missing job titles, total may not equal 100% due to rounding.*

Demographic differences among job specialties

The demographic patterns among the job specialties are quite similar to each other with a few exceptions. Levels of education and types of degrees earned, years of work experience, and retirement eligibility and plans of respondents vary by job specialty. (See Table E1 in Appendix E for the complete profiles by job specialty.) About one-fifth of the operations specialists and one-third of other technical specialists have baccalaureate or higher level degrees compared to two-thirds of employees in the remaining specialties. In addition, 30 percent or more of the employees in most specialties hold degrees in technical disciplines, while this is true for 19 percent of business specialists and only 11 percent of operations specialists. Further, more technology managers, operations specialists, and business specialists are eligible to retire (36 percent, 37 percent, and 32 percent respectively) and more of them plan to retire in the next three years (22 percent, 23 percent,

and 18 percent respectively) than do programmers and systems, database, telecommunications, and other technical specialists.

Grade level categories

We also grouped the respondents by the equivalent of their Civil Service grade levels into four categories, as shown in Table 3. About equal numbers of employees are currently working at the entry and journey levels. Middle and senior managers (not including CIOs) represent 13 percent of the workforce.

Table 3. Grade level categories of employees

Grade Level Categories	N	Percent of Total Respondents	Civil Service Grade Equivalents
Entry level	1,118	42%	G22 and below
Journey level	1,229	46%	G23-G25
Mid level management	286	11%	G27-G29
Upper level management	57	2%	G31 and above
Total	2690*	100%	

**Excludes 143 cases with missing grade levels.*

Demographic profiles across these four grade categories are very similar except for patterns of formal education, work experience, and retirement plans (See Table E2 in Appendix E for the complete profiles). Two-thirds of journey level and three-quarters of management level employees hold a bachelor's degree or higher, while this is the case for about half of the employees in grades allocated to the entry level. This pattern may reflect the concentration of operations and technical specialist positions in titles which are allocated to G-22 and below. As would be expected, employees in journey and higher grade categories have more public sector work experience than entry level employees. They are also eligible and plan to retire earlier than entry level employees. However, with respect to private sector work experience, 59 percent of entry level employees on average have five years of private sector work experience, compared to employees in other grade levels (on average 44 percent have 4 years or fewer).

Agency staff size categories

The agencies included in the survey population vary substantially by the size of their IT staff. Some agencies have more than 200 IT employees, others have fewer than 20. Therefore, we also grouped respondents according to the size of their agency IT staff as shown in Table 4. In subsequent sections of this report, we use three categories (small, medium, and large) to refer to the size of agency IT staff.

Table 4. Agency size categories by size of IT staff

Size Category	Range of IT Staff in the Agency	Number of Agencies in the Category	Number of Respondents	Percent of Respondents
Large	100 or more	16	2008	71%
Medium	50 to 99	11	532	19%
Small	< 50	27	293	10%
Total	- - -	- - -	2833	100%

The demographic profiles are very similar across agencies with different numbers of IT staff. However, they differ slightly with respect to agency tenure, private sector experience, and retirement plans. (See Table E3 in Appendix E for the complete profiles.) Nearly half of all employees in large and medium agencies have worked for a single agency throughout their tenure with New York State; this figure is slightly lower for employees in small agencies (40 percent). In addition, more than half of all employees in small and medium agencies have had private sector work experience whereas 45 percent of employees in large agencies have private sector work experience. With respect to retirement, 13 percent of non-managerial employees in large and small agencies plan to retire through 2009 compared to 9 percent in medium agencies. However, the retirement outlook changes significantly across all agency sizes by 2012, by which time almost one in four current employees plan to retire.

Skill Proficiency Ratings

Overview

New York State IT employees reported their personal level of proficiency in 126 skills associated with IT work in state government. (All the skills are listed in alphabetical order in Appendix C). Proficiency was rated by choosing one level from a five-point scale ranging from "none" to "expert." Overall, the greatest proficiency is concentrated in management skills, system design and development skills, technical support skills, and legacy technologies. Among the top 25 skills, eleven are general management skills such as oral and written communication and supervisory skills. Lower overall proficiency is associated with networking, web-based services, security, and information analysis and use. No skills in these areas appeared in the top 25.

There is little difference among proficiency rating patterns associated with agency size, grade level, or education. However, younger employees tend to have higher proficiency ratings in newer technical skills such as those associated with the Web, while older workers have higher proficiency ratings in management and traditional technical skills such as those associated with system design and development. The most striking differences are associated with job specialties. Within each specialty area, high proficiency exists in a number of skills appropriate to the specialty.

Assessing skill proficiency

A very wide variety of IT skills is needed to support an enterprise as diverse as state government. Each employee usually needs to have command of a suite of skills to accomplish daily work

assignments, but no single employee would be expected to be proficient in all 126 skills assessed in the survey. In this study, employees assessed their own skill proficiency by rating themselves using a five-point scale that ranged from "none" to "expert." Respondents were asked to reflect on their ability to apply each of the 126 skills in a work environment based on their personal experience and training, even if they did not currently use a particular skill. The proficiency scale and definitions are listed below:

- *None* – not able to apply this skill
- *Basic* – able to handle only the simplest assignments or tasks
- *Intermediate* – able to handle independently many types of assignments or tasks
- *Advanced* – able to handle independently nearly all types of assignments or tasks
- *Expert* – able to handle independently all types of assignments or tasks and serves as a role model or coach for others

Given the number of important variables that influence the state IT enterprise and workforce, no absolute measure of statewide proficiency is possible or appropriate. The skill proficiencies vary widely according to several factors. For example, some skills represent fundamental knowledge areas, such as principles of programming, which are prevalent in all agencies and most jobs. Others are very specific IT tools that are used only in certain situations or organizations, such as Java Studio. In addition, proficiency for each skill varies according to different contextual factors such as job specialty or because a certain agency uses one tool while other agencies use another for similar work. Moreover, the desirable distribution of proficiency levels can vary widely depending on these same factors. For example, for a very high-end technical tool, it may be quite appropriate that a few people have expert proficiency while most employees have little or none. For a different skill, one that is more linked to the essence of IT work such as principles of operating systems or system design and development, we would expect to see a wider distribution of proficiency with some employees at the high and low ends and most people in middle.

Because the proficiency ratings were based on a scale, we were able to calculate mean proficiency ratings for each skill. For purposes of estimating mean proficiency ratings, we omitted responses of "none" for all analyses except those which look at the data by job specialty. No single employee would possess proficiency in every skill. For example, we would expect very few people to report a proficiency in Linux because few state agencies have adopted or explored it. Similarly, a person whose job concentrates on desktop computing may have no need for proficiency in network architectures or mainframe operations. Therefore throughout the report (except for presentations that are based on job specialties) we use a proficiency rating scale of 1 – 4 where 1 = basic and 4 = expert. When exploring job specialties, however, we use the full five-point rating scale where 1 = none and 5 = expert. In these instances we included responses of "none" in our analysis to more accurately capture those instances where employees lack proficiency in skills that are actually relevant to the tasks and work activities they need to perform.

Table 5 illustrates the general proficiency rating data available for each skill. It shows the ten technical skills with the highest mean proficiency rating among employees who report having at least basic proficiency. (Table E4 in Appendix E shows similar data for all skills in the survey listed in alphabetical order.)

Table 5. Top ten technical skills by mean proficiency ratings

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Principles of programming	2,588	2.36	566 (22%)	645 (25%)	722 (28%)	329 (13%)	326 (13%)
Windows operating systems	2,809	2.35	544 (19%)	926(33%)	916 (33%)	283 (10%)	140 (5%)
COBOL	2,781	2.21	589 (21%)	424 (15%)	453 (16%)	249 (9%)	1,066 (38%)
Principles of operating systems	2,759	2.18	710 (26%)	922 (33%)	729 (26%)	217 (8%)	181 (7%)
Support for desktop applications	2,793	2.13	669 (24%)	666 (24%)	506 (18%)	211 (8%)	741 (27%)
Hardware & maintenance support	2,795	2.09	710 (25%)	559 (20%)	477 (17%)	207 (7%)	842 (30%)
Help desk activities	2,803	2.05	792 (28%)	627 (22%)	497 (18%)	196 (7%)	691 (25%)
Systems implementation	2,791	2.04	717 (26%)	822 (30%)	498 (18%)	157 (6%)	597 (21%)
System life cycle planning principles	2,793	2.02	759 (27%)	707 (25%)	506 (18%)	145 (5%)	676 (24%)
Testing & evaluation	2,797	1.98	791 (28%)	866 (31%)	454 (16%)	151 (5%)	535 (19%)
Structured system analysis and design principles	2,793	1.98	743 (27%)	749 (27%)	457 (16%)	125 (5%)	719 (26%)

** Means include those employees who have at least basic proficiency, calculated on a four-point rating scale: 1 = Basic, 2 = Intermediate, 3= Advanced, 4 = Expert. Row totals may not equal 100% due to rounding.*

Most of the top skills are broadly distributed across the levels of proficiency. For example, few employees reported having no proficiency in principles of operating systems, while the numbers reported at basic, intermediate, advanced and expert levels resemble a normal distribution with small numbers at the high and low ends, and most in the middle range. COBOL has a different rating distribution because its use is phasing out in most places and many employees have never used it. However, the mean proficiency rating among those who do have the skill is relatively high.

Overall patterns of skill proficiency ratings

The highest proficiency ratings were reported for management and traditional IT skills. The skill with the highest reported proficiency rating is principles of programming (mean 2.36 on a four-point scale). Among the top ten, the other technical skills are COBOL (2.21), principles of operating systems (2.16), support for desktop applications (2.13), and hardware maintenance and support (2.09). The management skills in the top ten were written communication (2.27), oral communication (2.21), customer service (2.16), leadership (2.14), and supervisory skills (2.12). Of the top 25 skills by mean proficiency rating, ten are management skills.

In the full set of 126 skills, overall mean proficiency ratings range from a high of 2.36 to a low of 1.48 on a four-point scale. On average, employees rated their proficiency level as basic for 30 skills, intermediate for 19, advanced for 10, expert for 3 and no proficiency for 62 skills. However, assessing all 126 skills by comparing only the mean scores masks important contextual factors that affect proficiency ratings. The next sections explore these contextual factors in more detail.

Skill proficiency rating patterns by job specialty

Not all skills are needed by all information technology employees. Instead, specific skill sets are associated with the type of work an employee performs. We therefore analyzed skill proficiency ratings within job specialties. Table 6 lists the high proficiency skills reported by respondents in each job specialty area. These are the skills whose mean proficiency ratings were the equivalent of "intermediate" (a mean of 3.0 on a 5-point scale) or higher in the survey results.

Overall, New York State's IT employees report high levels of proficiency in many skills that seem essential to their job specialties. For example, technology managers have high proficiency ratings in management competency skills such as supervision, leadership, and communication. Database administrators and analysts reported their highest proficiency ratings in skills associated with systems and database techniques, while programmers report high proficiency ratings in key programming and systems principles. Other technical specialists have high proficiency ratings in areas such as support and maintenance. (See Table E5 in Appendix E for a complete list of skill means by job specialty.)

Table 6. Top 10* skills with high proficiency ratings by job specialty (listed in order of mean proficiency ratings, starting with highest)

Technology managers	Database specialists	Data communications & telecommunications specialists	Operations specialists
▪ Supervisory skills ▪ Leadership ▪ Written communication ▪ Managing agency staff ▪ Planning & evaluation ▪ Oral communication ▪ Principles of programming ▪ Organizational awareness & business knowledge ▪ Project management ▪ Managing consultant staff	▪ Principles of programming ▪ Database design & development standards ▪ Database applications development techniques ▪ Written communication ▪ COBOL ▪ Windows operating system ▪ Structured system analysis & design principles ▪ System life cycle planning principles ▪ Testing & evaluation ▪ Oral communication ▪ Principles of operating systems	▪ Windows operating system ▪ Principles of operating systems ▪ Network configuration ▪ Written communication	▪ Mainframe operations ▪ Principles of operating systems ▪ Windows operating system ▪ Supervisory skills
Programmers	**Other Technical Specialists**	**Business Specialists**	**Systems specialists**
▪ Principles of programming ▪ Windows operating system ▪ Written communication ▪ Principles of operating systems ▪ Oral communication	▪ Windows operating system ▪ Principles of operating systems ▪ Support for desktop applications ▪ Help desk activities ▪ Hardware maintenance & support ▪ Customer service	▪ Written communication ▪ Oral communication ▪ Leadership ▪ Supervisory skills ▪ Customer service ▪ Windows operating system	▪ Principles of operating systems ▪ Principles of programming ▪ Windows operating system ▪ Written communication ▪ Oral communication

** High proficiency is defined as a rating of 3.0 or higher on a 5-point scale. Not all specialties had 10 skills that met this criterion.*

Skill proficiency rating patterns by grade level, age, and size of agency IT staff

As would be expected, those in upper and middle management levels reported higher proficiency ratings in a larger number of management skills than those at the entry or journey levels. Entry level employees have higher proficiency ratings in operations support activities, consistent with

observations that jobs allocated to G-22 and below tend to perform help desk, call center and desktop support tasks.

Age-related differences are also apparent. Younger (39 and younger) employees tend to have higher proficiency ratings in newer skills such as those associated with the Web and information analysis. This may be related to another pattern in which respondents with more private sector experience, who also tend to be younger, reported higher proficiency ratings in the same areas. Older employees (40 and older) have higher proficiency ratings management skills and mainframe-oriented technologies.

There were no substantial differences among small, medium, and large agencies with respect to the level or pattern of employee proficiency ratings.

Use and importance of skills

The survey also asked employees the extent to which certain skill groups (such as management, security, or information analysis) were important to their current work and the extent to which they currently used these groups of skills. Responses show expected patterns. People in the different job specialties were more likely to say that skills pertaining to their specialties were both more used and more important to their jobs. Older workers and those in higher grade levels were more likely to emphasize the use and importance of management skills than younger workers.

Training Demand

Overview

In addition to rating their personal level of proficiency on 126 skills associated with IT work, New York State IT employees also rated their need for training in each skill. Respondents reported whether they needed training in each skill and, if so, at what level. Choices included basic, intermediate, and advanced training levels. Overall, the greatest demand for training occurs among management skills, followed by skills associated with the Web and with security functions. Strong demand is also present for skills associated with system design and development and networking. Lesser demand is present for information analysis skills followed by operations support and mainframe-oriented technologies. Among the top 25 skills for training demand, eleven are general management skills.

There is little difference among patterns of training demand associated with agency size, grade level or education. As would be expected, different grade levels tend to have different demands for the number and type of skills. The different specialty areas tended to align their training needs with the skills associated with their specialties.

Assessing training demand

After rating their level of proficiency for the skills in the survey, respondents were asked if they needed training in these same skills in order to do their jobs. If they said yes, then they were asked to select the level of training needed. The choices were none, basic, intermediate, and advanced.

As with the proficiency rating scores, several variables influence training demand. One of them is grade level. More senior technology professionals often have basic proficiency in key skills and need higher level training to advance their capabilities. Conversely, managers may not need highly technical training but instead need training that imparts conceptual knowledge about various topics. Job specialty has an influence as well. Those who specialize in a given area need higher level training in certain skills. At the same time, people in any one specialty may need basic knowledge about skills in other specialties in order to understand how the work they do fits with work done by others. In addition, training demand can vary according to the history, size, and mission of an individual's organization. For all these reasons, the size and distribution of training demand varies considerably from one skill, or organization, or job type to another.

Table 7 illustrates the general training demand data for individual skills. It shows the ten technical skills with the highest training demand as measured by the total number of employees who say they need training at any level (Table E6 in Appendix E presents similar data for all skills in the survey listed in alphabetical order).

Table 7. Top ten technical skills by level of training demand

Skill	N*	None	Basic	Intermediate	Advanced	Percent who need training at any level
System security applications	2,696	1,418 (53%)	445 (17%)	546 (20%)	287 (11%)	47%
Website design & development	2,708	1435 (53%)	440 (16%)	503 (19%)	330 (12%)	47 %
Disaster recovery & planning	2,681	1,460 (55%)	411 (15%)	508 (19%)	302 (11%)	46 %
Intrusion detection	2,687	1,467 (55%)	487 (18%)	471 (18%)	262 (10%)	45%
Website management	2,678	1469 (55%)	468 (18%)	447 (17%)	294 (11%)	45%
Identity management & directory services	2,651	1490 (56%)	448 (17%)	448 (17%)	265 (10%)	44%
Encryption	2,662	1506 (57%)	494 (19%)	428 (16%)	234 (9%)	43 %
Web/IP	2,665	1514 (57%)	370 (14%)	480 (18%)	301 (11%)	43 %
Web servers	2,643	1506 (57%)	501 (19%)	389 (15%)	247 (9%)	43 %
Network configuration	2,665	1532 (58%)	345 (13%)	478 (18%)	310 (12%)	43 %

** Row totals may not equal 100 percent due to rounding*

The highest levels of training demand are concentrated in basic or immediate level training. For example, many employees want to know something about a specialized skill like encryption, but do not express a need for advanced training in the subject. For a newer technology like web servers, more employees requested basic training than intermediate or advanced. On the other hand, figures for many of the general management skills and IT management skills show that the majority of employees want advanced training and few want basic or intermediate levels. This is consistent with the generally higher levels of existing proficiency reported for management skills.

Overall patterns of training demand

In general, New York's IT employees express high training needs. On average, employees reported a need for training in 42 skills, comprising a mixture of general professional and management skills, broad IT concepts, and specific techniques or tools.

General patterns show that employees seek training at the next higher level of skill beyond their current proficiency. In responses to the open-ended question, many employees commented on the need for continuous training in their specialties as well as conceptual training in a variety of topics. They often pointed out that the rapid pace of technological change requires ongoing training to keep their core skills up to date. Many also cited the importance of having general familiarity with a variety of areas outside their own specialties in order to do a good job of contributing their particular expertise to larger efforts that combine skills and technologies from several specialty areas.

Every skill in the survey was selected for training by at least some employees. The highest training needs were expressed for management skills with project management (48 percent), leadership (48 percent), and supervisory skills (48 percent) as the top three. Negotiation and conflict resolution

(48 percent) and planning and evaluation (47 percent) were also in the top ten. Of the top 25 skills by number of employees who say they need training, eleven are management skills. Among the technical skills, system security applications (47 percent), website design and development (47 percent) and disaster recovery and planning (46 percent) ranked as the top three. Intrusion detection and website management were also among the top ten.

Training demand by job specialty

As with proficiency ratings, training demand is strongly influenced by job specialty. Across all specialties, relatively high levels of demand (by one-third or more of employees) were reported for roughly 25-40 individual skills. Table 8 lists the top ten skills for which respondents reported high training demand as measured by the proportion of employees in the specialty who said they need training in these skills.

In all specialty areas, employees reported a need for training in a mixture of management and technical skills. Among the management skills, negotiation and conflict resolution, project management, leadership, and supervisory skills are in the top ten for most job specialties. As would be expected, technical skills in the top ten vary considerably from one specialty to another, although system security applications appear in four of the eight specialty areas.

Table 8. Top ten skills for training demand by job specialties

Technology managers	Database specialists	Data communications & telecommunications specialists	Operations specialists
▪ IT strategic planning ▪ Business continuity planning ▪ Negotiation & conflict resolution ▪ IT risk assessment & management ▪ Contract management & vendor relations ▪ IT project portfolio management ▪ IT procurement ▪ IT asset management ▪ Leadership ▪ Capacity management	▪ Java ▪ Oracle ▪ Leadership ▪ Data warehousing ▪ Supervisory skills ▪ Project management ▪ Negotiation & conflict resolution ▪ Oral communication ▪ Disaster recovery & planning ▪ Website design & development	▪ Supervisory skills ▪ Network configuration ▪ Wireless technologies ▪ Project management ▪ Network architecture & design principles ▪ System security applications ▪ Intrusion detection ▪ Wide Area Networks (WAN) ▪ Firewalls ▪ Leadership	▪ UNIX ▪ Windows operating system ▪ Leadership ▪ Supervisory skills ▪ Oral communication ▪ Written communication ▪ Disaster recovery & planning ▪ Negotiation & conflict resolution ▪ Backup & recovery ▪ Principles of operating systems
Programmer	**Other technical specialists**	**Business specialists**	**Systems specialists**
▪ Website design & development ▪ Website management ▪ Project management ▪ Java ▪ Supervisory skills ▪ Leadership ▪ System security applications ▪ Negotiation & conflict resolution ▪ Web servers ▪ Website accessibility	▪ Intrusion detection ▪ Windows network operating systems ▪ Network configuration ▪ Wireless technologies ▪ Backup & recovery ▪ Microsoft Access ▪ Support for desktop applications ▪ Web/IP ▪ Encryption ▪ Hardware maintenance & support	▪ Website design & development ▪ System security applications ▪ Supervisory skills ▪ Web/IP ▪ Leadership ▪ Negotiation & conflict resolution ▪ Website management ▪ Planning & evaluation ▪ Intrusion detection ▪ Project management	▪ Linux operating systems ▪ Negotiation & conflict resolution ▪ Web/IP ▪ Windows operating system ▪ System security applications ▪ Project management ▪ Network architecture & design principles ▪ Identity management & directory services ▪ Leadership ▪ Network configuration

Training demand by grade level, age, and size of agency IT staff

Entry level employees on average reported a need for more training than employees in other grade levels, with an average of 49 skills. Journey level staff and middle level managers both average around 35 skills, while upper management reported training needs for an average of 23 skills.

Respondents in all grade levels said they need training in management skills. Middle level managers expressed a need training in both general management skills (such as project management and leadership) and IT management skills (such as IT strategic planning and risk assessment), while upper level managers concentrated more on the IT management skills. Entry, journey and middle management levels all said they need training in security. Entry level staff reported a need for the broadest range of training, including security, databases, system development, and networking topics, as well as management skills. Journey level respondents predominately focused on more general management, web-related, and security training. Middle managers were the only group to express high need for the management and use of information as an asset (e.g., knowledge management and workflow management).

We found no age-related differences in training demand. Younger (39 and younger) and older (40 and older) employees both say they need training in similar sets of skills. In addition, no significant differences appeared among small, medium, and large agencies with respect to the pattern of training demand.

IT Competency Framework

Overview

In order to create a concise way to work with the full range of skills, we organized the individual skills into logical clusters. The result was a set of seven broad competency areas with specific skills associated with each. Collectively, these competency areas encompass the entire IT function of state government.

In general, higher proficiency ratings are evident in the competency areas we call management, systems and databases, technical support services, and legacy technologies. Lower proficiency ratings are evident in the competency areas of infrastructure, web computing, and management and use of information as an asset. Training demand is higher in management, web computing and infrastructure competencies, and lower in systems and databases, management and use of information as an asset, technical support services, and legacy technologies.

Creating the competency framework

The data on individual skill proficiency ratings and training needs generated an overwhelming amount of detail. In order to manage so much information more economically and effectively, we used several data analysis techniques to organize the skills into logical clusters. Table 9 shows the competency area definitions and lists their associated skills. Statistically, some individual skills are associated with more than one competency area and, logically, competency areas can overlap in their coverage of concepts. For example, object-oriented analysis and design methodology is commonly used in the traditional systems development process, but it is also heavily used in web-based applications development. Similarly, proficiency in data warehousing not only requires good understanding of database design and development principles, but also information analysis and management skills and sound business understanding. However, for simplicity of analysis and presentation, each skill was assigned to the single competency area where its statistical association was strongest.

Table 9. Competency areas and associated skills

Management: (23 skills) Competency encompasses both general and IT management. General skills are associated with working at a leadership level in organizations, including managing staff, communicating, managing relationships, and planning and directing work. IT-oriented management is associated with the treatment of information technology and services as organizational assets, including planning, procuring, monitoring, and protecting those assets.

- IT asset management
- Business continuity planning
- Capacity management
- Change management
- Managing consultant staff
- Contract management & vendor relations
- Customer Relationship Management (CRM)
- Customer service
- Financial management
- Internal controls
- Leadership
- Managing agency staff
- Negotiation & conflict resolution
- Oral communication
- Organizational awareness & business knowledge
- Planning & evaluation
- IT procurement
- Project management
- IT project portfolio management
- IT risk assessment management
- IT strategic planning
- Supervisory skills
- Written communication

Infrastructure: (33 skills) Competency comprises those skills that assure the effective design, operation, and integration of networks, security features, operating systems, and associated support services.

- Network and architecture design principles
- Backup & recovery
- Biometrics
- Broadband technologies
- Cellular technologies
- Computer forensics
- Cryptography
- Disaster recovery & planning
- Encryption
- Firewalls
- Hardware & maintenance support
- Identity management & directory services
- Intrusion detection
- Linux operating systems
- Mac OS /OS X operating systems
- Mobile computing
- Network configuration
- Novell operating systems
- Open systems server administration
- Public Key Infrastructure (PKI)
- Principles of operating systems
- Satellite technologies
- System security applications
- Technology training activities
- Telephone /PBX
- Unified messaging services
- Video imaging
- Voice over IP
- Wide Area Networks (WAN)
- Web/IP
- Windows operating systems
- Windows network operating systems
- Wireless technologies

Web Computing: (29 skills) Competency associated with the Web encompasses the application of principles and effective use of tools and techniques that allow the Web to be used as a platform for well-designed, accessible information-based services.

- Borland JBuilder
- C
- C++
- ColdFusion
- DHTML/ HTML/ XHTML
- Eclipse
- IBM WebSphere Studio
- Java
- JavaScript
- Java Studio
- Microsoft Access
- Microsoft SQL
- MySQL
- Unix operating systems
- Oracle JDDevStudio
- Perl/CGI
- PHP
- Unified Modeling Language (UML)
- Visual Basic
- Visual Basic Script
- Visual Studio .NET
- Web accessibility
- Web design & development
- Web-based graphics & multimedia
- Website management
- Website privacy
- Website search administration
- Web servers
- XML/XSL

Systems & Databases: (19 skills) Competency encompasses the principles and techniques of system analysis, design, development, and implementation, including the ability to build applications and databases as integral components of systems.

- Database applications & development techniques
- CASE tools
- Database design & development standards
- Joint Application Development (JAD)
- System life cycle planning principles
- Object-oriented analysis & design principles
- Oracle
- Business process analysis
- Principles of programming
- SQL
- Quality assurance
- Rapid Application Development (RAD)/ prototyping
- Requirements analysis
- Structured system analysis & design principles
- Systems architecture
- Systems implementation
- Systems integration
- Technical documentation
- Testing & evaluation

Technical Support Services: (3 skills) Competency encompasses the skills associated with effective end-user computing and customer support.

- Support for desktop applications
- Help desk activities
- Call center activities

Management & Use of Information as an Asset: (12 skills) Competency in this area focuses on creating, preserving, and generating value from information content, including skills associated with data definition, records management, knowledge and information sharing, data analysis, and support for collaboration and decision making.

- Artificial Intelligence (AI)
- Collaboration software
- Content management
- Data warehousing
- Decision support systems
- Enterprise Resource Planning (ERP) systems
- Geographic Information Systems (GIS)
- Knowledge Management (KM)
- Metadata management
- Modeling & simulation
- Records management
- Workflow management

Legacy Technologies: (7 skills) Legacy-oriented competency encompasses the skills associated with effective use and management of mainframe computing and related programming languages and operating systems.

- COBOL
- Fortran
- IBM/DB2
- IBM mainframe
- Mainframe operations
- PowerBuilder
- Unisys mainframe

Statewide competency patterns

We used several methods to assess the relative strength of proficiency across the competency areas. These included calculating an overall mean proficiency rating for the skills in each competency area, counting the number and proportion of skills in each area that had mean proficiency ratings in the highest[1] and lowest[2] range, and looking at the number of skills in each competency for which the most frequent proficiency rating was high[3] or low[4]. All of these methods produced the same pattern. Table 10 provides a summary. Overall, higher proficiency ratings exists in technical support services, management, systems and databases, and legacy technologies while lower proficiency ratings exists in infrastructure, web computing, and management and use of information as an asset.

Table 10. Statewide competency overview - skill proficiency ratings

Higher overall skill proficiency ratings occurs in these competency areas	Lower overall skill proficiency ratings occurs in these competency areas
▪ Technical services	▪ Infrastructure
▪ Management	▪ Web computing
▪ Systems and databases	▪ Management and use of information as an asset
▪ Legacy systems	

We conducted a similar analysis of the training demand data looking for patterns of high numbers and proportions of employees who want training in skills assigned to each competency area. Training demand patterns by competency area are summarized in Table 11.

[1] Selected if the mean was 2.0 or higher on a scale of 1 – 4 or a mean of 3.0 or higher on a scale of 1 – 5.
[2] Selected if the mean was 1.5 or lower on a scale of 1 – 4 or a mean of 2.5 or lower on a scale of 1 – 5.
[3] Selected if the mode was equal to 3 or 4.
[4] Selected if the mode was equal to 1 or 2.

Table 11. Statewide competency overview - training demand

Higher training demand occurs in these competency areas	Lower training demand occurs in these competency areas
▪ Management	▪ Systems and databases
▪ Infrastructure	▪ Management and use of information as an asset
▪ Web computing	▪ Technical services
	▪ Legacy systems

Higher training demand for infrastructure and web computing match well with lower proficiency rating patterns for these competency areas. Lower training demand matches the higher proficiency ratings reported for systems and databases, technical services, and legacy systems. Management exhibits both higher proficiency ratings and higher demand, as noted above, while the management and use of information as an asset exhibits both lower proficiency ratings and lower demand. We use these results, along with the IT forecasts provided by the CIO surveys to conduct the gap analysis described later in this report.

Three-year IT Skills Forecast

Overview

CIOs were asked to assign a forecast to each of the 126 skills for three years into the future. The majority of CIOs chose a growth forecast for more skills in the infrastructure and web computing competency areas than in the others (eleven and nine skills respectively). The majority also chose growth forecasts for three management skills, four system and database skills and four skills in the competency area of management and use of information as an asset. No skills in technical support services or legacy technologies received a majority growth forecast. Some differences are evident across different size agencies, but at least half of the CIOs in agencies at all three size levels chose a growth forecast for fourteen skills, with most emphasis on infrastructure and web computing. These fourteen skills include website design and development, website management, system security applications, and identity management and directory services, as well as systems integration, project management, and records management.

Assessing the skill forecasts

The agency CIO survey provided agency-specific forecasts of the need for specific IT skills over the next three years. CIOs assigned a forecast to each of the 126 skills based on their knowledge of their agency operations and strategies. CIOs selected their forecasts from the following choices:

- *In use and growing* – currently in use and expect use to increase over the next three years
- *Steady state* – currently in use and expect use to remain stable over the next three years
- *In use, but declining* – currently in use, but expect use to decline over the next three years
- *Possible adoption* – planning to explore or currently exploring for possible adoption in the next three years
- *None expected* – not currently in use and not expected to be used over the next three years
- *Don't know* – do not know if this skill or technology will be used within the next three years

As with proficiency ratings and training demand, there is no one best way to assess the forecast data. Different agencies are in different phases of skill adoption and use based on their missions, size, and previous history. Therefore, we looked at the three-year forecasts in several ways.

Forecast patterns

One way to look at the data is to assess the number and kind of skills that fall into each forecast type. Viewed in this way, the following rough patterns emerge:

- *In use and growing forecast* – applied predominantly to skills associated with networks, security, the web, and information analysis and management.
- *Steady state forecast* – applied predominantly to foundational skills in both technical and management areas
- *Possible adoption forecast* – applied predominantly to emerging technologies associated with modern infrastructures and analytical tools
- *In use, but declining forecast* – applied predominantly to legacy technologies and specific types of web computing tools
- *None forecast* – applied predominantly to legacy technologies

Table 12 below illustrates how the forecasts are distributed across competency areas for forecasts other than growth. It shows the top five skills selected by CIOs for each forecast as measured by the number of CIOs who selected a particular forecast for a particular skill.

Table 12. Top five forecasts (other than growth) by competency area

Competency Area	Steady state (percent of CIOs choosing forecast)	Possible adoption (percent of CIOs choosing forecast)	In use, but declining (percent of CIOs choosing forecast)	None expected (percent of CIOs choosing forecast)
Management	▪ Internal controls (57%) ▪ Managing agency staff (55%)			
Infrastructure	▪ Hardware maintenance & support (71%) ▪ Principles of operating systems (63%)	▪ Voice over IP (56%) ▪ Public Key Infrastructure (PKI) (53%) ▪ Biometrics (61%) ▪ Video imaging (38%) ▪ Linux operating systems (38%)		▪ Mac OS/ OS X operating systems (85%)
Web computing			▪ Microsoft Access (35%) ▪ Visual Basic (22%)	▪ Borland JBuilder (80%)
Systems and databases				
Technical support services	▪ Support for desktop applications (64%)			
Management and use of information as an asset				
Legacy technologies			▪ COBOL (39%) ▪ Mainframe operations (26%) ▪ PowerBuilder (22%)	▪ Fortran (95%) ▪ Unisys mainframe (80%) ▪ IBM mainframe (64%)

To further illustrate these patterns, Tables E7 – E11 in Appendix E show the top ten skills in each forecast type and highlight the competency area associated with each skill.

This study is particularly concerned with gathering information that prepares New York for the future; therefore CIO growth forecasts for skills are especially relevant. Table 13 lists the skills in each competency area where at least 50 percent of the CIOs chose the growth forecast. The table shows that substantial growth is expected in five of the seven competency areas, with the greatest number of technical skills needed over the next three years falling in the infrastructure and web computing competencies.

Table 13. Skills with growth forecast by competency area

Competency Area	In use and growing (percent of CIOs choosing forecast)
Management	▪ Project management (66%) ▪ Change management (53%) ▪ Business continuity planning (50%)
Infrastructure	▪ System security applications (82%) ▪ Identity management & directory services (70%) ▪ Encryption (68%) ▪ Disaster recovery & planning (67%) ▪ Web/IP (66%) ▪ Intrusion detection (63%) ▪ Mobile computing (60%) ▪ Network architecture & design principles (54%) ▪ Windows operating system (52%) ▪ Wireless technologies (51%) ▪ Firewalls (51%)
Web computing	▪ Website design & development (82%) ▪ Website management (72%) ▪ DHTML/ HTML/ XHTML (63%) ▪ JavaScript (61%) ▪ Java (61%) ▪ XML/XSL (57%) ▪ Website accessibility (54%) ▪ Web servers (54%) ▪ Website search & administration (53%)
Systems and databases	▪ Systems architecture (56%) ▪ Systems integration (56%) ▪ Oracle (53%) ▪ Testing & evaluation (50%)
Technical support services	
Management and use of information as an asset	▪ Records management (56%) ▪ Workflow management (55%) ▪ Content management (51%) ▪ Data warehousing (51%)
Legacy technologies	

Growth forecasts by agencies with small, medium, and large IT staffs

When we examine the growth forecasts by IT staff size, some clear themes emerge. CIOs with large IT staffs were more likely to forecast growth for IT management skills, especially those associated with more complex IT operations such as IT project portfolio management and IT risk assessment. CIOs with medium and large IT staffs shared strong growth forecasts for web computing and systems and database skills, as well as for skills that comprise management and use of information as an asset. CIOs of small agencies were more likely to forecast growth in infrastructure skills, as were CIOs of medium agencies. Table 14 below highlights these similarities and differences in the growth forecasts across the three agency size groups. (Similar data for the other forecast types can be found in Tables E12 –E14 in Appendix E.

Table 14. Similarities and differences in growth forecast across agency size groups

Competency Area	In use and growing (50% or more of CIOs in all three agency size groups chose this forecast)	Differences among in use and growing forecasts (50% or more of CIOs in the listed size groups chose this forecast)
Management	▪ Project management	▪ Change management (medium, large) ▪ IT project portfolio management (medium, large) ▪ Business continuity planning (medium, large) ▪ IT asset management (medium, large) ▪ Financial management (medium) ▪ Organizational awareness & business knowledge (medium) ▪ Leadership (large) ▪ IT strategic planning (large) ▪ Managing consultant staff (large) ▪ IT risk assessment & management (large) ▪ Capacity management (large) ▪ Contract management & vendor relationships (large) ▪ IT procurement (large) ▪ Planning & evaluation (large)
Infrastructure	▪ System security applications ▪ Identity management & directory services ▪ Encryption ▪ Web/IP ▪ Mobile computing ▪ Disaster recovery planning ▪ Intrusion detection	▪ Network architecture & design principles (small, medium) ▪ Firewalls (small, medium) ▪ Windows operating systems (small, medium) ▪ Windows network operating systems (small, medium) ▪ Wireless technologies (small, medium) ▪ Network configuration (small, medium) ▪ Backup & recovery (small, medium) ▪ Technology training activities (small, medium) ▪ Open systems server administration (medium) ▪ Unified messaging services (medium) ▪ Linux operating systems (medium) ▪ Video imaging (medium) ▪ Cellular technologies (medium) ▪ Broadband technologies (large) ▪ Wide Area Networks (WAN) (large)
Web computing	▪ Website design & development ▪ Website Management ▪ DHTML/ HTML / XHTML	▪ Web servers (small, medium) ▪ Website accessibility (medium, large) ▪ Website search administration (medium, large) ▪ Website privacy (medium, large) ▪ Java (medium, large) ▪ JavaScript (medium, large) ▪ XML/ XSL (medium, large) ▪ UNIX (large) ▪ Unified Modeling Language (UML) (large)
Systems and databases	▪ Systems integration	▪ Object-oriented analysis & design principles (medium, large) ▪ Technical documentation (medium, large) ▪ Oracle (medium, large) ▪ Systems architecture (medium, large) ▪ Systems life cycle planning principles (medium, large) ▪ Testing & evaluation (medium, large) ▪ Database design & development standards (medium, large) ▪ Business process analysis (large) ▪ Quality assurance (large) ▪ Joint Application Development (JAD)/ prototyping (large) ▪ CASE tools (large) ▪ Requirements analysis (large)
Technical support services		▪ Call center activities (large) ▪ Help desk activities (medium)
Management and use of information as an asset	▪ Records management	▪ Data warehousing (medium, large) ▪ Content management (medium, large) ▪ Collaboration software (medium, large) ▪ Workflow management (medium, large)
Legacy technologies		

Statewide forecast highlights

The growth forecast is an important indication of where agencies are headed over the next three years. Both the overall growth forecast and in the agency size forecast highlighted three competency areas (Table 15): infrastructure, web computing, and management and use of information as an asset.

Table 15. Statewide forecast picture

Growth forecast appears most often in these competency areas
▪ Infrastructure
▪ Web computing
▪ Management and use of information as an asset

Gap Analysis

Overview

The two surveys provided a great deal of detailed information about current skill proficiencies, training need, and future forecasts for skills. We combined these three kinds of information with a fourth – the New York State IT Enterprise Architecture Principles which identifies key elements of the State's IT strategy.

Using all these sets of information, we "triangulated" on the skills and competencies that represent strong convergence among low proficiency ratings, high training demand, forecasted growth, and strategic importance. At the statewide level, the skills that emerged from this analysis fall almost entirely in the competency areas of infrastructure, web computing, and management and use of information as an asset. Two management skills, business continuity planning and IT risk assessment, also emerged. No appreciable gap was evident for the high-proficiency competency areas of systems and databases, technical support services, or legacy technologies. When the gap analysis was performed for individual job specialties, the same strong patterns were evident, although each specialty included a set of additional skills relevant to its work content.

Criteria for assessing need: low proficiency ratings, high training demand, growth forecast, strategic importance

One useful way to determine high priority areas for training investment is to look for the convergence of interests of the major stakeholders – employees, agency IT leaders, and statewide IT leaders. We have done this by starting with the skills for which employees reported low levels of current proficiency. We then refined this list by comparing it to the skills for which there is high employee demand for training. To complement the employee perspective, we identified low-proficiency skills for which agency CIOs reported a growth forecast in the CIO survey. The final refinement was to flag those low-proficiency, high-growth skills that are necessary to achieve the goals expressed in the statewide enterprise architecture principles. Each criterion is defined below:

- *Criterion 1.* Low current proficiency – different definitions are used for statewide and job specialty-specific analyses:
  (A) For the statewide analysis, a mean proficiency rating of 1.5 or less on a scale of 1 (basic) to 4 (expert). The mean for each skill excluded employees who reported their proficiency level as "none" on that skill.
  (B) For analysis of the job specialties, a mean proficiency rating of 2.0 or less on a scale of 1 (none) to 5 (expert). The mean for each skill includes employees who reported their proficiency level as "none" in order to capture lack of proficiency in relevant skills.
- *Criterion 2.* High employee demand for training – these skills fall in the top two quartiles of employee demand for training at any level from basic to advanced. Employees who reported no need for training on a particular skill are excluded from the demand calculation for that skill.
- *Criterion 3.* High growth forecast – at least 50 percent of the CIOs chose "in use and growing" as the three-year forecast for these skills.
- *Criterion 4.* Strategically important to the enterprise – these skills are directly related to achievement of the State's enterprise architecture goals *and* at least 40 percent of CIOs chose "in use and growing" as the three year forecast.

High impact skill investments

Skills with low proficiency ratings and various combinations of high training demand and high strategic or future need are considered "high impact skills" worthy of high-priority investments. That is, they represent the areas where investments to increase employee proficiency are most likely to result in more strategic and effective use of IT in state government. Figure 1 illustrates this convergence of interests.

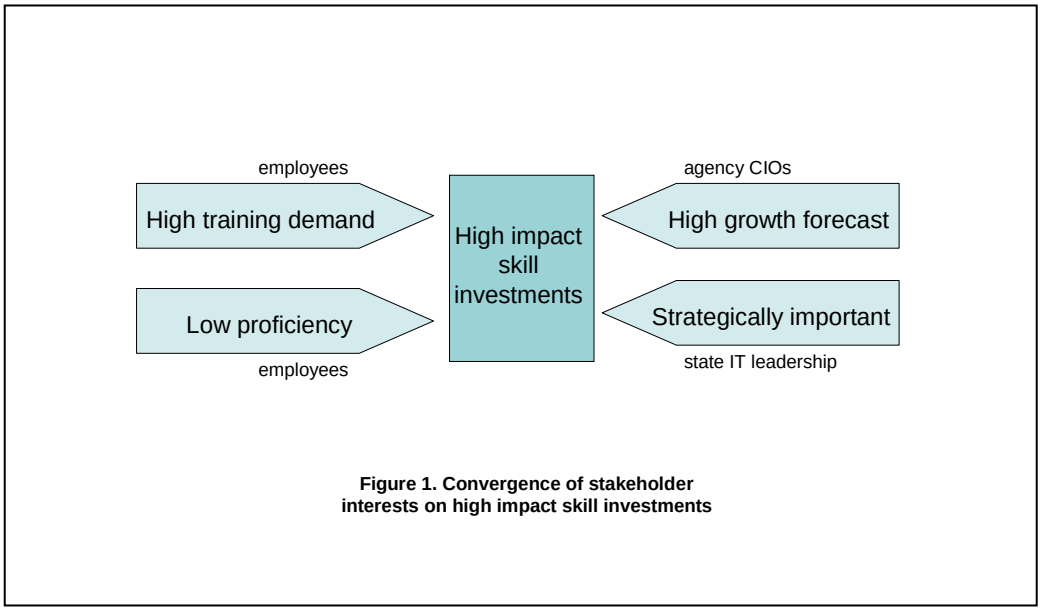

Figure 1. Convergence of stakeholder interests on high impact skill investments

We designated a skill as a "high impact skill investment" if it met one of the following tests:

- Low proficiency ratings + high training demand + high growth forecast + strategically important
- Low proficiency ratings + high training demand + high growth forecast
- Low proficiency ratings + high training demand + strategically important

Statewide Gap Analysis

The statewide gap analysis highlighted fourteen specific skills distributed across four of the six competency areas as shown in Table 16.

Table 16. High impact skill investments

Competency Area	Specific skills
Management	▪ Business continuity planning ▪ IT risk assessment and management
Infrastructure	▪ Systems security applications ▪ Identity management & directory services ▪ Encryption ▪ Intrusion detection ▪ Firewalls ▪ Wireless technologies
Web computing	▪ Java ▪ XML/XSL ▪ Website privacy
Systems and databases	
Technical support services	
Management and use of information as an asset	▪ Content management ▪ Data warehousing ▪ Records management
Legacy technologies	

Patterns by job specialty

We performed the same analysis for each job specialty to identify the high impact skill investments that pertain to each kind of IT specialization. Very similar results were produced. None of the high impact skills for any job specialty fell in either the technical support services or legacy technologies competency areas. Conversely, every specialty includes high impact skills in the competencies of infrastructure, web computing, and use and management of information as an asset. Moreover, many of the same individual skills occur in all or nearly all specialty areas. (The full results by job specialty are shown in Table E15 in Appendix E.)

All specialties except IT managers included high impact investments in the management competency area. This is not surprising, given the generally high level of management proficiency ratings among IT managers. Among the technical specialties, operations included the fewest number of high impact skills, while the business and other technical specialties had the most. These last results probably reflect the wide range of job assignments that can be found among employees whose titles fall in these last two specialty areas. In these two groups, agency level analyses will probably reveal clearer patterns than the statewide assessment is able to provide.

Workforce Development Considerations

Using the competencies as an organizing framework for skills development

The seven competency areas encompass a full range of capabilities for both IT professionals and IT organizations. Collectively, they represent a *competency framework* that is useful for considering both agency effectiveness and individual proficiency ratings across the full spectrum of IT activities. In this sense, no single person or agency could be expected to be expert in every individual skill, but (with the possible exception of legacy technologies) IT employees and organizations should possess some level of proficiency in each of the seven competency areas. The optimal degree of proficiency for an individual depends on his or her job specialty, work assignments, and level of responsibility. For example, a journeyman data communications specialist should have advanced or expert proficiency in the skills that comprise the core of this specialty area. This same person should have at least basic knowledge of the key principles and methodologies that make up the other competency areas. Many of the open-ended comments reflected a desire for this breadth of knowledge on the part of employees.

> *"Each IT track in the state workforce should have a basic understanding of the others. As an applications programmer, I may not need to be an expert in the tools used by Security or Operations, but a basic understanding of what they use and why would certainly improve my ability to respond to and understand their requests and to know what I need or can ask for from those resources."*

> "*Technical training is usually only given to technicians (programmers, DBAs, network administrators). However, the managers of those who are actually 'hands-on' rarely get any training to keep them up-to-date. There should be corresponding management-level type courses to help managers and supervisors remain current with their staff."*

Optimal proficiency for agency IT organizations depends on organizational context and the nature of the relationship between IT and the agency's overall mission. A large agency with extensive infrastructure, large application systems, and many employees who handle sensitive transactions needs high levels of proficiency in areas such security, IT management, and technical support services. A small agency that relies on the Office for Technology to provide centralized infrastructure and high-level technical services still needs at least basic proficiency in the principles of security and system design, while it may concentrate its own expertise in other areas such as content management. Some agencies can segment their IT workers into specialty areas, others need a broad range of capabilities concentrated in only a few individuals.

> *"The demands on an IT person working in a small bureau are over looked. The multitude of skills required to do it all are so many that becoming proficient at any one is impossible. One minute it's coordinating roll outs of new equipment, the next it's Internal Control reports, then update web pages, test new applications . . . develop business continuity plan [and so on]. There is really no way to follow one*

path of proficiency. With staff down to minimum, small bureaus require this type of person to do it all."

For all these reasons, the competency framework helps illustrate how staff development efforts could be organized into customizable competency-based programs that combine courses in related sets of skills into coherent curricula that include complementary topics and appropriate levels of intensity. The idea is to help employees acquire sets of related or complementary skills that round out their competency in all seven areas.

Employee motivations for training

Participants were asked to report the reasons they believed training was worthwhile to them. Multiple answers were allowed. Nearly all employees (92 percent) reported that training is worthwhile to improve their ability to do their existing work. Similarly, 83 percent said that training would prepare them for more demanding work and a greater variety of assignments. Table 16 in Appendix E provides the full set of responses.

"IT skills necessary to keep an organization afloat, let alone lead one to excellence are continually changing and extremely demanding. This year alone I've been involved in projects where network administration, OOP (Java and VB), COBOL, security, budgeting/financing, web design, WAS, and basic supervision and management skills are all needed."

"Changing technologies will require me in the future to use technologies which are little or no part of my current tasks. Once I have training in these areas I will be able to help in expanding the agency's ongoing transition to those technologies. Staff who are assigned to older technologies and not given training for newer technologies may feel they are in a dead-end situation. This can have an impact on motivation and morale."

Employee preferences for learning methods and communication

Participants were asked their preferences for learning three different types of skills: specific technical tools (such as software languages), general IT skills (such as design principles), and management skills (such as negotiation and conflict resolution). They were asked to choose the top two from among eight different methods for each skills category. Overwhelmingly, the most preferred method across all three categories was off-site classroom training. (See Table E17 in Appendix E). On-site classroom training was the second most preferred method. Self-paced e-learning garnered some interest for learning specific technical tools and general IT skills.

"I currently take part in the e-learning program that my agency offers. I find it very informative. My problem is allocating a block of time to actually work on the e-learning, without letting something else slide. Classroom training has its advantages, because it makes you leave the worksite and you can focus on that class the entire time."

In addition, many emphasized the need for practical application in addition to instruction.

> *"Training should be instructor led and should allow workers to get hands-on experience, if possible, in various areas. It is important to focus on real-life situations and to develop a real understanding of topics, as opposed to focusing on abstract ideas."*

A number of respondents offered suggestions for combining different training methods to get better results. For example, several said good quality books help them get familiar with a topic and serve as references after formal training has occurred. In a similar vein, some stated that e-learning is good for an introduction to a skill but it needs to be followed by more intensive and interactive methods if more than 'familiarity' is needed. Others recommended that formal training be combined with mentoring and coaching. Some advocated for college-level courses in some areas as well as the opportunity to attend technical conferences.

Many commented that the training they receive is often good quality, but the timing is ineffective, occurring, for example, when the funding is available rather than when the need and opportunity to apply the skill is imminent. Consequently, the training experience (and expense) can be mostly or entirely wasted.

Participants were also asked how they preferred to be informed of IT training opportunities. Nearly all (95 percent) chose e-mail. The second most selected option (53 percent) was to be informed through their agency's Intranet (see Table E18 in Appendix E).

CIO preferences for training methods and professional certifications

CIOs also overwhelmingly supported off-site classroom training for employees. For each of the three types of training surveyed, CIOs rate this method as their number one choice.

CIOs also favor professional certifications for a number of skill types. Three-quarters of the CIOs reported that professional certifications would or might be helpful in accomplishing their agencies' missions over the next three years. Of the kinds of certifications investigated, four were endorsed by 60 percent or more of the CIOs. These were project management, information systems security, network security, and databases. Currently, only 1-2 percent of employees hold certifications in these areas. (Table E 19 in Appendix E shows the number of employees holding current certifications and Table E20 presents the CIOs' preferences for certifications.)

Conclusions and Future Considerations

The New York State government enterprise spans thousands of employees, numerous agencies, and many different public service missions, as well as geographic locations. The proficiency of the State's IT workforce helps make the enterprise run smoothly and contributes to its effectiveness. This study produced a comprehensive current profile of demographics, proficiencies, and training needs of the current state IT workforce. It also produced a comprehensive set of agency-level IT forecasts for the next three years. Together, these profiles revealed the following high-level indicators of key training and other skill-related needs for statewide and agency-level leadership attention.

First, New York has a strong foundation for moving into the future. The study documented the following positive conditions:

The IT workforce:

- has strong and pervasive management skills
- is well-educated
- is very experienced in state government and in the missions of agencies
- has high proficiency in fundamental IT skills which will remain important into the future
- is highly motivated for training

Equally important, the study showed:

- A substantial gap exists between the current proficiency profile of the IT workforce and skills that are forecasted to grow in importance in the near future.
- Infrastructure, the web, and work associated with information content present substantial challenges. Most agency CIOs forecast growing need for skills in these competency areas, but current proficiency ratings are low in all three.

Fortunately, strong convergence is evident across employees, CIOs, and state IT leaders on the types of skills that are necessary to achieve and sustain an effective IT enterprise across state government in the future. These skills represent the most fruitful areas for investment. They emerged from a comparison of low current proficiency ratings, high future need, high employee demand for training, and strategic importance to the enterprise.

Training professionals can use the data from this study to construct comprehensive development programs and coherent curricula that address the needs of workers in a variety of job specialties as well as the core competencies that pertain to all IT professionals. In addition, similarities in key needs across all types of agencies present opportunities for partnerships and economies of scale in training and professional development investments.

In addition, the data set itself is a rich resource for use in other aspects of state and agency IT planning and development, including input to:

- Labor-Management decisions on training program priorities
- IT Training Academy decisions on the design of competency-based curricula and training programs
- collective purchasing of training programs for widely needed skills
- agency-level planning and spending to optimize needed competencies
- the statewide strategic plan and technology standards
- IT-related HR functions (such as recruitment and retention)

Finally, the study results also suggest areas for future investigation and leadership attention in the areas of workforce development, training program design, and enterprise IT planning.

Skill proficiency affects many aspects of IT workforce development. These aspects include assessing the relationship between job advancement and technical proficiency as well as the role education and skills assessments could play in recruitment. Other topics include the usefulness of a skills orientation to IT succession planning and better understanding of the relationships among training, employee satisfaction, and retention.

Training and other professional development programs would benefit from further evaluation. Future considerations for the design of learning opportunities include determining the effectiveness of formal education compared to skill-oriented training, as well as understanding the effectiveness of various methods and combinations of methods for achieving different competency goals. Another consideration is the possibility of identifying core competencies and ideal specialization profiles to help set priorities. In addition, consideration could be given to policies and methods for coordinated purchasing of professional development programs.

An important relationship exists between skills and the effectiveness of the IT enterprise. Future exploration in this area might include better understanding of how organizational culture and policies affect proficiency levels, consideration of current and needed skills in the process of selecting agency and statewide IT standards, and explicitly incorporating skills considerations into organizational strategies for moving to higher levels of IT effectiveness.

Appendix A: Methodology

The study consisted of two voluntary on line surveys, one directed to IT employees and the other to agency Chief Information Officers. Both were administered during March and April 2006.

The employee survey population included 4,882 IT professionals employed in 54 state agencies, authorities, and boards. The survey population consisted initially of all State employees who held one of a specified set of technical job titles and was augmented by other employees in non-technical titles who were identified by their employing agencies as performing some aspect of their agency's IT function. The initial list comprised 4,586 employees and was provided by the Department of Civil Service at the formal request of the State CIO. The additional employees were identified by their agencies during a process of list validation in which each agency designated a liaison who reviewed the Civil Service listing, made additions and corrections and added email addresses so that all employees could be contacted directly by the Center for Technology in Government (CTG) at the University at Albany, which conducted the study.

The employee survey instrument was based on a similar instrument used by the US Office of Personnel Management to assess the skill proficiency of federal IT employees. Due to differences in human resources (HR) terminology and focus, the federal instrument was substantially revised to meet the needs of New York State. The surveys were developed through several successive iterations of discussion with the HR committee. Employee union representatives also gave input on the employee survey. Both surveys were pre-tested by volunteers. They were administered on line using specialized commercial software.

The on line surveys collected data about 126 skills ranging from programming and security to system design and development, to IT management and general management skills. The employee survey was a self-assessment instrument that asked respondents to rate their current level of proficiency in each skill as well as their need for training in the same 126 skills. Demographic questions collected data on length of service, retirement intentions, and education. Employees also answered questions about their preferences for training methods and supplied comments and additional information in an open-ended question. The CIO survey covered the same 126 skills but asked these agency IT leaders to forecast the need their individual organizations would have for these skills three years into the future. Similar demographic, training, and open-ended questions were also included.

A formal human subjects research protocol was prepared by CTG in cooperation with the CIO Council HR Committee. The protocol was approved by the University at Albany Institutional Review Board. It included methods for obtaining informed consent and assuring individual respondents of their rights as research participants, descriptions of how identities and data confidentiality would be protected, and how the data would be used in the analysis. The protocol also included a draft of the questions to be included in the surveys.

An extensive communications and outreach plan included letters from the Office of the CIO to all agency heads, agency CIOs, and individual IT employees informing them of the goals of the survey and encouraging them to participate. Posters designed by a state agency staff member were printed

and distributed to work sites and several large meetings were held with employee groups from different agencies to discuss the survey before it took place. A project description, list of agency liaisons and Frequently Asked Questions (FAQ) were posted on CTG's web site and several professional organizations published articles in their newsletters. The two major employee unions endorsed the survey and held information sessions as well. A designated agency liaison answered employee questions and assured that technical problems with email administration due to firewalls or internet access policies could be avoided or quickly addressed.

Both surveys were conducted on line using Survey Monkey commercial software. Agency liaisons s and CIOs received weekly reports of their response rates until the survey closed. A help desk was administered at CTG for employees and liaisons to ask questions or discuss technical problems with accessing or answering the survey. Several alternative versions of the survey were available to employees with accessibility needs.

The employee response rate was 64 percent, including those who affirmatively declined to participate. The usable response rate was 58 percent, with very good representation by agency size, grade level and job specialty. Comparison of the responding sample to the population on these characteristics showed only minor variations, indicating the lack of a systematic response bias. The largest variation between sample and population occurred with employees in the large agencies (more than 200 IT employees). They constituted 47.2 percent of the population and 42.5 percent of the respondents. The differences for all other size, grade, and job specialty characteristics was considerably smaller. The CIO survey response rate was 100 percent.

The two data sets were analyzed separately and then compared to produce a statewide employee skills profile, IT forecast, and gap analysis. Additional variables were created or calculated during the analysis. For example, employees reported their current ages on the survey. After reviewing the distribution of ages, we then created age categories for use in some of the analyses. An age category variable was therefore added to each record. In addition, after categorizing job titles into job specialties, a job specialty code was assigned to each record. We also added a variable to identify whether the individual respondent worked in an agency with a large, medium, or small IT staff.

Factor analysis was used to investigate the existence of clusters among the skill proficiency variables, using the principal components technique and oblique rotation. An oblique rotation was used based on the assumption that some of the skill variables would be interrelated. A skill was considered to be part of a factor if its factor loading was 0.4 or higher. The resulting sets of skills were then subjected to reliability analysis to test how well they fit together as a coherent set of measures. Minor adjustments were made in assigning skills to sets. The reliability scores for the resulting factors were all 0.90 or higher, except for legacy technologies (which at .071 is still above the recommended threshold for high reliability). Summary competency area scores were calculated for each respondent by calculating the mean of that person's reported proficiency in the skills associated with each competency.

Both descriptive and inferential statistical methods were used. The analysis and presentation of demographic profiles are entirely descriptive. For most other aspects of the analysis we conducted parametric and/or non-parametric tests in order to detect and explore statistically significant differences among groups. In some cases, the data were not suitable for formal statistical tests of

group differences. For job specialties, in particular, the sizes of the groups are too disparate for such tests to be used with confidence (i.e., the programmer group alone represents nearly half the respondents and the remaining groups are much smaller). In this case, we described the results for each specialty separately. We also looked for evidence of bias that might be introduced by missing data for key variables. For example, missing data for the skill proficiency variables (which all respondents were asked to assess) were generally far below a threshold of 5 percent of cases, with no systematic patterns, indicating little or no bias is likely in the distribution of responses. In addition, we assessed the practical significance of the results with respect to the goals of the study. Throughout the analysis and report, we emphasize the broad tendencies and larger patterns that emerged from the data.

Proficiency rating patterns, training need patterns, and IT forecasts are all affected by various contextual influences that mitigate against taking a single analytical approach. As described in the text in each of these sections, we used multiple methods to make these assessments in order to minimize the bias that might be introduced by looking at the data in only one way. In all three areas, these multiple perspectives gave substantially the same result. These multiple methods were augmented by sensitivity analyses in which we applied different cut-off points and rounding methods to test the strength of the main findings. These alternative tests slightly affected the details, but did not change the overall pattern of proficiencies, training needs, and gaps.

Finally, additional agency level analyses will be conducted for those agencies where the number of employee respondents is large enough to assure confidentiality in accordance with the assurances in the Human Subjects Review and statement of informed consent.

Appendix B:
Project Sponsors and Participants

Collaborating agencies

CIO Council Human Resources Committee
http://www.cio.state.ny.us/ciocouncil.htm

New York State Office of Employee Relations (GOER)
http://www.goer.state.ny.us

New York State Office for Technology (OFT)
http://www.oft.state.ny.us/index.htm

Public Employees Federation (PEF) AFL–CIO
http://www.pef.org/

Civil Service Employees Association (CSEA)
http://www.csealocal1000.org/

Executive Sponsor

Michael R. Mittleman, Ph.D. – New York State Chief Information Officer (CIO)

IT Workforce Skills Assessment Project Members

Jay Canetto	Office of the State Comptroller
Marilyn Cordell	Office for Technology
Terri Daly	Office for Technology
Elaine Ehlinger	Office for Technology
David Gardam	Co-Chair, Office of Alcoholism and Substance Abuse Services
Jeff Grunfeld	Office of the State Comptroller
Nancy Gutterman	Office of the State Chief Information Officer
Celia Hamblin,	Co-Chair, Department of Labor
Deborah Heaphy	Department of Taxation and Finance
Melinda Hicks	Governor's Office of Employee Relations
Robert Kelly	Department of Housing and Community Renewal
Ronald Minafri	Insurance Department
Kathy Ravida	Office for Technology
Frank Slade	Department of Civil Service

Agency Liaisons

Yvette Alexopoulos	Office of General Services
Victor Artale	Office for the Aging
David Bradley	Governor's Office of Regulatory Reform
Mike Buttino	Higher Education Services Corporation
Maureen Cahill	State Board of Elections
Jim Campbell	Office of Homeland Security
Jay Canetto	Office of the State Comptroller
Gail Casey	Office of Real Property Services
Patrick Cassin	Office of Mental Health
Tony Cerulli	New York State Office of Science,Technology & Academic Research
Sandra Cocco	Department of State
Natalie Cole	New York State Police
Tom Corrado	Commission on Quality of Care and Advocacy for Persons with Disabilities
Elnora Cowan	Office of the Attorney General
Jane Craig	Department of Public Service
Michael Drake	State Liquor Authority
James Edgar	Public Employment Relations Board
Marc Ehlinger	Department of Insurance
Elaine Ehlinger	Office for Technology
Leigh Favitta	Dormitory Authority
Michelle Ganance	Department of Labor
David Gardam	Office of Alcoholism & Substance Abuse Services (OASAS)
Cindy Haskins	Office of the Inspector General
Diane Hodge	Office of Children and Family Services
Bill Johnson	Office of Cyber Security and Critical Infrastructure
Wendy Jordan	Division of the Budget
Armount Joseph	State Division of Human Rights
Stephanie Karwan	Thruway Authority
Bob Kelly	Division of Housing & Community Renewal
Karl Kelly	Division of Military & Naval Affairs
John Kinnicutt	New York State Racing and Wagering Board
Marina Kozitsky	Department of Banking
Roger Ksenich	Office of Mental Retardation & Developmental Disabilities
Remy Lafargue	Department of Motor Vehicles
Mary Lewis	State Division of Parole
David Loomis	Crime Victims Board
Eileen Ludwin	Department of Civil Service
Ramon Maseda	New York Power Authority
Paul McGinn	Office of Temporary Disability Assistance (OTDA)
Jean McWilliams	Division of Tax Appeals and Tax Appeals Tribunal
Herb Munoz	NYS Commission of Investigation
Debi Orton	Governor's Office of Employee Relations
Gene Pezdek	Department of Environmental Conservation
Ulrike Pohlig	State Emergency Management Office (SEMO)
Barb Remling	Office of Parks, Recreation, & Historic Preservation

Bob Sammons	State Insurance Fund
Wendy Scheening	Department of Agriculture & Markets
Michelle Schultz	Workers' Compensation Board
Brian Scott	Department of Health
Ray Sestak	Division of the Lottery (NYS Lottery)
Jim Shea	Division of Criminal Justice Services
Sharon Shear	Department of Correctional Services
Deb Shimkus	Department of Taxation & Finance
Kathy Weaver	Department of Transportation
Lynn Whitehouse	New York State Bridge Authority
Eileen Wierzbowski	Department of Education
David Young	NYS Energy Research & Development Authority (NYSERDA)

Appendix C: Skill Definitions

Table C1: Skill list and definitions (alphabetical order)

Definitions for most skills were provided in the survey. They are presented below.

- Artificial Intelligence (AI): principles, methods, and tools used to design systems that perform human intelligence functions.
- Backup & recovery
- Biometrics
- Borland JBuilder
- Business continuity planning: knowledge of how to build contingencies and strategies for minimizing financial and operational losses following service interruptions caused by natural, technological, and attack-related emergencies.
- Business process analysis: knowledge of different methods, metrics, tools, and techniques used to assess business processes.
- C
- C ++
- Call center activities: organizing and using a variety of technologies and techniques to improve the management and servicing of inbound and outbound phone calls serving internal customers (e.g., help desks) or external customers (e.g., customer service and support centers).
- Capacity Management: principles and methods for monitoring, estimating, or reporting actual performance or the performance capability of information systems or components.
- CASE tools
- Cellular technologies
- Change management: management practices used to ensure a smooth transition and minimal disruption during a system implementation, and during process changes introduced in an organization.
- COBOL
- ColdFusion
- Collaboration software (e.g. Lotus Notes, etc.)
- Computer forensics: knowledge of tools and techniques used in data recovery and preservation of electronic evidence.
- Content management: processes and technologies used to support the evolutionary life cycle of digital information, which includes the creating, editing, storing, terminology filing, organizing and publishing content on the web.
- Contract management & vendor relations: knowledge of how to work with legal counsel on contracts and maintain relationships with vendors. Participating in project negotiations and helping IT managers make informed decisions on which vendor can offer the best deal and the best service for a particular project. Dealing with invoices and back-end contract activity.
- Cryptography
- Customer Relationship Management (CRM): methodologies and tools to help manage customer relationships in an organized way, including strategies and software that optimize performance and customer satisfaction.
- Customer service: working with clients and customers to assess their needs, provide information or assistance, resolve problems, or satisfy expectations. Keeping on top of the organizational climate and mission changes and remaining sensitive to customer needs and concerns.
- Data warehousing: principles of data warehouses, including the population and maintenance of a central repository, in addition to knowing about the migration of data from legacy database systems into a data warehouse.
- Database applications & development techniques: activities related to the development of database applications for single or distributed database systems including web and desktop-based transactions, automated reports, stored procedures, triggers, etc.

- Database design & development standards: knowledge of the principles, methods, and tools for relational database design and development including normalization, conceptual data modeling (entity relationship diagram), data integrity, query, and physical implementation using SQL.
- Decision support systems: knowledge of decision support systems (DSS), and how to design and develop of a wide range of tools and technologies which are used to analyze business data in order to help users make business decisions more easily.
- DHTML/ HTML/ XHTML
- Disaster recovery & planning: advanced planning and preparations to minimize loss and ensure continuity of critical business functions in the event of disaster. Creating a document that defines the resources, actions, tasks, and data required to manage the business recovery process.
- Eclipse
- Encryption
- Enterprise Resource Planning (ERP) systems: activities related to the integration of all units and functions across an organization onto a single computer system that can serve all those functions' particular needs. Integration can include databases, tools, interfaces and applications.
- Financial Management: preparing, justifying and/or administering the budget for program areas; planning, administering, and monitoring expenditures to ensure cost-effective support of programs and policies; assessing financial condition of an organization.
- Firewalls
- Fortran
- Geographic Information Systems (GIS)
- Hardware & maintenance support
- Help desk activities: providing technical support for hardware and software to technology users either by telephone, fax or e-mail, or through listings of typical questions and answers. Involves solving problems directly or forwarding problems to appropriate experts.
- IBM mainframe
- IBM WebSphere Studio
- IBM/ DB2
- Identity management & directory services: knowledge of how to map logical names to physical addresses in a network. In addition to address naming, directory services include network resource location and mapping.
- Internal controls: knowledge of internal controls policies and procedures; promotion of operational efficiency and effectiveness; safeguarding assets; and ensuring the reliability of accounting data. Internal controls encompass both administrative and accounting controls.
- Intrusion detection
- IT asset management: knowledge of the systematic practices which effectively manage IT assets throughout the life cycle phases of requisition, procurement, deployment, maintenance and retirement.
- IT procurement: knowledge of various types of IT contracts, techniques for contracting or procurement, and contract negotiation and administration.
- IT project portfolio management: systematic approach to categorize and evaluate which set of projects to pursue in order to achieve the goals and objectives of the organization.
- IT risk assessment & management: risk assessment, risk mitigation, and IT evaluation and assessment that allow IT managers to balance the operational and economic costs of protecting IT systems and that help justify budget expenditures.
- IT strategic planning: knowledge of the processes of comprehensive, integrative IT planning that consider, at a minimum, the future of current decisions, overall policy, organizational development, and links to operational plans.
- Java

- JavaScript
- Java studio
- Joint Application Development (JAD): an application development process, aimed at achieving high levels of functional quality through the participation of clients/end users.
- Knowledge Management (KM): knowledge of how organizations capture, organize, and store knowledge and experiences of individual workers and groups and make this information available to others in the organization.
- Leadership: influencing, motivating, and challenging others; adapting leadership styles to a variety of situations.
- Linux operating systems
- Mac OS/ OS X operating systems
- Mainframe operations
- Managing agency staff: planning, distribution, coordination, and monitoring of work assignments of agency staff. Evaluating work performance, providing feedback on performance and conducting workforce planning.
- Managing consultant staff: planning, distribution, coordination, and monitoring work assignments of consultants. Evaluating work performance and providing feedback on their performance.
- Metadata management: knowledge of how to manage metadata and the ability to describe how and when and by whom a particular set of data was collected, and how the data was formatted.
- Microsoft Access
- Microsoft SQL
- Mobile computing
- Modeling & simulation: mathematical modeling and simulation tools and techniques to plan and conduct tests and evaluations of programs, evaluate design alternatives, and understand systems support decisions involving requirements.
- MYSQL
- Negotiation & conflict resolution: persuading others to accept recommendations, cooperate, or change their behavior; working with others towards an agreement; negotiating to find mutually acceptable solutions; knowledge of formal conflict resolution techniques.
- Network architecture & design principles: knowledge of how networks are effectively structured and designed including knowing the right connections for the Internet, intranets, extranets, local area networks, and wide area networks.
- Object-oriented analysis & design principles: understanding the iterative, object-oriented approach to analysis and design, using modeling techniques (e.g. use cases, class diagrams) and concepts such as objects, classes, encapsulation, abstraction, inheritance, and polymorphism.
- Open systems server administration
- Oracle
- Oracle JDdevelopment studio
- Oral Communication: making clear and convincing oral presentations (to individuals or groups) by speaking clearly, understanding the audience, and listening effectively to questions or comments.
- Organizational awareness & business knowledge: understanding and working effectively within the organization's mission and functions (including programs, policies, procedures, rules, and regulations), as well as within its social, political, and technological systems.
- Perl/ CGI
- PHP
- Public Key Infrastructure (PKI)
- Planning & evaluation: organizing work, setting priorities, and determining resource requirements; setting short- or long-term goals and strategies to achieve them; coordinating with other organizations to accomplish goals; monitoring progress and evaluating outcomes.

- PowerBuilder
- Principles of operating systems: knowledge about the fundamentals of basic operating systems tasks, such as recognizing keyboard input, sending output to the display screen, tracking files and directories on disk, and controlling peripheral devices.
- Principles of programming: knowledge about general programming concepts independent of specific languages. Concepts include general programming constructs, problem specification and deconstruction techniques, data structure, algorithm design and implementation.
- Project management: knowledge, skills, tools, and techniques to direct and coordinate human and material resources at all phases in a project: origination, initiation, planning, execution and control, and closeout. Balancing competing demands and mitigating risks to ensure an acceptable product is delivered to stakeholders and sponsors within budget, scope, time, and quality standards.
- Rapid Application Development (RAD) / Prototyping: knowledge of Rapid Application Development (RAD) to create applications more quickly through such strategies as using fewer formal methodologies and reusing software components.
- Quality assurance: principles, methods, and tools of quality assurance and quality control used to ensure that a product meets or exceeds functional requirements and standards.
- Records management: activities related to the physical or digital maintenance of public records from creation through destruction.
- Requirements analysis: principles and methods to identify, analyze, specify, design, and manage functional and infrastructure requirements (i.e., translating functional requirements into technical requirements and/or presenting alternative technologies or approaches).
- Satellite technologies
- SQL
- Structured system analysis & design principles: understanding the sequential approach to systems analysis and design (problem definition, feasibility study, fact gathering and analysis, business systems options, requirements definition, logical and physical design) using appropriate techniques and conventions for each stage such as data flow and entity relationship diagrams.
- Supervisory skills: working with employees to set and communicate performance standards by setting clear goals; dealing effectively with organizational performance problems as well as with individual employee problems.
- Support for desktop applications
- Systems implementation: deployment of a new information system including execution, educating users, placing the system into production, confirming all required data are available and accurate, and validating that business functions that interact with the system are functioning properly.
- System security applications: knowledge of methods, tools, and procedures to protect information systems and data, as well as understanding how to develop information security plans and provide or restore security of information systems and network services.
- Systems architecture: methodologies used in the design and development of information systems, including the physical structure of a system's internal operations and interactions with other systems.
- Systems integration: principles, methods, and procedures for integrating and optimizing multiple information systems and system components such as computers, instrumentation, and equipment to share data or applications with other components in the same or other functional areas.
- Systems life cycle planning principles: knowledge of the overall process of developing information systems through a multi-step process from investigation of initial requirements through analysis, design, implementation and maintenance.
- Technical documentation: knowledge of procedures for developing and maintaining technical and operational support documentation.
- Technology training activities: activities to provide technology training to others, such as: IT curriculum planning and management, IT training vendor selection and monitoring, IT content development, and the delivery of IT training.
- Telephone/ PBX
- Testing & evaluation: principles, methods, and tools for analyzing and developing systems' test and evaluation procedures and technical characteristics of IT systems, including identifying critical operational issues.

- Unified messaging services (e.g., email, voice, text)
- Unified Modeling Language (UML)
- Unisys mainframe
- Unix
- Visual Basic
- Visual Basic Script
- Video imaging
- Visual Studio .NET
- Voice over IP
- Web servers
- Web/ IP
- Web- based graphics & multimedia
- Website accessibility: knowledge of tools, equipment, and technologies used to make websites accessible to all users, especially those with disabilities.
- Web design & development: planning and production of websites, including, but not limited to information structure, layout and visual design of graphics, text and images, networked delivery, and technical development.
- Website management: management and maintenance of an enterprise's web site or portal. Understanding how to develop and update web pages, perform backups, and ensure user access to the site, monitoring site traffic and knowing if site capacity meets traffic demands.
- Website privacy: protection of web visitors' information on the web site. Developing policies and software to authenticate users and authorize their access to certain content, establishing rules for the types of information that can be displayed to users, implementing enterprise privacy policies, and examining web logs and statistics to detect intrusion.
- Website search & administration: installation and maintenance of an enterprise's search capability for public or internal web sites including installing software or devices, establishing crawl parameters to ensure that proper documents are included or excluded from results, establishing policies and procedures regarding logs, archives, and reports, and analyzing search statistics to allow for an improved search experience for visitors.
- Wide Area Networks (WAN)
- Windows operating systems
- Windows network operating systems
- Wireless technologies
- Workflow management: knowledge of workflow management approaches for internal and external process integration and automated events. Internal and external process integration allows for the definition of business processes that span applications and automated events enable automated tasks to be performed.
- Written communication: presenting information, analysis, ideas, and positions in writing in a clear and convincing manner. Organizing ideas in a clear, appropriate, and grammatically correct written manner.
- XMI/ XSL

Appendix D: Employee Survey Questions

Table D1: List of Survey Questions

- Section 1: Skills
  - What is your current level of proficiency in each of the following (126) skills?
    - Choices: none, basic, intermediate, advanced, expert
  - Do you need additional training in any of the skills identified in the question above? (yes/no)
  - What level of training do you need for each skill?
    - Choices: none, basic, intermediate, advanced

- Section 2: Use, Importance, & Training Preferences
  - In the last year, how often have you personally used each of the following (11) types of skills?
    - Choices: very often, frequently, occasionally, seldom, never, don't know
  - How important is each of the following (11) types of skills to the successful conduct of your own work?
    - Choices: extremely important, very important, moderately important, not very important, not at all important, don't know
  - Which of the following 8 methods would you prefer for learning specific technical tools?
  - Which of the following 8 methods would you prefer for learning general IT skills?
  - Which of the following 8 methods would you prefer for learning general management skills?
  - How would you prefer to be informed of upcoming IT training events? (5 choices)
  - Which of the following are reasons why training is worthwhile to you? (7 choices)

- Section 3: Certifications
  - Do you currently hold professional certifications in any of the (15) categories listed below? (yes/no)
  - In which categories do you hold professional certifications?

- Section 4: Demographics
  - What is your highest level of education?
  - Do you have a college degree in any of the following fields?
  - How many total years of New York State service do you have?
  - How many years have you worked in your current agency?
  - How many different New York State agencies have you worked for during your career in state government?
  - How many years of public sector IT experience do you have?
  - How many years of private sector IT experience do you have?
  - In what year are you eligible to retire from state service?
  - In what year do you plan to retire from state service?
  - Do you plan to leave the state workforce before you are eligible to retire?
  - Would you work part-time for the State after you retire?
  - What is your current age?

Appendix E: Data Tables

Table E1. Demographic profiles by job specialty

Characteristics	Technology managers (n=271)	Operations specialists (n=64)	Systems specialists (n=107)	Database specialist (n=119)	Data/telecomm. specialists (n=177)	Programmer (n=1400)	Other technical specialists (n=357)	Business specialists (n=242)
Mean age	49	49	46	47	47	45	42	47
Age range	30 – 64	32 – 60	24 – 62	27 – 63	24 – 63	22 – 74	22 – 64	20 – 65
Percent with any college education	98 %	89 %	99 %	98 %	94 %	98 %	92 %	96 %
Percent with bachelor's degree or higher	72%	16 %	72 %	73 %	46 %	61 %	33 %	78 %
Percent with degree in a technical field (CS, IS, MIS)	44 %	11 %	46 %	45 %	29 %	47 %	31 %	19 %
Percent with certifications	13 %	7 %	14 %	12 %	23 %	15 %	22 %	18 %
Mean years of experience in NYS government	23	22	18	19	17	14	12	19
Mean years of experience in current agency	15	10	10	13	11	11	8	13
Percent with all NYS experience in a single agency	36 %	13 %	36 %	35 %	37 %	54 %	51 %	53 %
Percent with all NYS experience in two agencies	29 %	48 %	32 %	42 %	33 %	25 %	28 %	28 %
Percent with private sector IT experience	41%	42 %	50 %	47 %	60 %	53 %	51 %	32 %
Mean years of private sector IT experience	2	4	3	3	5	4	4	2
Percent eligible to retire within 3 years (2006 – 2009)	36 %	37 %	22 %	24 %	21 %	18 %	9 %	32 %
Percent planning to retire within 3 years (2006 – 2009)	22 %	23 %	11 %	14 %	11 %	10 %	7 %	18 %
Percent eligible to retire within 6 years (2006 – 2012)	54 %	47 %	35 %	40 %	35 %	29 %	19 %	45 %
Percent planning to retire within 6 years (2006 – 2012)	41 %	40 %	20 %	28 %	25 %	21 %	14 %	35 %
Percent interested in working for NYS after retirement	77 %	78 %	76%	83 %	79 %	73 %	77 %	76 %

Table E2. Demographic profiles by grade level categories

Characteristics	Entry level (n=1,118)	Journey level (n=1,229)	Mid level managers (n=286)	Upper level managers (n=57)
Mean age	43	47	49	52
Age range	20-68	24-69	30-63	35-64
Percent with any college education	94 %	98 %	98 %	100 %
Percent with bachelor's degree or higher	47 %	65 %	75 %	78 %
Percent with degree in a technical field (CS, IS, MIS)	40 %	40 %	36 %	42 %
Mean years of experience in NYS government	12	18	23	25
Mean years of experience in current agency	9	12	16	16
Percent with all NYS experience in a single agency	59 %	41 %	41 %	40 %
Percent with all NYS experience in two agencies	25 %	32 %	27 %	21 %
Percent with private sector IT experience	52 %	44 %	40 %	47 %
Mean years of private sector IT experience	5	3	2	3
Percent eligible to retire within 3 years (2006 -2009)	11 %	25 %	37 %	47 %
Percent planning to retire within 3 years (2006 – 2009)	6 %	14 %	20 %	27 %
Percent eligible to retire within 6 years (2006 -2012)	20 %	38 %	55 %	70 %
Percent planning to retire within 6 years (2006 – 2012)	14 %	28 %	41 %	60 %
Percent interested in working for NYS after retirement	74 %	76 %	78 %	75 %

Table E3. Demographic profiles by agency size

Characteristics	Large Agencies (n=2,008)	Medium Agencies (n=532)	Small Agencies (n=293)
Mean age	46	46	45
Age range	20-70	21-68	22-65
Percent with any college education	94 %	96 %	98 %
Percent with bachelor's degree or higher	58 %	65 %	60 %
Percent with degree in a technical field (CS, IS, MIS)	39 %	40 %	45 %
Mean years of experience in NYS government	16	16	15
Mean years of experience in current agency	11	12	9
Percent with all NYS experience in a single agency	50 %	51 %	38 %
Percent with all NYS experience in two agencies	28 %	28 %	30 %
Percent with private sector IT experience	45 %	53 %	56 %
Mean years of private sector IT experience	4	4	4
Percent eligible to retire within 3 years (2006 – 2009)	21%	22 %	20 %
Percent planning to retire within 3 years (2006 – 2009)	13 %	9 %	13 %
Percent eligible to retire within 6 years (2006 – 2012)	33 %	37 %	31 %
Percent planning to retire within 6 years (2006 – 2012)	25 %	24 %	25 %
Percent interested in working for NYS after retirement	76%	72%	76%

Table E4. Skill by skill proficiency ratings (listed in alphabetical order)

** Means include those employees who have at least basic proficiency, calculated on a four-point rating scale: 1 = Basic, 2 = Intermediate, 3= Advanced, 4 = Expert.*

Note: Row totals may not equal 100% due to rounding.

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Artificial Intelligence (AI)	2,759	1.28	457 (17%)	102 (4%)	20 (1%)	8 (.3%)	2172 (79%)
Backup & recovery	2,803	1.91	853 (30%)	578 (21%)	403 (14%)	141 (5%)	828 (30%)
Biometrics	2,781	1.25	481 (17%)	82 (3%)	26 (1%)	5 (.2%)	2187 (79%)
Borland JBuilder	2,771	1.36	170 (6%)	45 (2%)	12 (.4%)	5 (.2%)	2539 (92%)
Broadband technologies	2,783	1.50	722 (26%)	297 (11%)	108 (4%)	20 (1%)	1636 (59%)
Business continuity planning	2,758	1.49	706 (26%)	303 (11%)	93 (3%)	21 (1%)	1635 (59%)
Business process analysis	2,785	1.85	802 (29%)	695 (25%)	317 (11%)	99 (4%)	872 (31%)
C	2,762	1.57	630 (23%)	324 (12%)	98 (4%)	32 (1%)	1678 (61%)
C++	2,755	1.56	624 (23%)	342 (12%)	90 (3%)	29 (1%)	1670 (61%)
Call center activities	2,787	1.89	740 (27%)	511 (18%)	311 (11%)	120 (4%)	1105 (40%)
Capacity management	2,760	1.50	611 (22%)	268 (10%)	87 (3%)	17 (1%)	1777 (64%)
CASE tools	2,779	1.59	873 (31%)	505 (18%)	146 (5%)	42 (2%)	1213 (44%)
Cellular technologies	2,790	1.33	638 (23%)	156 (6%)	50 (2%)	9 (.3%)	1937 (69%)
Change management	2,768	1.66	769 (28%)	459 (17%)	191 (7%)	41 (2%)	1308 (47%)
COBOL	2,781	2.21	589 (21%)	424 (15%)	453 (16%)	249 (9%)	1066 (38%)
ColdFusion	2,759	1.72	167 (6%)	75 (3%)	39 (1%)	21 (1%)	2457 (89%)
Collaboration software	2,772	1.57	675 (24%)	273 (10%)	129 (5%)	36 (1%)	1659 (60%)
Computer forensics	2,782	1.40	532 (19%)	197 (7%)	50 (2%)	5 (.2%)	1998 (72%)
Content management	2,769	1.48	776 (28%)	354 (13%)	94 (3%)	18 (1%)	1527 (55%)
Contract management & vendor relations	2,765	1.63	676 (24%)	328 (12%)	148 (5%)	43 (2%)	1570 (57%)
Cryptography	2,778	1.28	510 (18%)	104 (4%)	32 (1%)	4 (.1%)	2128 (77%)
Customer Relationship Management (CRM)	2,771	1.68	713 (26%)	443 (16%)	167 (6%)	51 (2%)	1397 (50%)
Customer service	2,790	2.16	691 (25%)	830 (30%)	628 (23%)	221 (8%)	420 (15%)
Data warehousing	2,791	1.48	913 (33%)	381 (14%)	112 (4%)	25 (1%)	1360 (49%)
Database applications development techniques	2,760	1.87	862 (31%)	627 (23%)	378 (14%)	116 (4%)	777 (28%)
Database design & development standards	2,777	1.87	929 (34%)	678 (24%)	388 (14%)	135 (5%)	647 (23%)

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Decision support systems	2,774	1.43	585 (21%)	208 (8%)	61 (2%)	16 (1%)	1904 (69%)
DHTML/HTML/XHTML	2,770	1.75	806 (29%)	440 (16%)	227 (8%)	94 (3%)	1203 (43%)
Disaster recovery & planning	2,790	1.57	933 (33%)	545 (20%)	169 (6%)	24 (1%)	1119 (40%)
Eclipse	2,771	1.51	155 (6%)	61 (2%)	18 (1%)	9 (.3%)	2528 (91%)
Encryption	2,789	1.33	1002 (36%)	256 (9%)	78 (3%)	9 (.3%)	1444 (52%)
Enterprise Resource Planning (ERP) systems	2,762	1.44	563 (20%)	184 (7%)	61 (2%)	18 (1%)	1936 (70%)
Financial management	2,770	1.60	804 (29%)	460 (17%)	154 (6%)	36 (1%)	1316 (48%)
Firewalls	2,777	1.39	646 (23%)	233 (8%)	53 (2%)	9 (.3%)	1836 (66%)
Fortran	2,742	1.43	636 (23%)	217 (8%)	63 (2%)	20 (1%)	1806 (66%)
Geographic Information Systems (GIS)	2,772	1.35	566 (20%)	139 (5%)	39 (1%)	17 (1%)	2011 (73%)
Hardware & maintenance support	2,795	2.09	710 (25%)	559 (20%)	477 (17%)	207 (7%)	842 (30%)
Help desk activities	2,803	2.05	792 (28%)	627 (22%)	497 (18%)	196 (7%)	691 (25%)
IBM mainframe	2,792	1.76	710 (25%)	404 (15%)	239 (9%)	68 (2%)	1371 (49%)
IBM WebSphere Studio	2,786	1.38	291 (10%)	74 (3%)	20 (1%)	13 (1%)	2388 (86%)
IBM/ DB2	2,737	1.69	473 (17%)	256 (9%)	128 (5%)	35 (1%)	1845 (67%)
Identity management & directory services	2,790	1.51	810 (29%)	379 (14%)	120 (4%)	19 (1%)	1462 (52%)
Internal controls	2,766	1.72	861 (31%)	626 (23%)	240 (9%)	60 (2%)	979 (35%)
Intrusion detection	2,802	1.34	1132 (40%)	295 (11%)	83 (3%)	20 (1%)	1272 (45%)
IT asset management	2,769	1.56	715 (26%)	360 (13%)	127 (5%)	25 (1%)	1542 (56%)
IT procurement	2,776	1.59	723 (26%)	360 (13%)	138 (5%)	37 (1%)	1518 (55%)
IT project portfolio management	2,781	1.55	770 (28%)	369 (13%)	132 (5%)	29 (1%)	1481 (53%)
IT risk assessment & management	2,772	1.52	738 (27%)	380 (14%)	99 (4%)	23 (1%)	1532 (55%)
IT strategic planning	2,775	1.56	745 (27%)	362 (13%)	120 (4%)	34 (1%)	1514 (55%)
Java	2,773	1.50	642 (23%)	239 (9%)	85 (3%)	29 (1%)	1778 (64%)
JavaScript	2,770	1.65	546 (20%)	238 (9%)	131 (5%)	40 (1%)	1815 (66%)
Java studio	2,783	1.38	277 (10%)	70 (3%)	23 (1%)	10 (.4%)	2403 (86%)
Joint Application Development (JAD)	2,781	1.70	610 (22%)	407 (15%)	167 (6%)	37 (1%)	1560 (56%)
Knowledge Management (KM)	2,781	1.56	941 (34%)	465 (17%)	175 (6%)	29 (1%)	1171 (42%)
Leadership	2,790	2.14	692 (25%)	895 (32%)	668 (24%)	185 (7%)	350 (13%)
Linux operating systems	2,776	1.45	606 (22%)	219 (8%)	73 (3%)	17 (1%)	1861 (67%)

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Mac OS/OS X operating systems	2,757	1.34	528 (19%)	141 (5%)	39 (1%)	8 (0.3%)	2041 (74%)
Mainframe operations	2,791	1.71	670 (24%)	305 (11%)	172 (6%)	72 (3%)	1572 (56%)
Managing agency staff	2,778	1.93	749 (27%)	747 (27%)	412 (15%)	94 (3%)	776 (28%)
Managing consultant staff	2,775	1.88	703 (25%)	584 (21%)	325 (12%)	88 (3%)	1075 (39%)
Metadata management	2,761	1.42	519 (19%)	191 (7%)	48 (2%)	12 (.4%)	1991 (72%)
Microsoft Access	2,798	1.77	1013 (36%)	728 (26%)	299 (11%)	109 (4%)	649 (23%)
Microsoft SQL	2,746	1.59	753 (27%)	361 (13%)	138 (5%)	40 (2%)	1454 (53%)
Mobile computing	2,774	1.59	747 (27%)	408 (15%)	144 (5%)	27 (1%)	1448 (52%)
Modeling & simulation	2,775	1.44	669 (24%)	252 (9%)	75 (3%)	14 (1%)	1765 (64%)
MySQL	2,718	1.52	400 (15%)	187 (7%)	64 (2%)	9 (.3%)	2058 (76%)
Negotiation & conflict resolution	2,777	1.93	811 (29%)	850 (31%)	436 (16%)	108 (4%)	572 (21%)
Network architecture & design principles	2,763	1.62	978 (35%)	512 (19%)	210 (8%)	48 (2%)	1015 (37%)
Network configuration	2,800	1.69	900 (32%)	505 (18%)	257 (9%)	57 (2%)	1081 (39%)
Novell operating systems	2,775	1.58	661 (24%)	306 (11%)	121 (4%)	35 (1%)	1652 (60%)
Object-oriented analysis & design principles	2,786	1.72	875 (31%)	585 (21%)	255 (9%)	61 (2%)	1010 (36%)
Open systems server administration	2,784	1.80	673 (24%)	382 (14%)	222 (8%)	87 (3%)	1420 (51%)
Oracle	2,777	1.70	643 (23%)	361 (13%)	172 (6%)	50 (2%)	1551 (56%)
Oracle JDdevelopment studio	2,787	1.42	195 (7%)	58 (2%)	24 (1%)	4 (.1%)	2506 (90%)
Oral communication	2,797	2.21	628 (23%)	969 (35%)	753 (27%)	210 (8%)	237 (9%)
Organizational awareness & business knowledge	2,774	1.90	814 (29%)	764 (28%)	415 (15%)	96 (4%)	685 (25%)
Perl/CGI	2,759	1.46	328 (12%)	109 (4%)	33 (1%)	16 (1%)	2273 (82%)
PHP	2,741	1.61	132 (5%)	53 (2%)	24 (1%)	11 (.4%)	2521 (92%)
Public Key Infrastructure (PKI)	2,779	1.31	628 (23%)	160 (6%)	41 (2%)	7 (.3%)	1943 (70%)
Planning & evaluation	2,776	1.90	842 (30%)	815 (29%)	409 (15%)	103 (4%)	607 (22%)
PowerBuilder	2,755	1.76	200 (7%)	111 (4%)	48 (2%)	29 (1%)	2367 (86%)
Principles of operating systems	2,759	2.18	710 (26%)	922 (33%)	729 (26%)	217 (8%)	181 (7%)
Principles of programming	2,588	2.36	566 (22%)	645 (25%)	722 (28%)	329 (13%)	326 (13%)
Project management	2,800	1.84	984 (35%)	816 (29%)	396 (14%)	106 (4%)	498 (18%)
Quality assurance	2,767	1.77	879 (32%)	644 (23%)	289 (10%)	76 (3%)	879 (32%)
Rapid Application Development (RAD) / prototyping	2,770	1.68	615 (22%)	359 (13%)	153 (6%)	46 (2%)	1597 (58%)

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Records management	2,768	1.54	909 (33%)	467 (17%)	146 (5%)	27 (1%)	1219 (44%)
Requirements analysis	2,786	1.97	726 (26%)	743 (27%)	419 (15%)	123 (4%)	775 (28%)
Satellite technologies	2,783	1.27	479 (17%)	87 (3%)	27 (1%)	7 (.3%)	2183 (78%)
SQL	2,766	1.89	519 (19%)	397 (14%)	239 (9%)	75 (3%)	1536 (56%)
Structured system analysis & design principles	2,793	1.98	743 (27%)	749 (27%)	457 (16%)	125 (5%)	719 (26%)
Supervisory skills	2,799	2.12	689 (25%)	958 (34%)	677 (24%)	159 (6%)	316 (11%)
Support for desktop applications	2,793	2.13	669 (24%)	666 (24%)	506 (18%)	211 (8%)	741 (27%)
Systems implementation	2,791	2.04	717 (26%)	822 (30%)	498 (18%)	157 (6%)	597 (21%)
System security applications	2,786	1.50	1055 (38%)	475 (17%)	158 (6%)	20 (1%)	1078 (39%)
Systems architecture	2,790	1.69	919 (33%)	617 (22%)	249 (9%)	54 (2%)	951 (34%)
Systems integration	2,788	1.75	866 (31%)	672 (24%)	280 (10%)	62 (2%)	908 (33%)
Systems life cycle planning principles	2,793	2.02	759 (27%)	707 (25%)	506 (18%)	145 (5%)	676 (24%)
Technical documentation	2,786	1.93	810 (29%)	883 (32%)	417 (15%)	123 (4%)	553 (20%)
Technology training activities	2,778	1.76	873 (31%)	647 (23%)	240 (9%)	95 (3%)	923 (33%)
Telephone /PBX	2,776	1.41	641 (23%)	162 (6%)	72 (3%)	22 (1%)	1879 (68%)
Testing & evaluation	2,797	1.98	791 (28%)	866 (31%)	454 (16%)	151 (5%)	535 (19%)
Unified messaging services	2,787	1.70	816 (29%)	481 (17%)	234 (8%)	51 (2%)	1205 (43%)
Unified Modeling Language (UML)	2,744	1.50	427 (16%)	192 (7%)	58 (2%)	11 (.4%)	2056 (75%)
Unisys mainframe	2,783	1.70	491 (18%)	260 (9%)	129 (5%)	41 (2%)	1862 (67%)
Unix	2,790	1.50	979 (35%)	406 (15%)	149 (5%)	27 (1%)	1229 (44%)
Visual Basic	2,781	1.65	876 (32%)	399 (14%)	185 (7%)	74 (3%)	1247 (45%)
Visual Basic Script	2,770	1.60	627 (23%)	239 (9%)	125 (5%)	44 (2%)	1735 (63%)
Video imaging	2,760	1.43	568 (21%)	184 (7%)	64 (2%)	16 (1%)	1928 (70%)
Visual Studio .NET	2,794	1.51	399 (14%)	149 (5%)	50 (2%)	22 (1%)	2174 (78%)
Voice over IP	2,778	1.35	600 (22%)	155 (6%)	48 (2%)	11 (.4%)	1964 (71%)
Web servers	2,785	1.61	654 (24%)	262 (9%)	137 (5%)	45 (2%)	1687 (61%)
Web/ IP	2,788	1.68	957 (34%)	510 (18%)	230 (8%)	77 (3%)	1014 (36%)
Web-based graphics & multimedia	2,773	1.52	423 (15%)	141 (5%)	72 (3%)	19 (1%)	2118 (76%)
Website accessibility	2,790	1.63	764 (27%)	351 (13%)	152 (5%)	60 (2%)	1463 (52%)

Skill	N	Mean*	Basic	Intermediate	Advanced	Expert	None
Website design & development	2,809	1.72	930 (33%)	455 (16%)	232 (8%)	105 (4%)	1087 (39%)
Website management	2,794	1.74	718 (26%)	357 (13%)	213 (8%)	78 (3%)	1428 (51%)
Website privacy	2,779	1.53	702 (25%)	255 (9%)	123 (4%)	30 (1%)	1669 (60%)
Website search & administration	2,788	1.59	623 (22%)	249 (9%)	130 (5%)	32 (1%)	1754 (63%)
Wide Area Networks (WAN)	2,784	1.62	833 (30%)	421 (15%)	178 (6%)	45 (2%)	1307 (47%)
Windows operating systems	2,809	2.35	544 (19%)	926 (33%)	916 (33%)	283 (10%)	140 (5%)
Windows network operating systems	2,798	1.86	873 (31%)	591 (21%)	371 (13%)	115 (4%)	848 (30%)
Wireless technologies	2,797	1.52	842 (30%)	377 (14%)	140 (5%)	22 (1%)	1416 (51%)
Workflow management	2,793	1.56	1020 (37%)	519 (19%)	184 (7%)	32 (1%)	1038 (37%)
Written communication	2,798	2.27	576 (21%)	988 (35%)	814 (29%)	240 (9%)	180 (6%)
XML/XSL	2,748	1.48	522 (19%)	170 (6%)	71 (3%)	22 (1%)	1963 (71%)

Table E5. Skill proficiency ratings by job specialty

** Means calculated on a five-point rating scale: 1 = None, 2 = Basic, 3= Intermediate, 4 = Advanced, 5 = Expert.*

Technology managers		Database specialists		Datacomm/telecomm specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Supervisory skills	3.76	Principles of Programming	3.80	Windows operating system	3.34
Leadership	3.70	Database design & development standards	3.61	Principles of operating systems	3.19
Written communication	3.69	Database applications development techniques	3.43	Network configuration	3.14
Managing agency staff	3.63	Written communication	3.28	Written communication	2.99
Planning & evaluation	3.54	COBOL	3.14	Oral communication	2.94
Oral communication	3.53	Windows operating system	3.12	Windows network operating systems	2.94
Principles of Programming	3.51	Structured system analysis & design principles	3.02	Network architecture & design principles	2.90
Organizational awareness & business knowledge	3.47	System life cycle planning principles	3.01	Hardware maintenance & support	2.88
Project management	3.40	Testing & evaluation	2.97	Customer service	2.86
Managing consultant staff	3.37	Oral communication	2.96	Supervisory skills	2.84
System life cycle planning principles	3.35	Principles of operating systems	2.95	Help desk activities	2.81
Customer service	3.32	Systems implementation	2.93	Leadership	2.81
Negotiation & conflict resolution	3.26	Technical documentation	2.85	Wide Area Networks (WAN)	2.77
Systems implementation	3.23	Requirements analysis	2.81	Backup & recovery	2.64
Structured system analysis & design principles	3.18	Supervisory skills	2.77	Support for desktop applications	2.61
Requirements analysis	3.17	Leadership	2.72	Web/ IP	2.53
Testing & evaluation	3.05	SQL	2.65	Planning & evaluation	2.51
Business process analysis	2.98	Business process analysis	2.61	Managing agency staff	2.47
COBOL	2.98	Customer service	2.56	Wireless technologies	2.47
Technical documentation	2.98	Oracle	2.54	Principles of Programming	2.47
Internal controls	2.97	Project management	2.53	Negotiation & conflict resolution	2.45
Principles of operating systems	2.94	Backup & recovery	2.51	Project management	2.44
Systems integration	2.83	Planning & evaluation	2.49	Mobile computing	2.43
Change management	2.83	Systems architecture	2.47	Unified messaging services	2.42
Windows operating system	2.77	Quality assurance	2.44	Organizational awareness & business knowledge	2.39
Database design & development standards	2.73	Systems integration	2.43	Call center activities	2.34
Quality assurance	2.73	Microsoft Access	2.41	Open systems server administration	2.30
Systems architecture	2.71	Managing agency staff	2.38	Systems implementation	2.28
IT procurement	2.62	Object-oriented analysis & design principles	2.37	Disaster recovery & planning	2.26
IT project portfolio management	2.62	Negotiation & conflict resolution	2.35	Intrusion detection	2.24
IT strategic planning	2.61	Organizational awareness & business knowledge	2.33	Broadband technologies	2.22
Database applications development techniques	2.59	Data warehousing	2.26	Technical documentation	2.22
Contract management & vendor relations	2.58	IBM mainframe	2.25	Managing consultant staff	2.18
Financial management	2.55	Managing consultant staff	2.21	Technology training activities	2.17
Disaster recovery & planning	2.54	Microsoft SQL	2.20	System security applications	2.16
IT risk assessment & management	2.50	Support for desktop applications	2.19	Testing & evaluation	2.16
Backup & recovery	2.49	CASE Tools	2.19	Internal controls	2.13
Business continuity planning	2.43	UNIX operating systems	2.19	Telephone/ PBX	2.11

Technology managers		Database specialists		Datacomm/telecomm specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Customer Relationship Management (CRM)	2.43	Rapid Application Development (RAD)/ Prototyping	2.13	System life cycle planning principles	2.08
Help desk activities	2.39	Disaster recovery & planning	2.11	Identity management & directory services	2.06
IT asset management	2.36	IBM/ DB2	2.10	Microsoft Access	2.05
Joint Application Development (JAD)	2.34	Joint Application Development (JAD)	2.08	Novell operating systems	1.99
Object-oriented analysis & design principles	2.33	Help desk activities	2.08	Systems architecture	1.98
Hardware maintenance & support	2.32	Website design & development	2.06	Structured system analysis & design principles	1.97
Workflow management	2.30	DHTML/ HTML/ XHTML	2.04	Encryption	1.96
Technology training activities	2.28	Internal controls	2.03	IT procurement	1.95
System security applications	2.25	Technology training activities	1.96	Requirements analysis	1.94
Support for desktop applications	2.24	Workflow management	1.92	Voice over IP	1.91
Network architecture & design principles	2.21	Hardware maintenance & support	1.91	UNIX operating systems	1.91
Capacity management	2.20	System security applications	1.90	Systems integration	1.91
Rapid Application Development (RAD)/ Prototyping	2.19	Knowledge Management (KM)	1.85	Customer Relationship Management (CRM)	1.90
Knowledge Management (KM)	2.14	Mainframe operations	1.85	COBOL	1.90
Windows network operating systems	2.11	Visual Basic	1.85	Change management	1.88
Microsoft Access	2.10	Change management	1.84	Contract management & vendor relations	1.88
Identity management & directory services	2.09	Records management	1.84	Firewalls	1.88
Records management	2.09	Metadata management	1.82	Database design & development standards	1.85
Data warehousing	2.07	Fortran	1.82	CASE Tools	1.85
CASE Tools	2.06	Financial management	1.78	Financial management	1.84
Web/ IP	2.04	Windows network operating systems	1.77	IT asset management	1.84
Network configuration	2.04	C	1.77	Business process analysis	1.81
IBM mainframe	2.03	Website management	1.77	Video imaging	1.79
Mainframe operations	1.97	Network architecture & design principles	1.75	Quality assurance	1.77
Call center activities	1.96	IT project portfolio management	1.71	Cellular technologies	1.77
Website design & development	1.93	C ++	1.71	Workflow management	1.75
Content management	1.93	Modeling & simulation	1.69	Database applications development techniques	1.74
Open systems server administration	1.91	Call center activities	1.69	IT strategic planning	1.73
Encryption	1.90	Identity management & directory services	1.66	Linux operating systems	1.73
Intrusion detection	1.85	Web/ IP	1.65	Capacity management	1.71
Wide Area Networks (WAN)	1.83	Unisys mainframe	1.64	IT risk assessment & management	1.71
Oracle	1.83	Content management	1.64	Object-oriented analysis & design principles	1.70
Website management	1.83	Capacity management	1.64	Visual Basic	1.67
UNIX operating systems	1.82	Encryption	1.63	Knowledge Management (KM)	1.67
Mobile computing	1.81	Web servers	1.63	Business continuity planning	1.67
Unified messaging services	1.78	Decision support systems	1.62	Public Key Infrastructure (PKI)	1.67
SQL	1.77	Open systems server administration	1.62	Web servers	1.67
Collaboration software	1.76	IT risk assessment & management	1.61	Website design & development	1.65
Fortran	1.75	Website accessibility	1.61	DHTML/ HTML/ XHTML	1.64
Wireless technologies	1.74	IT strategic planning	1.60	IT project portfolio management	1.62
DHTML/ HTML/ XHTML	1.74	Intrusion detection	1.59	Computer forensics	1.61
Website accessibility	1.73	Collaboration software	1.58	Records management	1.57

Technology managers		Database specialists		Datacomm/telecomm specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Enterprise Resource Planning (ERP) systems	1.71	Unified messaging services	1.58	Website management	1.56
Decision support systems	1.70	Java	1.58	Satellite technologies	1.55
Unisys mainframe	1.67	Network configuration	1.58	Mainframe operations	1.55
Website privacy	1.67	Enterprise Resource Planning (ERP) systems	1.57	Collaboration software	1.54
Web servers	1.67	Customer Relationship Management (CRM)	1.56	C	1.53
Microsoft SQL	1.66	Visual Basic Script	1.56	IBM mainframe	1.53
Modeling & simulation	1.65	Business continuity planning	1.53	Data warehousing	1.49
Visual Basic	1.64	JavaScript	1.53	Microsoft SQL	1.49
Public Key Infrastructure (PKI)	1.61	Website privacy	1.52	C ++	1.49
IBM/ DB2	1.59	Contract management & vendor relations	1.50	Website accessibility	1.48
Metadata management	1.59	Linux operating systems	1.50	Cryptology	1.47
Firewalls	1.57	Geographic Information Systems (GIS)	1.48	Website privacy	1.45
Website search administration	1.56	IT procurement	1.48	Visual Basic Script	1.45
Novell operating systems	1.56	XML/XSL	1.47	Mac OS/ OS X operating systems	1.44
Broadband technologies	1.55	IT asset management	1.45	Website search administration	1.44
C	1.49	Mobile computing	1.45	Fortran	1.43
Visual Basic Script	1.46	Website search administration	1.42	Content management	1.43
Geographic Information Systems (GIS)	1.45	Wide Area Networks (WAN)	1.41	Unisys mainframe	1.38
Computer forensics	1.44	Novell operating systems	1.39	Modeling & simulation	1.37
Linux operating systems	1.43	PowerBuilder	1.39	Biometrics	1.37
Unified Modeling Language (UML)	1.41	MYSQL	1.38	SQL	1.35
Biometrics	1.41	Unified Messaging Language (UML)	1.36	Geographic Information Systems (GIS)	1.33
Voice over IP	1.40	Wireless technologies	1.35	Rapid Application Development (RAD)/ Prototyping	1.32
XML/XSL	1.39	Firewalls	1.34	Joint Application Development (JAD)	1.31
Video imaging	1.38	Perl/CGI	1.34	Oracle	1.30
C ++	1.38	Public Key Infrastructure (PKI)	1.33	JavaScript	1.28
JavaScript	1.38	Mac OS/ OS X operating systems	1.31	Java	1.26
Java	1.37	Computer forensics	1.30	Decision support systems	1.25
Cryptology	1.37	Broadband technologies	1.29	Enterprise Resource Planning (ERP) systems	1.23
Telephone/ PBX	1.36	Cryptology	1.27	MYSQL	1.23
Artificial Intelligence (AI)	1.32	Visual Studio .NET	1.26	Visual Studio .NET	1.21
Cellular technologies	1.32	Artificial Intelligence (AI)	1.23	IBM/ DB2	1.20
Visual Studio .NET	1.26	Oracle Jdeveloper Studio	1.21	XML/XSL	1.20
Satellite technologies	1.24	Telephone/ PBX	1.18	Metadata management	1.20
Web-based graphics & multimedia	1.24	Cellular technologies	1.18	Perl/CGI	1.19
MYSQL	1.23	Video imaging	1.17	Unified Modeling Language (UML)	1.19
PowerBuilder	1.21	Biometrics	1.17	Web-based graphics & multimedia	1.19
IBM WebSphere Studio	1.21	Voice over IP	1.16	Artificial Intelligence (AI)	1.18
Perl/CGI	1.21	Web-based graphics & multimedia	1.15	IBM WebSphere Studio	1.15
ColdFusion	1.16	Satellite technologies	1.14	Java Studio	1.12
Mac OS/ OS X operating systems	1.12	IBM WebSphere Studio	1.11	PowerBuilder	1.11
Java Studio	1.12	Java Studio	1.10	ColdFusion	1.09

Technology managers		Database specialists		Datacomm/telecomm specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Eclipse	1.11	ColdFusion	1.09	Oracle Jdeveloper Studio	1.09
Oracle Jdeveloper Studio	1.09	Eclipse	1.08	Borland JBuilder	1.07
Borland JBuilder	1.05	PHP	1.08	PHP	1.07
PHP	1.04	Borland JBuilder	1.07	Eclipse	1.06

Operations specialists		Programmers		Other technical specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Mainframe operations	3.70	Principles of Programming	3.39	Windows operating system	3.63
Principles of operating systems	3.41	Windows operating system	3.25	Principles of operating systems	3.29
Windows operating system	3.34	Written communication	3.04	Support for desktop applications	3.28
Supervisory skills	3.13	Principles of operating systems	2.98	Help desk activities	3.23
Leadership	2.89	Oral communication	2.95	Hardware maintenance & support	3.22
IBM mainframe	2.83	Testing & evaluation	2.80	Customer service	3.06
Written communication	2.78	Supervisory skills	2.76	Written communication	2.89
Oral communication	2.71	Leadership	2.75	Oral communication	2.88
Unisys mainframe	2.70	Systems implementation	2.74	Windows network operating systems	2.85
Customer service	2.53	System life cycle planning principles	2.70	Call center activities	2.76
Negotiation & conflict resolution	2.45	Customer service	2.69	Backup & recovery	2.73
Backup & recovery	2.41	Technical documentation	2.69	Leadership	2.70
Hardware maintenance & support	2.41	Structured system analysis & design principles	2.67	Supervisory skills	2.61
Help desk activities	2.33	COBOL	2.61	Technology training activities	2.54
Managing agency staff	2.30	Database design & development standards	2.61	Unified messaging services	2.41
Planning & evaluation	2.08	Requirements analysis	2.58	Microsoft access	2.41
Organizational awareness & business knowledge	2.03	Database applications development techniques	2.55	Negotiation & conflict resolution	2.40
Principles of Programming	1.97	Microsoft access	2.49	Web/ IP	2.39
Call center activities	1.95	Support for desktop applications	2.49	Network configuration	2.34
Support for desktop applications	1.89	Project management	2.46	Principles of Programming	2.24
Workflow management	1.88	Negotiation & conflict resolution	2.42	Open systems server administration	2.21
UNIX operating systems	1.86	Business process analysis	2.40	Wide Area Networks (WAN)	2.18
Windows network operating systems	1.86	Help desk activities	2.40	Technical documentation	2.16
Disaster recovery & planning	1.83	Planning & evaluation	2.35	Network architecture & design principles	2.13
Managing consultant staff	1.77	Quality assurance	2.32	Planning & evaluation	2.09
Internal controls	1.74	Object-oriented analysis & design principles	2.30	Mobile computing	2.08
Open systems server administration	1.71	Organizational awareness & business knowledge	2.29	Organizational awareness & business knowledge	2.08
Web/ IP	1.69	Hardware maintenance & support	2.29	Wireless technologies	2.07
Technology training activities	1.68	Systems integration	2.26	Testing & evaluation	2.05
Records management	1.66	Managing agency staff	2.22	Project management	2.05
Knowledge Management (KM)	1.65	Website design & development	2.19	Systems implementation	2.05
COBOL	1.64	Windows network operating systems	2.18	Website design & development	2.03
Unified messaging services	1.62	Systems architecture	2.16	DHTML/ HTML/ XHTML	1.97
Project management	1.60	DHTML/ HTML/ XHTML	2.16	System security applications	1.95
Technical documentation	1.58	Backup & recovery	2.15	Broadband technologies	1.93

Operations specialists		Programmers		Other technical specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Microsoft access	1.56	Visual Basic	2.11	Database design & development standards	1.91
Network configuration	1.48	SQL	2.07	Workflow management	1.91
Wide Area Networks (WAN)	1.45	Technology training activities	2.06	Knowledge Management (KM)	1.90
Testing & evaluation	1.45	Call center activities	2.01	Managing agency staff	1.89
Intrusion detection	1.45	Web/ IP	1.99	Website management	1.88
Network architecture & design principles	1.41	Internal controls	1.98	Intrusion detection	1.86
Quality assurance	1.41	Managing consultant staff	1.98	Website accessibility	1.86
Financial management	1.40	Workflow management	1.97	Mainframe operations	1.85
Database design & development standards	1.39	IBM mainframe	1.96	Customer Relationship Management (CRM)	1.85
Broadband technologies	1.38	CASE Tools	1.95	Novell operating systems	1.85
Systems implementation	1.38	Website management	1.92	Records management	1.84
Customer Relationship Management (CRM)	1.35	Knowledge Management (KM)	1.90	Internal controls	1.83
System security applications	1.34	Network architecture & design principles	1.90	Collaboration software	1.83
Mac OS/ OS X operating systems	1.34	Oracle	1.90	Disaster recovery & planning	1.82
Data warehousing	1.33	Network configuration	1.89	Database applications development techniques	1.81
Systems architecture	1.33	Microsoft SQL	1.87	Quality assurance	1.80
Linux operating systems	1.32	Unified messaging services	1.87	System life cycle planning principles	1.79
Mobile computing	1.32	Records management	1.86	Visual Basic	1.79
Novell operating systems	1.30	UNIX operating systems	1.85	Systems integration	1.78
Wireless technologies	1.30	Website accessibility	1.84	Identity management & directory services	1.76
System life cycle planning principles	1.30	Joint Application Development (JAD)	1.83	CASE Tools	1.75
DHTML/ HTML/ XHTML	1.29	System security applications	1.81	Structured system analysis & design principles	1.75
Website accessibility	1.29	Rapid Application Development (RAD)/ Prototyping	1.80	UNIX operating systems	1.75
IBM/ DB2	1.28	Disaster recovery & planning	1.79	Requirements analysis	1.75
Collaboration software	1.27	Data warehousing	1.76	Managing consultant staff	1.74
Contract management & vendor relations	1.27	Open systems server administration	1.75	IT asset management	1.74
Telephone/ PBX	1.27	Change management	1.75	IBM mainframe	1.72
Fortran	1.27	C ++	1.75	Systems architecture	1.72
Database applications development techniques	1.27	Wide Area Networks (WAN)	1.74	Video imaging	1.69
Requirements analysis	1.27	C	1.72	Cellular technologies	1.69
Structured system analysis & design principles	1.27	Financial management	1.72	Telephone/ PBX	1.68
Systems integration	1.27	JavaScript	1.72	Encryption	1.68
Website design & development	1.27	Customer Relationship Management (CRM)	1.71	Object-oriented analysis & design principles	1.67
Change management	1.26	IBM/ DB2	1.70	Business process analysis	1.66
Cellular technologies	1.25	Visual Basic Script	1.70	Website privacy	1.65
Encryption	1.25	Content management	1.68	Contract management & vendor relations	1.65
Business process analysis	1.24	Java	1.68	IT procurement	1.64
Website management	1.22	Web servers	1.65	Change management	1.64
Microsoft SQL	1.22	Website search administration	1.64	Financial management	1.64
Website privacy	1.21	Website privacy	1.64	Web servers	1.62
C ++	1.20	Mainframe operations	1.63	Content management	1.62

Operations specialists		Programmers		Other technical specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
Web servers	1.19	Intrusion detection	1.63	Website search administration	1.62
CASE Tools	1.18	IT project portfolio management	1.63	Firewalls	1.61
IT project portfolio management	1.18	Wireless technologies	1.61	Microsoft SQL	1.60
Web-based graphics & multimedia	1.17	Collaboration software	1.61	C ++	1.59
Oracle	1.17	Identity management & directory services	1.61	Data warehousing	1.59
C	1.16	Mobile computing	1.60	Visual Basic Script	1.59
Identity management & directory services	1.16	Novell operating systems	1.59	IT strategic planning	1.58
Joint Application Development (JAD)	1.16	Unisys mainframe	1.57	Voice over IP	1.58
Website search administration	1.16	IT risk assessment & management	1.56	Linux operating systems	1.55
Business continuity planning	1.16	Encryption	1.56	C	1.55
Visual Basic	1.16	Modeling & simulation	1.56	Mac OS/ OS X operating systems	1.53
Enterprise Resource Planning (ERP) systems	1.15	IT strategic planning	1.55	IT risk assessment & management	1.52
IT procurement	1.15	IT procurement	1.54	Unisys mainframe	1.50
IT strategic planning	1.15	IT asset management	1.54	Web-based graphics & multimedia	1.50
Firewalls	1.15	Contract management & vendor relations	1.54	JavaScript	1.50
Object-oriented analysis & design principles	1.15	XML/XSL	1.52	IT project portfolio management	1.49
IT risk assessment & management	1.14	Broadband technologies	1.52	COBOL	1.48
Satellite technologies	1.14	Fortran	1.52	Java	1.48
Video imaging	1.14	Business continuity planning	1.47	Modeling & simulation	1.47
IT asset management	1.13	Unified Modeling Language (UML)	1.46	Business continuity planning	1.45
Public Key Infrastructure (PKI)	1.13	Decision support systems	1.46	Computer forensics	1.45
Content management	1.11	MYSQL	1.44	SQL	1.44
Geographic Information Systems (GIS)	1.11	Linux operating systems	1.44	Satellite technologies	1.44
Java	1.11	Capacity management	1.42	Capacity management	1.40
SQL	1.11	Enterprise Resource Planning (ERP) systems	1.42	Oracle	1.39
Visual Basic Script	1.11	Visual Studio .NET	1.40	Public Key Infrastructure (PKI)	1.39
Capacity management	1.10	Metadata management	1.40	MYSQL	1.37
Modeling & simulation	1.10	Web-based graphics & multimedia	1.39	Geographic Information Systems (GIS)	1.37
Computer forensics	1.10	Telephone/ PBX	1.36	Decision support systems	1.37
Cryptology	1.10	Firewalls	1.36	Enterprise Resource Planning (ERP) systems	1.37
Voice over IP	1.10	Video imaging	1.35	Rapid Application Development (RAD)/ Prototyping	1.36
JavaScript	1.10	Geographic Information Systems (GIS)	1.35	Joint Application Development (JAD)	1.35
Rapid Application Development (RAD)/ Prototyping	1.10	Mac OS/ OS X operating systems	1.33	XML/XSL	1.33
XML/XSL	1.08	Computer forensics	1.33	Cryptology	1.32
Artificial Intelligence (AI)	1.07	Cellular technologies	1.32	Visual Studio .NET	1.32
Decision support systems	1.06	PowerBuilder	1.31	Metadata management	1.29
Biometrics	1.06	Public Key Infrastructure (PKI)	1.31	Artificial Intelligence (AI)	1.26
ColdFusion	1.05	Voice over IP	1.31	Biometrics	1.26
IBM WebSphere Studio	1.05	Perl/CGI	1.30	Unified Modeling Language (UML)	1.25
Java Studio	1.05	Artificial Intelligence (AI)	1.29	IBM/ DB2	1.24
Oracle Jdeveloper Studio	1.05	Cryptology	1.25	Java Studio	1.22
Metadata management	1.03	ColdFusion	1.24	Perl/CGI	1.21

Operations specialists		Programmers		Other technical specialists	
Skill	Mean*	Skill	Mean*	Skill	Mean*
MYSQL	1.03	IBM WebSphere Studio	1.23	Fortran	1.21
Unified Modeling Language (UML)	1.03	Java Studio	1.23	PHP	1.18
Eclipse	1.03	Biometrics	1.22	IBM WebSphere Studio	1.17
Perl/CGI	1.02	Satellite technologies	1.21	ColdFusion	1.15
PowerBuilder	1.02	Oracle Jdeveloper Studio	1.18	PowerBuilder	1.15
Borland JBuilder	1.02	Eclipse	1.17	Borland JBuilder	1.13
Visual Studio .NET	1.02	PHP	1.16	Eclipse	1.11
PHP	1.00	Borland JBuilder	1.15	Oracle Jdeveloper Studio	1.11

Business specialists		Systems specialists	
Skill	Mean*	Skill	Mean*
Written communication	3.46	Principles of operating systems	3.51
Oral communication	3.27	Principles of Programming	3.45
Leadership	3.05	Windows operating system	3.20
Supervisory skills	3.04	Written communication	3.09
Customer service	3.01	Oral communication	3.00
Windows operating system	3.01	Backup & recovery	2.83
Negotiation & conflict resolution	2.77	Supervisory skills	2.83
Organizational awareness & business knowledge	2.76	Systems implementation	2.76
Planning & evaluation	2.68	COBOL	2.75
Principles of operating systems	2.67	Leadership	2.74
Project management	2.66	Technical documentation	2.72
Managing agency staff	2.65	Hardware maintenance & support	2.66
Support for desktop applications	2.60	Customer service	2.65
Help desk activities	2.59	System life cycle planning principles	2.64
Internal controls	2.44	Testing & evaluation	2.60
Technology training activities	2.42	Structured system analysis & design principles	2.57
Hardware maintenance & support	2.38	Project management	2.55
Managing consultant staff	2.34	Help desk activities	2.50
Microsoft Access	2.34	Planning & evaluation	2.43
Systems implementation	2.31	Open systems server administration	2.43
Testing & evaluation	2.29	Support for desktop applications	2.42
Call center activities	2.27	Windows network operating systems	2.41
Principles of Programming	2.24	Managing agency staff	2.41
Backup & recovery	2.23	Negotiation & conflict resolution	2.38
Windows network operating systems	2.20	Systems architecture	2.37
Technical documentation	2.16	UNIX operating systems	2.33
Financial management	2.16	Organizational awareness & business knowledge	2.32
Business process analysis	2.14	Requirements analysis	2.32
Requirements analysis	2.13	Disaster recovery & planning	2.28
Database design & development standards	2.10	System security applications	2.28

Business specialists		Systems specialists	
Skill	Mean*	Skill	Mean*
System life cycle planning principles	2.08	Database design & development standards	2.26
Customer Relationship Management (CRM)	2.07	Web/ IP	2.23
Records management	2.02	Systems integration	2.23
Workflow management	2.02	Managing consultant staff	2.22
Quality assurance	2.01	Database applications development techniques	2.22
Unified messaging services	2.01	Network architecture & design principles	2.21
Web/ IP	2.00	Technology training activities	2.19
Website design & development	1.99	DHTML/ HTML/ XHTML	2.16
Network configuration	1.97	Network configuration	2.15
Knowledge Management (KM)	1.97	Quality assurance	2.13
Database applications development techniques	1.96	Microsoft Access	2.13
Structured system analysis & design principles	1.95	Mainframe operations	2.12
Change management	1.92	Object-oriented analysis & design principles	2.12
IT strategic planning	1.91	Website design & development	2.12
Network architecture & design principles	1.91	IBM mainframe	2.10
Systems integration	1.89	Website management	2.04
System security applications	1.89	Business process analysis	2.03
IT procurement	1.86	Internal controls	2.00
IT project portfolio management	1.84	Visual Basic	1.98
Website management	1.84	Call center activities	1.98
Disaster recovery & planning	1.83	Unified messaging services	1.94
IT risk assessment & management	1.83	Intrusion detection	1.91
Mobile computing	1.82	Web servers	1.91
Wireless technologies	1.82	Workflow management	1.90
Contract management & vendor relations	1.81	Linux operating systems	1.89
IT asset management	1.80	Change management	1.88
DHTML/ HTML/ XHTML	1.78	Identity management & directory services	1.87
Systems architecture	1.78	Wide Area Networks (WAN)	1.86
Identity management & directory services	1.75	Website accessibility	1.86
Website accessibility	1.75	Encryption	1.79
Business continuity planning	1.74	JavaScript	1.79
Open systems server administration	1.73	Collaboration software	1.78
Wide Area Networks (WAN)	1.72	Mobile computing	1.78
Data warehousing	1.68	CASE Tools	1.77
Intrusion detection	1.67	SQL	1.77
Content management	1.67	Fortran	1.76
Object-oriented analysis & design principles	1.67	Knowledge Management (KM)	1.76
Novell operating systems	1.66	Wireless technologies	1.76
CASE Tools	1.64	C	1.75
Website privacy	1.62	Visual Basic Script	1.74
Broadband technologies	1.60	Rapid Application Development (RAD)/ Prototyping	1.74
Visual Basic	1.60	Records management	1.72

Business specialists		Systems specialists	
Skill	Mean*	Skill	Mean*
COBOL	1.58	Oracle	1.71
Website search administration	1.58	IT project portfolio management	1.71
Encryption	1.57	Content management	1.70
Joint Application Development (JAD)	1.54	Customer Relationship Management (CRM)	1.70
Web servers	1.52	C ++	1.70
UNIX operating systems	1.50	IT procurement	1.69
Collaboration software	1.50	Novell operating systems	1.69
Firewalls	1.49	Java	1.68
SQL	1.47	Data warehousing	1.67
Video imaging	1.47	IT strategic planning	1.67
Microsoft SQL	1.47	Public Key Infrastructure (PKI)	1.66
Rapid Application Development (RAD)/ Prototyping	1.47	Contract management & vendor relations	1.66
Capacity management	1.46	Financial management	1.65
Decision support systems	1.46	IT asset management	1.65
Telephone/ PBX	1.45	Website privacy	1.64
Modeling & simulation	1.45	IT risk assessment & management	1.63
Computer forensics	1.45	Capacity management	1.63
IBM mainframe	1.45	Firewalls	1.62
Geographic Information Systems (GIS)	1.44	Website search administration	1.62
Web-based graphics & multimedia	1.44	Microsoft SQL	1.62
Mainframe operations	1.43	Joint Application Development (JAD)	1.61
Oracle	1.42	Computer forensics	1.61
Cellular technologies	1.41	IBM/ DB2	1.57
Public Key Infrastructure (PKI)	1.40	Unisys mainframe	1.57
Enterprise Resource Planning (ERP) systems	1.39	Business continuity planning	1.56
Visual Basic Script	1.39	Modeling & simulation	1.56
Voice over IP	1.39	Broadband technologies	1.56
Metadata management	1.37	XML/XSL	1.52
JavaScript	1.37	Cellular technologies	1.47
Linux operating systems	1.36	Video imaging	1.45
Biometrics	1.36	Cryptology	1.45
MYSQL	1.34	Voice over IP	1.41
C	1.31	Perl/CGI	1.40
XML/XSL	1.30	Mac OS/ OS X operating systems	1.40
C ++	1.30	Unified Modeling Language (UML)	1.39
Mac OS/ OS X operating systems	1.29	Decision support systems	1.39
Cryptology	1.29	Artificial Intelligence (AI)	1.39
Java	1.28	Metadata management	1.38
Unisys mainframe	1.28	Telephone/ PBX	1.38
Satellite technologies	1.28	Enterprise Resource Planning (ERP) systems	1.38
Fortran	1.26	MYSQL	1.36
Visual Studio .NET	1.23	Visual Studio .NET	1.33

Business specialists		Systems specialists	
Skill	Mean*	Skill	Mean*
IBM/ DB2	1.22	Web-based graphics & multimedia	1.33
Artificial Intelligence (AI)	1.21	Geographic Information Systems (GIS)	1.31
ColdFusion	1.20	Satellite technologies	1.30
Unified Modeling Language (UML)	1.19	IBM WebSphere Studio	1.30
Perl/CGI	1.17	Biometrics	1.30
Java Studio	1.13	PowerBuilder	1.25
PowerBuilder	1.13	PHP	1.21
IBM WebSphere Studio	1.11	Eclipse	1.20
PHP	1.10	Java Studio	1.18
Oracle Jdeveloper Studio	1.09	ColdFusion	1.15
Borland JBuilder	1.07	Oracle Jdeveloper Studio	1.12
Eclipse	1.06	Borland JBuilder	1.09

Table E6. Skill by skill training demand (listed in alphabetical order)

Note: Row totals may not equal 100% due to rounding.

Skill	N	None	Basic	Intermediate	Advanced	Percent who need training at any level
Artificial Intelligence (AI)	2599	1956 (75%)	399 (15%)	163 (6%)	81 (3%)	25%
Backup & recovery	2713	1780 (66%)	249 (9%)	326 (12%)	358 (13%)	34%
Biometrics	2586	1711 (66%)	480 (19%)	266 (10%)	129 (5%)	34%
Borland JBuilder	2503	1938 (77%)	369 (15%)	122 (5%)	74 (3%)	23%
Broadband technologies	2596	1673 (65%)	391 (15%)	354 (14%)	178 (7%)	36%
Business continuity planning	2646	1652 (62%)	384 (15%)	406 (15%)	204 (8%)	38%
Business process analysis	2633	1569 (60%)	334 (13%)	402 (15%)	328 (13%)	40%
C	2375	1875 (79%)	262 (11%)	159 (7%)	79 (3%)	21%
C++	2427	1791 (74%)	304 (13%)	221 (9%)	111 (5%)	26%
Call center activities	2643	1936 (73%)	213 (8%)	258 (10%)	236 (9%)	27%
Capacity management	2656	1707 (64%)	405 (15%)	379 (14%)	165 (6%)	36%
CASE tools	2633	1614 (61%)	400 (15%)	397 (15%)	222 (8%)	39%
Cellular technologies	2567	1777 (69%)	427 (16%)	245 (10%)	118 (5%)	31%
Change management	2658	1627 (61%)	390 (15%)	412 (16%)	229 (9%)	39%
COBOL	2376	1935 (81%)	196 (8%)	131 (6%)	114 (5%)	19%
ColdFusion	2409	1843 (77%)	329 (14%)	147 (6%)	90 (4%)	23%
Collaboration software	2610	1849 (71%)	331 (13%)	297 (11%)	133 (5%)	29%

Skill	N	None	Basic	Intermediate	Advanced	Percent who need training at any level
Computer forensics	2627	1597 (61%)	496 (19%)	347 (13%)	187 (7%)	39%
Content management	2652	1711 (65%)	423 (16%)	344 (13%)	174 (7%)	35%
Contract management & vendor relations	2666	1690 (63%)	406 (15%)	383 (14%)	187 (7%)	37%
Cryptography	2597	1693 (65%)	473 (18%)	282 (11%)	149 (6%)	35%
Customer Relationship Management (CRM)	2638	1671 (63%)	381 (14%)	379 (14%)	207 (8%)	37%
Customer service	2604	1518 (58%)	199 (8%)	406 (16%)	481 (19%)	42%
Data warehousing	2699	1694 (63%)	390 (14%)	408 (15%)	207 (8%)	37%
Database applications development techniques	2600	1522 (59%)	280 (11%)	425 (16%)	373 (14%)	41%
Database design & development standards	2586	1525 (59%)	271 (11%)	425 (16%)	365 (14%)	41%
Decision support systems	2630	1811 (69%)	433 (17%)	268 (10%)	118 (5%)	31%
DHTML/ HTML/ XHTML	2503	1535 (61%)	340 (14%)	369 (15%)	259 (10%)	39%
Disaster recovery & planning	2681	1460 (55%)	411 (15%)	508 (19%)	302 (11%)	46%
Eclipse	2517	1903 (76%)	387 (15%)	142 (6%)	85 (3%)	24%
Encryption	2662	1506 (57%)	494 (19%)	428 (16%)	234 (9%)	43%
Enterprise Resource Planning (ERP) systems	2610	1833 (70%)	402 (15%)	256 (10%)	119 (5%)	30%
Financial management	2606	1536 (59%)	368 (14%)	428 (16%)	274 (11%)	41%
Firewalls	2640	1534 (58%)	475 (18%)	400 (15%)	231 (9%)	42%
Fortran	2332	2063 (89%)	180 (8%)	58 (3%)	31 (1%)	12%
Geographic Information Systems (GIS)	2607	1890 (73%)	388 (15%)	220 (8%)	109 (4%)	28%
Hardware & maintenance support	2674	1828 (68%)	218 (8%)	271 (10%)	357 (13%)	32%
Help desk activities	2664	1893 (71%)	198 (7%)	268 (10%)	305 (11%)	29%
IBM mainframe	2533	1896 (75%)	271 (11%)	225 (9%)	141 (6%)	25%
IBM WebSphere Studio	2579	1776 (69%)	490 (19%)	196 (8%)	117 (5%)	31%
IBM/ DB2	2491	1842 (74%)	290 (12%)	213 (9%)	146 (6%)	26%
Identity management & directory services	2651	1490 (56%)	448 (17%)	448 (17%)	265 (10%)	44%
Internal controls	2601	1506 (58%)	331 (13%)	442 (17%)	322 (12%)	42%
Intrusion detection	2687	1467 (55%)	487 (18%)	471 (18%)	262 (10%)	45%
IT asset management	2655	1667 (63%)	389 (15%)	411 (16%)	188 (7%)	37%
IT procurement	2645	1665 (63%)	399 (15%)	378 (14%)	203 (8%)	37%
IT project portfolio management	2682	1644 (61%)	394 (15%)	418 (16%)	226 (8%)	39%

Skill	N	None	Basic	Intermediate	Advanced	Percent who need training at any level
IT risk assessment & management	2684	1608 (60%)	405 (15%)	434 (16%)	237 (9%)	40%
IT strategic planning	2675	1608 (60%)	403 (15%)	421 (16%)	243 (9%)	40%
Java	2593	1471 (57%)	473 (18%)	409 (16%)	240 (9%)	43%
JavaScript	2532	1488 (59%)	466 (18%)	366 (15%)	212 (8%)	41%
Java studio	2583	1719 (67%)	501 (19%)	246 (10%)	117 (5%)	33%
Joint Application Development (JAD)	2582	1715 (66%)	361 (14%)	303 (12%)	203 (8%)	34%
Knowledge Management (KM)	2682	1685 (63%)	391 (15%)	418 (16%)	188 (7%)	37%
Leadership	2666	1378 (52%)	186 (7%)	493 (19%)	609 (23%)	48%
Linux operating systems	2606	1747 (67%)	396 (15%)	287 (11%)	176 (7%)	33%
MacOS/ OS X operating systems	2480	1992 (80%)	291 (12%)	132 (5%)	65 (3%)	20%
Mainframe operations	2642	2004 (76%)	272 (10%)	216 (8%)	150 (6%)	24%
Managing agency staff	2646	1457 (55%)	229 (9%)	509 (19%)	451 (17%)	45%
Managing consultant staff	2636	1491 (57%)	268 (10%)	469 (18%)	408 (16%)	43%
Metadata management	2633	1827 (69%)	414 (16%)	266 (10%)	126 (5%)	31%
Microsoft Access	2578	1626 (63%)	232 (9%)	398 (15%)	322 (13%)	37%
Microsoft SQL	2591	1652 (64%)	356 (14%)	339 (13%)	244 (9%)	36%
Mobile computing	2612	1639 (63%)	400 (15%)	380 (15%)	193 (7%)	37%
Modeling & simulation	2633	1810 (69%)	404 (15%)	284 (11%)	135 (5%)	31%
MySQL	2483	1818 (73%)	327 (13%)	216 (9%)	122 (5%)	27%
Negotiation & conflict resolution	2669	1391 (52%)	243 (9%)	500 (19%)	535 (20%)	48%
Network architecture & design principles	2624	1539 (59%)	349 (13%)	460 (18%)	276 (11%)	41%
Network configuration	2665	1532 (58%)	345 (13%)	478 (18%)	310 (12%)	43%
Novell operating systems	2568	1776 (69%)	354 (14%)	265 (10%)	173 (7%)	31%
Object-oriented analysis & design principles	2640	1604 (61%)	323 (12%)	392 (15%)	321 (12%)	39%
Open systems server administration	2685	1871 (70%)	282 (11%)	285 (11%)	247 (9%)	30%
Oracle	2649	1602 (61%)	373 (14%)	350 (13%)	324 (12%)	40%
Oracle Development studio	2562	1791 (70%)	470 (18%)	186 (7%)	115 (5%)	30%

Skill	N	None	Basic	Intermediate	Advanced	Percent who need training at any level
Oral communication	2639	1443 (55%)	150 (6%)	481 (18%)	565 (21%)	45%
Organizational awareness & business knowledge	2614	1442 (55%)	261 (10%)	482 (18%)	429 (16%)	45%
Perl/CGI	2396	1794 (75%)	331 (14%)	176 (7%)	95 (4%)	25%
PHP	2354	1887 (80%)	287(12%)	115 (5%)	65 (3%)	20%
Public Key Infrastructure (PKI)	2619	1627 (62%)	483 (18%)	329 (13%)	180 (7%)	38%
Planning & evaluation	2636	1408 (53%)	236 (9%)	527 (20%)	465 (18%)	47%
PowerBuilder	2366	1870 (79%)	328 (14%)	93 (4%)	75 (3%)	21%
Principles of operating systems	2523	1673 (66%)	135 (5%)	340 (14%)	375 (15%)	34%
Principles of programming	2336	1654 (71%)	178 (8%)	286 (12%)	218 (9%)	29%
Project management	2689	1391 (52%)	240 (9%)	533 (20%)	525 (20%)	48%
Quality assurance	2590	1601 (62%)	334 (13%)	377 (15%)	278 (11%)	38%
Rapid Application Development (RAD)/ prototyping	2586	1718 (66%)	386 (15%)	279 (11%)	203 (8%)	34%
Records management	2659	1735 (65%)	383 (14%)	367 (14%)	174 (7%)	35%
Requirements analysis	2614	1570 (60%)	296 (11%)	406 (16%)	342 (13%)	40%
Satellite technologies	2566	1786 (70%)	442 (17%)	233 (9%)	105 (4%)	30%
SQL	2481	1626 (66%)	292 (12%)	279 (11%)	284 (11%)	34%
Structured system analysis & design principles	2614	1595 (61%)	283 (11%)	404 (16%)	332 (13%)	39%
Supervisory skills	2661	1380 (52%)	169 (6%)	507 (19%)	605 (23%)	48%
Support for desktop applications	2668	1848 (69%)	197 (7%)	282 (11%)	341 (13%)	31%
Systems implementation	2612	1574 (60%)	281 (11%)	420 (16%)	337 (13%)	40%
System security applications	2696	1418 (53%)	445 (17%)	546 (20%)	287 (11%)	47%
Systems architecture	2624	1562 (60%)	357 (14%)	419 (16%)	286 (11%)	40%
Systems integration	2620	1558 (60%)	336 (13%)	423 (16%)	303 (12%)	41%
System life cycle planning principles	2609	1620 (62%)	273 (11%)	398 (15%)	318 (12%)	38%
Technical documentation	2618	1588 (61%)	278 (11%)	425 (16%)	327 (13%)	39%
Technology training activities	2668	1850 (69%)	235 (9%)	327 (12%)	256 (10%)	31%
Telephone /PBX	2547	1807 (71%)	375 (15%)	234 (9%)	131 (5%)	29%
Testing & evaluation	2616	1572 (60%)	261 (10%)	431 (17%)	352 (14%)	40%
Unified messaging services	2576	1656 (64%)	338 (13%)	372 (14%)	210 (8%)	36%
Unified Modeling Language (UML)	2576	1772 (69%)	386 (15%)	246 (10%)	172 (7%)	31%

Skill	N	None	Basic	Intermediate	Advanced	Percent who need training at any level
Unisys mainframe	2516	1973 (78%)	296 (12%)	155 (6%)	92 (4%)	22%
Unix	2628	1676 (64%)	347 (13%)	387 (15%)	218 (8%)	36%
Visual Basic	2521	1575 (63%)	324 (13%)	386 (15%)	236 (9%)	38%
Visual Basic Script	2474	1592 (64%)	413 (17%)	307 (12%)	162 (7%)	36%
Video imaging	2559	1738 (68%)	420 (16%)	265 (10%)	136 (5%)	32%
Visual Studio .NET	2603	1695 (65%)	465 (18%)	274 (11%)	169 (7%)	35%
Voice over IP	2594	1690 (65%)	441 (17%)	309 (12%)	154 (6%)	35%
Web servers	2643	1506 (57%)	501 (19%)	389 (15%)	247 (9%)	43%
Web/IP	2665	1514 (57%)	370 (14%)	480 (18%)	301 (11%)	43%
Web-based graphics & multimedia	2557	1667 (65%)	476 (19%)	248 (10%)	166 (7%)	35%
Website accessibility	2636	1510 (57%)	476 (18%)	404 (15%)	246 (9%)	43%
Website design & development	2708	1435 (53%)	440 (16%)	503 (19%)	330 (12%)	47%
Website management	2678	1469 (55%)	468 (18%)	447 (17%)	294 (11%)	45%
Website privacy	2636	1507 (57%)	502 (19%)	388 (15%)	239 (9%)	43%
Website search & administration	2635	1535 (58%)	494 (19%)	376 (14%)	230 (9%)	42%
Wide Area Networks (WAN)	2621	1591 (61%)	350 (13%)	398 (15%)	282 (11%)	39%
Windows operating systems	2639	1619 (61%)	103 (4%)	311 (12%)	606 (23%)	39%
Windows network operating systems	2645	1530 (58%)	282 (11%)	445 (17%)	388 (15%)	42%
Wireless technologies	2659	1574 (60%)	418 (16%)	447 (17%)	220 (8%)	41%
Workflow management	2700	1671 (62%)	390 (14%)	443 (16%)	196 (7%)	38%
Written communication	2627	1436 (55%)	139 (5%)	467 (18%)	585 (22%)	45%
XML/XSL	2510	1582 (63%)	408 (16%)	313 (13%)	207 (8%)	37%

Table E7. Top ten skills with *none expected and in use, but declining* forecast over the next three years

Skill (percent of CIOs choosing forecast)	Competency Area
▪ Fortran (98%)	▪ Legacy technologies
▪ Unisys mainframe (95%)	▪ Legacy technologies
▪ COBOL (88%)	▪ Legacy technologies
▪ Mac OS/OS X operating systems (87%)	▪ Infrastructure
▪ Mainframe operations (84%)	▪ Legacy technologies
▪ IBM mainframe (82%)	▪ Legacy technologies
▪ Borland JBuilder (80%)	▪ Web computing
▪ Novell operating systems (75%)	▪ Infrastructure
▪ C (75%)	▪ Web computing
▪ PowerBuilder (73%)	▪ Legacy technologies

Table E8. Top ten skills with *in use, but declining* forecast over the next three years

Skill (percent of CIOs choosing forecast)	Competency Area
▪ COBOL (39%)	▪ Legacy technologies
▪ Microsoft Access (35%)	▪ Web computing
▪ Mainframe operations (26%)	▪ Legacy technologies
▪ PowerBuilder (22%)	▪ Legacy technologies
▪ Visual Basic (22%)	▪ Web computing
▪ IBM mainframe (18%)	▪ Legacy technologies
▪ Visual Basic Script (17%)	▪ Web computing
▪ Novell operating systems (16%)	▪ Infrastructure
▪ Unisys mainframe (15%)	▪ Legacy technologies
▪ C ++ (14%)	▪ Web computing

Table E9. Top ten skills with *possible adoption* forecast over the next three years

Skill (percent of CIOs choosing forecast)	Competency Area
▪ Biometrics (61%)	▪ Infrastructure
▪ Voice over IP (56%)	▪ Infrastructure
▪ Public Key Infrastructure (PKI) (53%)	▪ Infrastructure
▪ Video imaging (38%)	▪ Infrastructure
▪ Linux operating systems (38%)	▪ Infrastructure
▪ Wireless technologies (35%)	▪ Infrastructure
▪ Decision support systems (35%)	▪ Management and use of information as an asset
▪ Modeling & simulation (32%)	▪ Management and use of information as an asset
▪ Cryptology (32%)	▪ Infrastructure
▪ IT project portfolio management (30%)	▪ Management

Table E10. Top ten skills with *steady state* forecast over the next three years

Skill (percent of CIOs choosing forecast)	Competency Area
▪ Hardware maintenance & support (71%)	▪ Infrastructure
▪ Support for desktop applications (64%)	▪ Technical support services
▪ Principles of operating systems (63%)	▪ Infrastructure
▪ Internal controls (57%)	▪ Management
▪ Managing agency staff (55%)	▪ Management
▪ Principles of programming (55%)	▪ Systems & databases
▪ Financial management (54%)	▪ Management
▪ IT procurement (54%)	▪ Management
▪ Oral communication (52%)	▪ Management
▪ Backup & recovery (52%)	▪ Infrastructure

Table E11. Top ten skills with *in use and growing* forecast over the next three years

Skill (percent of CIOs choosing forecast)	Competency Area
▪ System security applications (82%)	▪ Infrastructure
▪ Website design & development (82%)	▪ Web computing
▪ Website management (72%)	▪ Web computing
▪ Identity management & directory services (70%)	▪ Infrastructure
▪ Encryption (68%)	▪ Infrastructure
▪ Disaster recovery & planning (67%)	▪ Infrastructure
▪ Web/ IP (66%)	▪ Web computing
▪ Project management (66%)	▪ Management
▪ DHTML/ HTML/ XHTML (63%)	▪ Web computing
▪ Intrusion detection (63%)	▪ Infrastructure

Table E12. Similarities and differences in the *in use and declining* forecast across agency size groups

Competency Area	At least 50 percent of CIOs in all agency size groups chose forecast for these skills	Small (at least 50 percent of CIOs)	Medium (at least 50 percent of CIOs)	Large (at least 50 percent of CIOs)
Management				
Infrastructure				
Web computing				
Systems and databases				
Technical support services				
Management and use of information as an asset				
Legacy technologies			▪ COBOL ▪ Mainframe operating systems ▪ IBM mainframe operating systems	▪ COBOL

Table E13. Similarities and differences in *possible adoption* forecast across agency size groups

Competency Area	At least 50 percent of CIOs in all agency size groups chose forecast for these skills	Small (at least 50 percent of CIOs)	Medium (at least 50 percent of CIOs)	Large (at least 50 percent of CIOs)
Management				
Infrastructure	▪ Biometrics	▪ Public Key Infrastructure (PKI) ▪ Voice over IP		▪ Public Key Infrastructure (PKI) ▪ Voice over IP
Web computing				
Systems and databases			▪ CASE tools	
Technical support services				
Management and use of information as an asset				
Legacy technologies				

Table E14. Similarities and differences in *steady state* forecast across agency size groups

Competency Area	At least 50 percent of CIOs in all agency size groups chose forecast for these skills	Small (at least 50 percent of CIOs)	Medium (at least 50 percent of CIOs)	Large (at least 50 percent of CIOs)
Management	▪ Internal controls ▪ Managing agency staff	▪ IT asset management ▪ Financial management ▪ IT procurement	▪ IT procurement ▪ Customer Relationship Management (CRM) ▪ IT strategic planning ▪ Planning & evaluation ▪ Leadership ▪ Negotiation & conflict resolution ▪ Supervisory skills ▪ Customer service	▪ Financial management ▪ Negotiation & conflict resolution ▪ Supervisory skills ▪ Customer service
Infrastructure	▪ Hardware & maintenance support	▪ Principles of operating systems ▪ Backup & recovery	▪ Principles of operating systems ▪ Backup & recovery ▪ Wide Area Networks (WAN)	▪ Telephone/ PBX ▪ Windows network operating systems ▪ Windows operating systems ▪ Open system server administration ▪ Technology training activities
Web computing			▪ Microsoft Access	▪ Microsoft Access ▪ Java ▪ Microsoft SQL
Systems and databases		▪ Database design & development principles ▪ Quality assurance ▪ Testing & evaluation ▪ Principles of programming		▪ Principles of programming ▪ Structured system analysis & design principles
Technical support services	▪ Help desk activities	▪ Support for desktop applications	▪ Call center activities	▪ Support for desktop applications
Management and use of information as an asset				
Legacy technologies				

Table E15. High impact skill investments by job specialty

Competency Area	IT managers	Operations specialists	Database specialists	Systems specialists
Management		▪ Project management	▪ Business continuity planning ▪ Change management ▪ IT strategic planning ▪ IT risk assessment & management	▪ Business continuity planning ▪ Change management ▪ IT risk assessment & management ▪ IT strategic planning ▪ IT asset management
Infrastructure	▪ Encryption ▪ Firewalls ▪ Intrusion detection ▪ Wireless technologies ▪ Web/ IP	▪ Firewalls ▪ Encryption ▪ Intrusion detection ▪ System security applications ▪ Disaster recovery & planning	▪ Identity management & directory services ▪ Network architecture & design principles ▪ System security applications ▪ Firewalls ▪ Intrusion detection ▪ Encryption ▪ Web/ IP ▪ Network configuration	▪ Identity management & directory services ▪ Firewalls ▪ Wireless technologies ▪ Mobile computing ▪ Intrusion detection ▪ Encryption ▪ Unified messaging services ▪ Wide Area Networks (WAN)
Web computing	▪ Website design & development ▪ Website management ▪ Website privacy ▪ Web accessibility ▪ Website search & administration		▪ Website search & administration ▪ XML/XSL ▪ JavaScript ▪ Java ▪ Website accessibility ▪ Web servers ▪ Website management ▪ DHTML/ HTML/ XHTML ▪ Website privacy	▪ XML/XSL ▪ Website search & administration ▪ Website accessibility ▪ Web servers ▪ Java ▪ JavaScript ▪ Website management ▪ Website privacy
Systems and databases				▪ Oracle ▪ Business process analysis
Technical support services				
Management and use of information as an asset	▪ Content management		▪ Content management ▪ Records management ▪ Workflow management ▪ Artificial Intelligence (AI)	▪ Content management ▪ Workflow management ▪ Data warehousing
Legacy technologies				

Table E15. High impact skill investments by job specialty (continued)

Competency Area	Datacomm/telecomm specialists	Programmers	Other technical specialists	Program/business specialists
Management	■ Change management ■ Business continuity Planning ■ IT risk assessment & management	■ Business continuity planning ■ Change management ■ IT strategic planning ■ IT risk assessment & management ■ IT asset management	■ IT asset management ■ IT risk assessment and mgmt ■ IT strategic planning	■ Business continuity planning ■ Change management ■ IT risk assessment & management ■ IT strategic planning ■ IT asset management
Infrastructure	■ Encryption ■ Firewalls	■ Identity management & directory services ■ Disaster recovery planning ■ System security applications ■ Network architecture & design principles ■ Firewalls ■ Encryption ■ Mobile computing ■ Wireless technologies ■ Intrusion detection ■ Web/ IP ■ Wide Area Networks (WAN) ■ Unified messaging services ■ Network configuration	■ System security applications ■ Identity management & directory services ■ Disaster recovery & planning ■ Encryption ■ Intrusion detection ■ Firewalls	■ Disaster recovery planning ■ Identity management & directory services ■ Network architecture & design principles ■ System security applications ■ Encryption ■ Intrusion detection ■ Mobile computing ■ Web/ IP ■ Wireless technologies ■ Network configuration ■ Wide Area Networks (WAN)
Web computing	■ Website design & development	■ XML/XSL ■ Website search & administration ■ Web servers ■ Java ■ JavaScript ■ Website accessibility ■ Website management ■ Website privacy	■ Website design & development ■ Website management ■ DHTML/ HTML/ XHTML ■ Java ■ JavaScript ■ Web servers ■ Website accessibility ■ Website search & administration ■ Website privacy	■ DHTML/ HTML/ XHTML ■ Java ■ JavaScript ■ Web servers ■ Website accessibility ■ Website design & development ■ Website management ■ Website search & administration ■ XML/XSL ■ Website privacy
Systems and databases		■ Oracle	■ Database design & development standards ■ Systems integration ■ Systems architecture ■ Oracle ■ System life cycle planning principles ■ Object-oriented analysis & design principles ■ Database applications development techniques ■ Business process analysis ■ Systems implementation ■ Requirements analysis ■ Structured system analysis & design principles ■ Quality assurance	■ System architecture ■ Systems integration ■ Database applications & development techniques ■ Object-oriented analysis & design principles ■ Quality assurance ■ Structured system analysis & design principles
Technical support services				
Management and Use of Information as an Asset		■ Content management ■ Records management ■ Workflow management ■ Data warehousing	■ Records management ■ Workflow management ■ Content management ■ Data warehousing	■ Content management ■ Data warehousing ■ Records management

Table E16. Reasons training is worthwhile to employees

Rank	Skill Item	N*	% of respondents
1	To improve my ability to do existing work	2,609	92 %
2	To prepare me for more demanding assignments	2,351	83 %
3	To prepare me for a greater variety of assignments	2,344	83 %
4	To prepare me for management opportunities	1,906	67 %
5	To help me score better on Civil Service exams	1,185	42 %
6	To give me more opportunity to transfer to jobs in other agencies	1.041	37 %

** Respondents were allowed to select all that apply*

Table E17. Employee preferences for training methods

		Training Focus														
		Technical tools				Specific IT skills				Management skills						
Training Method	Description	1st Pref.	%	2nd Pref.	%	1st Pref.	%	2nd Pref.	%	1st Pref.	%	2nd Pref.	%	Total count	As 1st Pref.	As 2nd Pref.
Off-site classroom	Traditional instructor-led.	1,300	47%	700	25%	1,157	41%	655	24%	1,032	37%	614	22%	5,458	3,489	1,969
On-site classroom	Traditional instructor-led.	1,051	38%	962	35%	995	36%	864	31%	943	34%	809	29%	5,624	2,989	2,635
Virtual classroom	Real-time instructor-led, delivered via Internet at your desktop.	83	3%	257	9%	151	5%	301	11%	172	6%	222	8%	1,186	406	780
Self-taught	No instructor, use of books, reference guides, or user manuals available at your facility.	81	3%	154	6%	99	4%	167	6%	80	3%	177	6%	758	260	498
Self-paced eLearning	No instructor, self-study tutorials, delivered via the Internet at your desktop.	123	4%	292	11%	216	8%	376	14%	180	6%	333	12%	1,520	519	1,001
Coaching or mentoring		135	5%	235	9%	120	4%	222	8%	275	10%	309	11%	1,296	530	766
Video conferencing	Instructional session, bringing together people at different locations.	4	0%	27	1%	11	0%	39	1%	34	1%	78	3%	193	49	144
Workshops	Workshops provided at trade or other professional conferences	20	1%	151	5%	48	2%	153	6%	94	3%	243	9%	709	162	547
	Number of Responses	*2,797*		*2778*		*2,797*		*2777*		*2,810*		*2785*				
	Missing	*36*		*55*		*36*		*56*		*36*		*48*				
	Total Responses	*2,833*		*2,833*		*2,833*		*2,833*		*2,833*		*2,833*				

** Respondents were asked for their first and second preference*

Table E18. Employee preferences for being informed about training

Rank	Skill Item	N*	% of respondents
1	Email	2,676	95 %
2	Posting on your agency's Intranet	1,506	53 %
3	Posting on a Website outside of your agency	630	22 %
4	Printed flyers posted at your facility	570	20 %

** Respondents were allowed to select all that apply*

Table E19. Employee certifications

Rank	Skill Item	N*	% of respondents
1	Operating systems	146	5 %
2	Computing	139	5 %
3	Network support	134	5 %
4	Information systems	106	4 %
5	Database	58	2 %
6	Business applications	55	2 %
7	Project management	54	2 %
8	Software development	52	2 %
9	Website design & management	36	1 %
10	Network security	33	1 %
11	Training	31	1 %
12	Information systems security	29	1 %
13	Healthcare	7	< 1 %
14	Quality assurance	4	< 1 %
15	Chief information officer (CIO)	2	< 1 %
	Total number of employees with any certification	439	16 %

** Respondents were allowed to select all that apply*

Table E20. CIO preferences for employee certifications

Rank	Skill Item	N	% of CIOs
1	Project management	39	68 %
2	Information systems security	39	68 %
3	Network security	38	67 %
4	Database	34	60 %
5	Network support	28	49 %
6	Operating systems	25	44 %
7	Web	24	42 %
8	Software development	22	39 %
9	Chief information officer (CIO)	20	35 %
10	Information systems	18	32 %
11	Business applications	16	28 %
12	Quality assurance	13	23 %
13	Computing	12	21 %
14	Training	7	12 %
15	Healthcare	3	5 %

** Respondents were allowed to select all that apply*