Information Technology Task Force Report: Findings and Recommendations

Illinois Workforce Investment Board
Information Technology Task Force
John Rico, Chair

June 18, 2009

Introduction

The Illinois Workforce Investment Board (IWIB) established the Information Technology Task Force in March 2008 to develop recommendations for addressing workforce development needs in the information technology sector in Illinois. The task force was asked to focus on identifying major trends and new directions in the information technology sector, define the major career pathways and critical occupations in relation to the Information Technology Career Cluster framework and make recommendations for improving the information technology workforce in Illinois.

This report summarizes the major findings and recommendations of the Information Technology Task Force. The first section provides information on the work of the task force including task force membership, meetings, and the major issues addressed. The second section defines the information technology (IT) sector in Illinois and the importance of the sector for the economic development of the state. It also presents a new career cluster framework for the IT sector in Illinois and defines four critical functions that provide the foundation of career pathways. This section then presents the core IT occupations that carry out these functions. The third section addresses major trends in the information technology sector and the need for strong technical, business and general skills in the IT workforce. The final section summarizes major findings and recommendations.

Background

The Information Technology Task Force was chaired by John Rico, President and CEO of Rico Enterprises. The task force included representatives from employers and unions as well as universities, community colleges, and K-12 education as well as state education, workforce development and economic development agencies. The task force also included representatives from the Mayor's Council of Technology Advisors advising Mayor Daley on information technology issues in Chicago. The task force members are listed in Appendix A.

The task force met six times between December 2008 and May 2009 and held a conference call in June, 2009 to review the final draft report submitted to the IWIB at the June 2009 meeting. The first two meetings focused on defining the information technology sector from both an industry and occupational perspective. Task force members also reviewed alternative definitions and frameworks for the IT sector and developed an integrated framework that defined the core functions and occupations. The task force then reviewed information on IT-related postsecondary programs. The final two meetings focused on refining the IT framework and developing recommendations.

Information Technology Sector in Illinois

Defining the Information Technology Sector. The information technology (IT) sector consists of all organizations and occupations primarily engaged in the research, design, development, implementation and support of digital systems, including software and hardware, that convert, store, organize, protect, transmit, retrieve, share, and utilize information. This definition captures the information technology functions carried out by information technology businesses as well as information technology units within government, education, and businesses from other sectors such as healthcare, manufacturing, transportation and logistics, and financial services. These critical functions are primarily carried out by a core set of information technology occupations that are defined and described in the next section.

Why Important for Economic Development in Illinois. The information technology sector is critical to the economic development of the state because of two major reasons.

- New Platform for All Work. First, information technology is now the new platform for conducting all work in the public and private sectors. All businesses, government agencies, non-profit organizations, and educational institutions must use information technology tools and systems to effectively carry out their primary functions with all workers being asked to use these tools and systems in some way. In general, information technology is now a general utility that all organizations and individuals must use and leverage to remain competitive in today's digital world. The capacity of all organizations and workers to use information tools and systems at even the most basic level will increasingly have a major impact on state economic development.
- Major Source of Competitive Differentiation. Second, information technology has become a major source for competitive differentiation and advantage for businesses in other key sectors critical to the economic development of most states including Illinois. Some analysts argue that since the 1990's, leading companies have utilized information technology and the growing power of the Internet to support major innovations in business models, products, services, and processes. As a result, more companies in the future will compete in part on how they leverage and use technology to drive and support innovation across the entire organization. This will require a new generation of workers at all levels who are experts at using advanced and specialized information tools and systems to drive innovation and improve performance. It also will require information technology professionals to have strong business and entrepreneurship skills and more specialized knowledge of information technology applications in key sectors (e.g., healthcare, manufacturing) as

well as more general core business functions and processes (e.g., human resource management).

Because of the importance of information technology to state economic development, the Task Force believes that Illinois must take immediate actions to dramatically improve the IT skills of the current and future workforce. Illinois must prepare a workforce that is highly skilled in both using and developing advanced information technology tools and systems to drive innovation and overall business performance. The task force believes that Illinois must have a three-level strategy:

- Level 1: Basic Applications for All Workers--All Illinois workers must develop a basic level of information technology skills regardless of where they work. This is a fundamental work readiness skill that is needed to be productive workers.
- Level 2: Advanced Users of Specialized IT Applications and Systems--Most workers must become highly skilled users of specialized IT tools and systems (e.g., logistics planning, engineering design, multimedia production) that are needed to carry out critical functions and processes in all sectors and drive and support innovation.
- Level 3: Core IT Workers—Illinois must produce more core IT workers who can develop, maintain and support information technology applications and systems including the advanced applications used by specialized IT users.

The task force believes that all three levels must be addressed in any future IT workforce development initiative in Illinois. However, the focus of this report is on the core IT workforce.

Defining the Core IT Workforce: Critical Functions and Occupations

The Information Technology Task Force was asked to identify the most critical functions and occupations addressed in national IT frameworks including the Information Technology Career Cluster Framework developed by the U.S. Department of Education. The task force spent considerable time in reviewing this framework as well as the CompTIA job roles framework, the Information Technology Competency Model developed by the U.S. Department of Labor, and an information technology organizational framework provided by a task force business representative.

The task force had major concerns about the Career Cluster framework because it did not address the critical role of research and development and gave too much emphasis to multimedia applications carried out by Level 2 advanced users

rather than Level 3 core IT workers. Task force members emphasized that the public and private research and development activities going on in Illinois are critical to state economic development and must be a major focus in workforce development. They also emphasized that the framework should not just recognize one major "vertical" application, but should be designed to provide a platform for a number of vertical application areas critical to the economic development of Illinois. The Department of Labor framework provided a comprehensive view of workforce skills for IT but had not developed the upper part of the framework that could be compared to the career pathways in the Career Clusters model. The strongest support was given to the information technology organizational framework and how it could be integrated with the Career Clusters framework (excluding the multimedia pathway) and the CompTIA job roles framework.

Illinois Framework for Critical IT Functions: Based on this review, the task force developed an alternative integrated framework addressing four major functions that provide the basis for IT career pathways in Illinois. As shown in Figure 1, these pathways are:

- Research and Development: Research, develop and evaluate "new to the world" or innovative advances in existing hardware and software products and services to improve digital infrastructures, technology and information services, and integration services. This includes research and development conducted by businesses, universities, government agencies, public and private laboratories and other research and development entities.

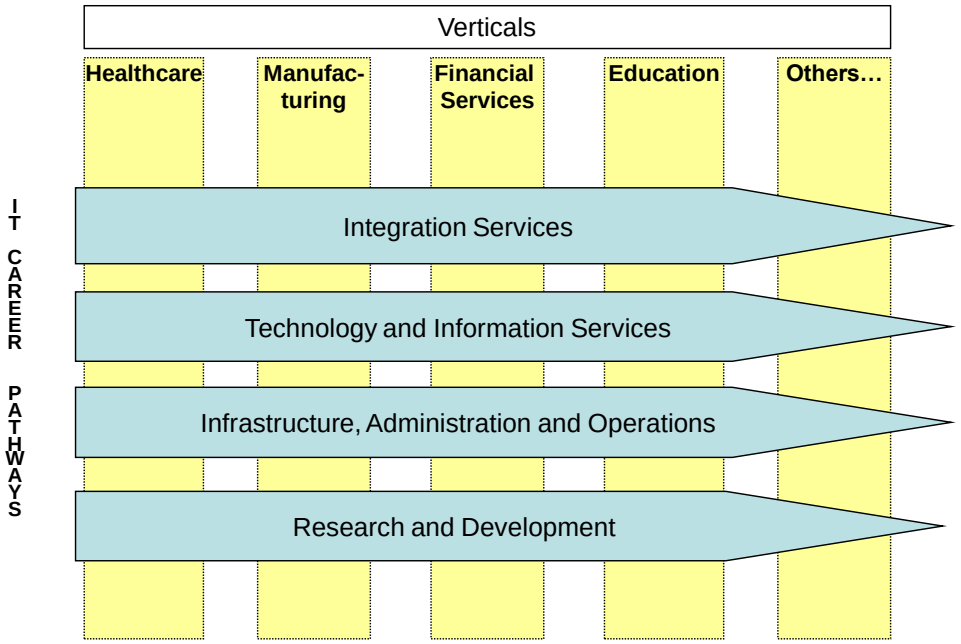
- Infrastructure, Administration and Operations: Develop, configure, monitor, analyze, troubleshoot, manage, maintain, support and improve wired, wireless and combined digital infrastructures including servers, data center operations, networks, network segments and components, and client devices including mobile devices.

- Technology and Information Services: Design, develop, troubleshoot, improve, update and maintain software for operating systems, application services, database services, and web services across the entire infrastructure including computers, networks, and client devices. This includes specialized "vertical" services in a variety of vertical areas such as healthcare, financial services, manufacturing, transportation and logistics and others.

- Integration Services: Identify, obtain, analyze, integrate and administer information technology resources across organizational networks (including business to business), organizations, and organizational units to meet strategic enterprise and business process needs and requirements.

This also includes specialized "vertical" services in a variety of vertical areas such as healthcare, financial services, manufacturing, transportation and logistics and others.

Figure 1: IT Career Cluster Pathways and Vertical Specializations



Core IT Occupations: Definitions and Employment Trends. These critical functions are carried out by a wide variety of core IT professionals playing various job roles with job titles varying within and across employers and sectors. In reviewing existing government occupational statistics, task force members raised major concerns about the occupational titles and descriptions and whether they reflected changing job roles and titles in the information technology sector. After considerable discussion, the task force identified a core set of IT occupations that capture many of the job roles and titles. They decided to expand the widely referenced list of IT occupations from the Standard Occupational Classification (SOC) system to include related science and engineering occupations including technicians to reflect the stronger emphasis on research and development. They also added information technology management and technical writing occupations. The expanded list of core IT occupations is presented in Figure 2. The formal Standard Occupational Classification (SOC) definitions are provided in Appendix B.

Figure 2: Statewide Employment Projections for Core IT Occupations*

Title	Base Year Employment 2006	Proj Year Employment 2016	Change 2006 - 2016 Number	Change 2006 - 2016 Percent
Total, All Occupations	6,354,095	7,094,886	740,791	11.66
Total, Information Tech. Occupations	176,234	219,960	43,726	24.81
Computer & Information Systems Mgrs	12,756	15,003	2,247	17.62
Computer/Info. Scientists, Research	1,027	1,334	307	29.89
Computer Programmers	24,532	26,243	1,711	6.97
Computer Sftwr Engnrs, Applications	17,073	26,057	8,984	52.62
Computer Softwre Engineers, Systems	14,866	22,620	7,754	52.16
Computer Support Specialists	21,478	25,329	3,851	17.93
Computer Systems Analysts	19,161	26,856	7,695	40.16
Database Administrators	5,162	6,620	1,458	28.24
Network/Computer Sys Administrators	12,804	16,485	3,681	28.75
Network Systems & Data Comm Analysts	8,302	12,390	4,088	49.24
Computer Specialists, All Other	14,000	16,672	2,672	19.09
Computer Hardware Engineers	1,528	1,711	183	11.98
Electrical Engineers	5,220	5,180	-40	-0.77
Electronics Engineers, exc Computer	5,394	5,684	290	5.38
Electrical and Electronics Drafters	911	873	-38	-4.17
Electrical & Electronic Eng Techs	4,220	4,261	41	0.97
Technical Writers	1,389	1,600	211	15.19
Computer Operators	6,411	5,042	-1,369	-21.35

Source: Illinois Department of Employment Security
*These projections were completed before the current economic downturn and may not reflect short-term growth and job openings.

As shown in Figure 2, the most recent state employment projections show strong employment growth for these core IT occupations between 2006 and 2016. These projections were developed before the current economic downturn, and, therefore may not reflect short-term growth and job openings. However, they do provide useful information on more long-term employment opportunities as we emerge from the recession.

These eighteen core IT occupations are projected to show strong employment growth over the next 10 years, outpacing employment growth in the state economy as a whole. Between 2006 and 2016, these core IT occupations are projected to grow by almost 25 percent compared to about 12 percent for all occupations.

The strongest job growth is expected for those occupations that are focused in working with customers to design and develop software applications. This can be seen in the strong growth projected for business systems analysts and

software applications engineers. Strong growth is also projected for software systems engineers.

Those core IT occupations involved in network administration and management are also expected to experience strong growth. This can be seen in the projected growth for network and computer system administrators and analysts.

As reflected in national studies, there will likely be lower growth in jobs for computer programmers. This may be due to rising productivity in software development and advances in software applications that allow software applications users (i.e., Level 2 users referenced earlier) to carry out many of the work tasks previously done by programmers. This also may reflect the growing global sourcing of routine programming.

The only core IT occupation that is expected to show major job losses is computer operators. This is most likely due to the growing role of networks and the support provided to these networks by computer support specialists and network administrators.

Information Technology Sector Trends

The IT task force identified a number of trends that will have major implications for IT workforce development in Illinois:

- Information Technology and Industry Convergence. The IT sector is being shaped by the integration and convergence of computing, communications, broadcasting, and entertainment technology and the merging and integration of previously separate industries and businesses in telecommunications, computing, broadcasting, entertainment, and others. This is creating new business models and new products and services and new business opportunities throughout the IT sector.
- Internet as the Primary Platform. The Internet is now the primary platform for the development and management of information technology services. Future applications increasingly leverage the power the Internet.
- Software Delivered as a Service. Software will increasingly be delivered as a service rather than a purchased product. Software developers and publishers will increasingly offer their services over the Internet on a subscription or fee basis and will provide total support for customers in using the software.
- E-Commerce and Business Enterprise Platforms. Businesses are increasing moving to e-commerce using business enterprise platforms that better connect them to customers, partners, suppliers and other businesses.

- Collaboration and Networking. The first phase of web applications focused on searching, locating, and managing information. The next phase will increasingly focus on web applications that support collaboration and networking.
- Social Networking. The major aspect of this shift in the use of the Internet is the growth of social networking applications. These applications will increasingly move to professional and workplace uses.
- Growing Role of Interactive Media Applications. As highlighted in the national Career Clusters framework, there will be a growing role for interactive media applications including major innovations in user interfaces.
- Automation and Exporting of Routine IT Functions. Routine IT functions including programming and network support are increasingly being automated or outsourced.
- Strategic Vertical Applications. Businesses are increasingly seeing the strategic role of IT applications in creating and maintaining competitive advantage which will create new opportunities for IT businesses in vertical specialties.
- Entrepreneurship and Small Business Development. Entrepreneurship and small business start ups will continue to be a major source of innovation and growth in the IT sector.
- Mobility of Applications and Use. New software applications will increasingly focus on a wide variety of mobile devices that allow users to access information and communicate any time and anywhere.
- Green IT. Information technology systems and devices are one of the largest users of electrical power and face major challenges in managing the deconstruction and reuse of materials to reduce environmental impact. Future efforts to develop more energy efficient systems and devices and reduce overall environmental impacts will provide both challenges and opportunities for the IT sector.
- Research and Development. The pace of scientific and technological advance will continue to accelerate requiring IT companies to continue to invest in research and development and work with universities and other partners to remain competitive.

Need for Stronger Business and General Skills

From the first meeting, IT Task Force members raised very serious concerns about the lack of business skills and more general workplace skills in the IT workforce, and that there was an urgent need to address these problems before more students enter the workforce. In discussing major trends in the IT sector, task force members emphasized the growing importance of business and more

general workplace skills. IT workers in the future must have strong IT technical skills, but they also must have strong business skills including both general business skills and, as presented earlier, more specialized knowledge of information technology applications in key sectors (e.g., healthcare, manufacturing) as well as more general core business functions and processes (e.g., human resource management). They also must have stronger general skills including project management, communication, and teamwork skills. These business and general skills are critical for workers in companies that are focused on a vertical specialization strategy in key sectors such as healthcare.

Figure 3: Critical IT Skills: Technical, Business and General Skills

Technical Skills	Business Intelligence Data Warehousing Database Design & Management Desktop support / helpdesk Interactive Media Internet Computing IT Architecture IT Operations IT Security	Mainframe Legacy Programming Social Networking Services System Analysis and Design System integration System Testing Telecommunications User Experience Design Web-based Technologies
Business Skills	Company specific knowledge Functional Area / Process knowledge Industry Knowledge Product/services knowledge	
General Skills	Analytical Internship experience Negotiation Oral Presentation Program Management Project Integration	Project Management Teamwork User relationship management Working globally Written Communications

The Information Technology Task Force partnered with the University of Illinois at Chicago to conduct an initial survey of Illinois employers to determine major trends in IT investment and their workforce development needs. The survey design and major findings are summarized in Appendix C. As shown in Figure 3, this survey asked employers to identify their most critical skill requirements including technical, business, and general skills. These skills are defined in Appendix C.

This survey was completed by 100 Illinois employers across a wide variety of industry sectors including both small and large employers. It included responses

from both IT employers and employers from other industries that employ IT workers and purchase IT services from IT employers. In general, all Illinois employer groups reported that a combination of technical, business, and general skills is important for both entry-level and mid-level employees.

It is not possible to draw major conclusions from this initial survey on critical skill requirements across major industry sectors in Illinois because of the small number of employers surveyed. However, this survey does provide initial validation of the task force observations that IT workers need strong business and general skills, especially those in vertical specialization areas.

Findings and Recommendations

Building an IT-Enabled Workforce

Because of the critical importance of information technology to the economic development of the state, Illinois should take immediate action to ensure that we have a strong IT-enabled workforce. Illinois should develop a statewide plan to ensure that all students and workers have the necessary IT skills to be competitive in today's job market. As described earlier, this plan should contain at least three levels of IT skill development:

- Level 1: Basic Applications for All Workers—All K-12 students should be able to use basic information technology tools and platforms for learning and work based on the National Education Technology Standards (NETS) and related national industry-recognized standards. Similar standards should be used for postsecondary students and adults participating in digital divide and workforce development programs.
- Level 2: Advanced Users of Specialized Applications and Systems---All education and training programs in Illinois should be required to provide students with skills in the use of leading-edge, advanced IT applications for their chosen careers including communications, healthcare, transportation and logistics, manufacturing, and engineering.
- Level 3: Core IT Workers—More students should be given the opportunity to enter careers in the core information technology occupations identified in this report. These students should be given more opportunities to develop vertical specializations and expertise wherever possible.

This plan should include three major components for all three levels. The first component should set clear expectations on what should be done at each level. For example, Illinois should clearly communicate what is expected for K-12 students in the NETS and related standards and what that would look like in schools and classrooms. This should also be done for digital divide and workforce programs. The second component should identify and promote

leading practices at all three levels. The third component should develop program and grant approval requirements and incentives to encourage schools and colleges to move quickly to meet these expectations by moving best practices to scale throughout Illinois.

In addition, for Level 3, Illinois should use the IT Task Force framework as the new Career Clusters framework to develop and promote Level 3 IT programs of study in Illinois with a strong focus on building vertical dimensions as recommended below. This framework also should be used to develop career information and should be used by Illinois workNet to provide information on IT education and employment opportunities.

Building the Vertical Dimension into IT Education

Illinois should promote the growth of the information technology sector by promoting vertical specializations in critical industries where Illinois is a leading player such as healthcare, financial services, education, transportation and logistics and manufacturing. Illinois should support information technology businesses in becoming leaders in developing business applications that will drive and support breakthrough innovations and improvements in business models and core business processes in these critical industries. This vertical specialization will promote job growth in both the information technology sector and other critical industries in Illinois.

This economic development effort should be supported by workforce development initiatives that create a new generation of IT vertical specialists. These specialists should have stronger overall business and general skills as described in this report as well as the technical skills and experiences to develop leading-edge IT applications to support business innovation and growth in key vertical specializations. Illinois should promote leading secondary and postsecondary models for building the vertical dimension into IT education.

These efforts should start with key statewide sectors including healthcare, manufacturing and transportation and logistics as well as financial services and education. The current national focus on healthcare IT applications (e.g., electronic medical records), for example, may provide immediate opportunities for Illinois to promote vertical specializations in healthcare. The recently launched Illinois Biomedicine Collaborative Enterprise (IBCE) initiative provides a unique opportunity to promote the growth of healthcare vertical specializations in the Illinois IT community. The IBCE should expand its efforts to promote adoption of electronic medical records and explore ways to use IT to transform healthcare and improve the entire "bench to bedside" research and development

process in the biomedical sector. This will provide a richer environment for the growth of healthcare vertical specialization in the IT sector in Illinois.

Current national and state initiatives in improving the use of IT in education also will provide immediate opportunities. Illinois should focus on building a strong education vertical specialization that promotes IT specialization in educational applications at the secondary and postsecondary levels. This would have a dual benefit in Illinois. It would promote innovation in the use of technology in education to provide all students with Level 1 and Level 2 information technology skills as well as improve overall educational productivity. And, it will help create jobs in IT businesses with a vertical specialization in education.

To support these efforts, Illinois should first focus on ensuring that high schools, colleges and universities in Illinois are developing programs that build healthcare and education vertical specializations. Illinois should convene colleges and universities to promote these vertical specializations and leading models and practices in cooperation with industry associations. Illinois should then launch similar efforts for vertical specializations in other sectors including financial services, manufacturing, transportation and logistics, agriculture, and energy and utilities (e.g., smart grid, water management).

Developing Stronger Business and General Skills

Illinois should ensure that all secondary and postsecondary IT programs build stronger business and general skills into their curricula in addition to technical IT skills. These business and general skills are summarized in Figure 3 and defined in Appendix C.

One critical general skill is project management. Project management should be a cornerstone in all IT education programs at the secondary and postsecondary levels and provide the context for students to learn and practice other business and general skills. All IT students should be given opportunities to learn project management skills and use these skills in managing and participating in authentic real-world IT projects as members of cross-functional teams before completing their programs. Illinois should identify leading models for providing students project management opportunities and promote these models throughout the state. Illinois should convene meetings among high schools, community colleges, and universities to share leading models and practices and encourage schools and colleges to include project management and other critical business and general skills in all IT programs. Based on this outreach effort, Illinois should consider including this as a requirement in program approval and funding.

Promoting Entrepreneurship and Innovation

Critical to the success of the Illinois technology sector is a strong entrepreneurial and innovation environment. Illinois must continue to support and promote entrepreneurial ideals among information technology workers. These efforts must be supported by the inclusion of entrepreneurial studies within IT education programs at both the secondary and postsecondary levels. These programs should give IT students showing interest in business entrepreneurship the passion and opportunities to pursue working for and starting small businesses in the information technology sector across all sectors of the Illinois economy. These efforts must be then supported by the business community developing programs through public/private partnerships in which the new endeavors can get going rapidly. In so doing, Illinois will become a model state in the promotion of IT entrepreneurship and IT industry job creation. Illinois should convene business and education leaders to promote leading practices in promoting entrepreneurship in the IT sector.

In addition, Illinois should continue to promote innovation across the entire IT sector including a strong push to promote both applied and basic research and development. This should include efforts to promote stronger partnerships between IT businesses and universities. As part of these efforts, IT students enrolled in IT programs in the Research and Development pathway should be given opportunities to participate in real-world research and development projects similar to the projects for students in other IT pathway programs. This effort should be designed to keep engineering and computer science students in Illinois after completing their programs. Illinois should convene meetings with IT businesses and universities to promote research and development partnerships and provide students at all levels to participate in research and development projects.

Promoting Industry-Education Partnerships

Illinois should promote stronger industry-education partnerships. These partnerships should be designed to provide students with the opportunities to explore career, entrepreneurship and research and development opportunities and gain valuable project management experiences and build business and general workplace skills through internships and group projects with Illinois employers. Illinois should identify and promote leading national and state models for providing these opportunities. In particular, Illinois should explore how to expand the Illinois Innovation Talent project and similar efforts to involve more secondary and postsecondary students in real-world projects in all of the four IT pathways as well as projects that promote vertical specializations in key sectors including healthcare, education, manufacturing, financial services, and transportation and logistics.

This effort should be supported by the development of a new IT platform that can manage industry-sponsored projects and provide all students with an opportunity to participate in at least one meaningful industry-sponsored project before completing their programs. This platform should be modeled from leading private sector platforms for hosting industry challenges and managing team projects using leading project management tools.

Developing Model High School Programs

Illinois should use the IT Task Force's career cluster framework and other recommendations to develop and pilot-test a new model for high-school programs of study in information technology. This new model should provide students starting in the 9th grade with opportunities to explore and pursue careers in one or more of the four major pathways and have the option to explore a vertical specialization. This model should also provide the business and general skills identified by the task force and have the opportunity to learn project management skills by working on industry-sponsored team projects. This new model should connect with P-20 programs of study based on the new career cluster framework recommended by the IT Task Force.

The new Chicago Academy for Advanced Technology (CAAT) provides a promising green field opportunity to develop and pilot-test a model high school program based on the Task Force recommendations. Many of the Task Force members are currently involved in the planning for the academy. Illinois should work with the CAAT planning team and other high school planning teams interested in implementing the Task Force recommendations to develop and pilot-test the new statewide model.

Keeping Track of Changing Needs and Shortages in the IT Sector

The Illinois Technology Task Force did not have time to conduct a comprehensive baseline analysis of IT programs based on the new IT framework containing the four core IT functions. The task force also did not have the time to conduct more in-depth research into the changing skill requirements for IT jobs in these four major functional areas. Like other IWIB task forces, the IT Task Force recommends that Illinois partner with the IT sector to conduct a more comprehensive baseline analysis that will address both changing skills requirements as well as the performance of the P-20 education and workforce programs in meeting the workforce needs of the IT sector in Illinois.

Illinois should also establish ongoing monitoring efforts to continuously update and review changing skill requirements in the IT sector and evaluate progress in improving the performance of the P-20 education and workforce pipeline in meeting skill shortages across all four career pathways and all major vertical

specializations. In particular, the Illinois Workforce Investment Board should annually convene information technology industry, education, and workforce development stakeholders to review progress in implementing the Information Technology Task Force recommendations, review results from ongoing monitoring efforts, and recommend additional actions to meet the needs of the IT sector in Illinois based on research and reports from other stakeholder groups such as the forthcoming report from the Latino Technology Association.

Summary and Next Steps

The Information Technology sector, as defined by the IT Task Force, is a large and growing part of the Illinois economy. This sector is critical to the economic development of the state because it provides the technology platform for critical business functions and processes in all sectors of the Illinois economy, and is increasingly the source of competitive differentiation and growth for many of the most critical sectors including healthcare, manufacturing, transportation and logistics, and financial services as well as education. This is most clearly seen in the role that IT is playing in the transformation of healthcare. As a result, more Illinois companies in the future will compete in part on how they leverage and use technology to drive and support innovation across the entire organization. This will require a strong IT sector in Illinois supported by a world-class IT-enabled workforce and a new generation of IT professionals.

To promote economic development, Illinois must develop a new generation of workers at all levels who are experts at using advanced and specialized information tools and systems to drive innovation and improve performance. This new generation of information technology professionals must have stronger business and entrepreneurship skills, general workplace skills, and more specialized knowledge of information technology applications in key sectors (e.g., healthcare, manufacturing) or "vertical specializations" as well as more general core business functions and processes (e.g., human resource management). In addition, Illinois also must take steps to support a whole new generation of IT entrepreneurs to start and grow new IT companies and a new generation of scientists and engineers to maintain a strong IT research and development infrastructure for driving innovation.

In order to produce this new generation of IT talent, the IT Task Force believes that Illinois should adopt a new IT career cluster model that is based on four major pathways: (1) Research and Development, (2) Infrastructure, Administration and Operations, (3) Technology and Information Services, and (4) Integration Services. This framework also should provide options for students to pursue vertical specializations for sectors critical to state and regional economic development.

This new career cluster framework should provide the foundation for a three-level workforce development strategy for building an IT-enabled workforce in Illinois that will: (1) provide all workers with basic IT applications skills, (2) expand the number of highly skilled users of specialized IT tools and systems that are needed to carry out critical business functions and processes in key sectors and drive and support innovation, and (3) expand the number of core IT workers in all four major career pathways along with opportunities to pursue vertical specializations.

The Task Force has developed a series of recommendations to implement this new vision for developing the next generation of IT talent. In particular, Illinois must take immediate actions to integrate business and general skills into IT programs at all levels and build stronger vertical specializations. We cannot afford to let one more cohort of students leave secondary and postsecondary IT programs without these skills. These recommendations also address the need for Illinois to continually analyze the changing needs of the IT sector and mark progress in addressing these needs and implementing the Task Force recommendations. In summary, Illinois must now take immediate actions to implement these recommendations to promote economic development and expand economic opportunities for Illinois workers throughout the state and put in place systems to continuously monitor changing needs and measure progress in building a competitive workforce.

Appendix A---Information Technology Task Force Members

Chair—John Rico, President and CEO, Rico Enterprises

Michael Alt, Vice President of Network Support, AT&T
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John Barr, Illinois Department of Commerce and Economic Opportunity
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Mehdi Zargham, Southern Illinois University
Barbara Zeller, CIO, NICOR

Appendix B-- Core Information Technology Occupations: Standard Occupational Classification Descriptions

15-1011 Computer and Information Scientists, Research

Conduct research into fundamental computer and information science as theorists, designers, or inventors. Solve or develop solutions to problems in the field of computer hardware and software.

15-1021 Computer Programmers

Convert project specifications and statements of problems and procedures to detailed logical flow charts for coding into computer language. Develop and write computer programs to store, locate, and retrieve specific documents, data, and information. May program web sites.

15-1031 Computer Software Engineers, Applications

Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team. Exclude "Computer Hardware Engineers" (17-2061).

15-1032 Computer Software Engineers, Systems Software

Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. Apply principles and techniques of computer science, engineering, and mathematical analysis.

15-1041 Computer Support Specialists

Provide technical assistance to computer system users. Answer questions or resolve computer problems for clients in person, via telephone or from remote location. May provide assistance concerning the use of computer hardware and software, including

printing, installation, word processing, electronic mail, and operating systems. Exclude "Network and Computer Systems Administrators" (15-1071).

15-1051 Computer Systems Analysts

Analyze science, engineering, business, and all other data processing problems for application to electronic data processing systems. Analyze user requirements, procedures, and problems to automate or improve existing systems and review computer system capabilities, workflow, and scheduling limitations. May analyze or recommend commercially available software. Exclude persons working primarily as "Engineers" (17-2011 through 17-2199), "Mathematicians" (15-2021), or "Scientists" (19-1011 through 19-3099). May supervise computer programmers.

15-1061 Database Administrators

Coordinate changes to computer databases, test and implement the database applying knowledge of database management systems. May plan, coordinate, and implement security measures to safeguard computer databases.

15-1071 Network and Computer Systems Administrators

Install, configure, and support an organization's local area network (LAN), wide area network (WAN), and Internet system or a segment of a network system. Maintain network hardware and software. Monitor network to ensure network availability to all system users and perform necessary maintenance to support network availability. May supervise other network support and client server specialists and plan, coordinate, and implement network security measures. Exclude "Computer Support Specialists" (15-1041).

15-1081 Network Systems and Data Communications Analysts

Analyze, design, test, and evaluate network systems, such as local area networks (LAN), wide area networks (WAN), Internet, intranet, and other data communications systems. Perform network modeling, analysis, and planning. Research and recommend network and data communications hardware and software. Include telecommunications specialists who deal with the interfacing of computer and communications equipment. May supervise computer programmers.

15-1099 Computer Specialists, All Other

All computer specialists not listed separately.

11-3021 Computer and Information Systems Managers

Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming. Exclude "Computer Specialists" (15-1011 through 15-1099).

27-3042 Technical Writers

Write technical materials, such as equipment manuals, appendices, or operating and maintenance instructions. May assist in layout work.

17-2071 Electrical Engineers

Design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use. Exclude "Computer Hardware Engineers" (17-2061).

17-2072 Electronics Engineers, Except Computer

Research, design, develop, and test electronic components and systems for commercial, industrial, military, or scientific use utilizing knowledge of electronic theory and materials properties. Design electronic circuits and components for use in fields such as telecommunications, aerospace guidance and propulsion control, acoustics, or instruments and controls. Exclude "Computer Hardware Engineers" (17-2061).

17-2061 Computer Hardware Engineers

Research, design, develop, and test computer or computer-related equipment for commercial, industrial, military, or scientific use. May supervise the manufacturing and installation of computer or computer-related equipment and components. Exclude "Computer Software Engineers, Applications" (15-1031) and "Computer Software Engineers, Systems Software" (15-1032).

17-3023 Electrical and Electronic Engineering Technicians

Apply electrical and electronic theory and related knowledge, usually under the direction of engineering staff, to design, build, repair, calibrate, and modify electrical

components, circuitry, controls, and machinery for subsequent evaluation and use by engineering staff in making engineering design decisions. Exclude "Broadcast Technicians" (27-4012).

17-3012 Electrical and Electronics Drafters

Prepare wiring diagrams, circuit board assembly diagrams, and layout drawings used for manufacture, installation, and repair of electrical equipment in factories, power plants, and buildings.

43-9011 Computer Operators

Monitor and control electronic computer and peripheral electronic data processing equipment to process business, scientific, engineering, and other data according to operating instructions. May enter commands at a computer terminal and set controls on computer and peripheral devices. Monitor and respond to operating and error messages. Exclude "Data Entry Keyers" (43-9021).

Appendix C: IT Survey Background and Findings

A survey was distributed to approximately 5000 firms in Illinois from February to May 2009. The sample population was chosen to reflect demographics of Illinois firms. The response rate was approximately 2%, or 102 completed usable responses. Fifty-six percent of the individuals completing the survey for their firm listed their job title as 'C' level, e.g., CEO, CIO, etc., or Vice-President.

The industry classification and size of the respondent companies is similar to the demographics of firms in Illinois. The Computer Systems and Information Services industry segment is somewhat overrepresented in the sample. In addition to industry classification, firms were asked to indicate whether they were an IT vendor or IT user. Fifty-eight respondents (57%) identified their firm as an IT user firm and 44 (43%) as an IT vendor.

Firms are categorized as Large, those with greater than 100 employees, or Small to Medium (SME), those with less than or equal to100 employees. Forty-five of the respondents (or 44%) are categorized as Large firms and 57 (56%) are SME.

Ability to Recruit IT Talent in Illinois

Respondents were asked to assess their firm's ability to recruit both entry-level and mid-level IT professionals with required skills for available jobs. Ability was measured by 5-point Likert scale with 1= Very Difficult and 5 = Very Easy. Firms appear to have somewhat more difficulty recruiting skilled mid-level IT talent than entry-level talent**.** Thirty-five percent of firms reported it was either very difficult or somewhat difficult to find mid-level talent while 27% of firms reported difficulty finding entry-level talent.

Analysis by firm size
Thirty-one percent of Large firms report difficulty in finding skilled- entry-level IT professionals while 23% of SME's report difficulty. Both large firms and SME's report similar difficulty recruiting skilled mid-level IT professionals, i.e., 36% of respondents or 16 firms and 35% or 20 firms respectively.

Analysis by industry segment
Differences were reported across industry segments in ability to recruit talent. Computer Systems and IT Services have largest number of firms reporting difficulty finding entry-level and mid-level IT professionals, i.e., 8 firms or 27% of respondents and 11 firms or 37% respectively. Other industry segments with high rates of firms reporting difficulty are: Education (entry-level - 40% or 2 firms and mid-level – 60% or 3 firms), Financial Services (entry and mid-level - 40% or 2 firms), Healthcare (entry and mid-level - 43% or 3 firms) and Transportation, warehousing & logistics (mid-level – 43% or 3 firms).

Forecast of Skill Needs for IT Talent in Illinois

Respondents were asked to forecast the importance of specific IT skills for entry-level and mid-level IT professionals to be employed in their firm in 2 years. The categories and component skills (with clarifying definitions) are shown in Table 1. Importance was measured by 5-point Likert scale with 1= Unimportant and 5 = Very Important.

Data was analyzed by category of skills, i.e., technical, business, and general. All groups report that a combination of technical, business, and general skills is important for both entry-level and mid-level employees.

Analysis by firm size
Respondents in both categories want a combination of technical, general and business skills (no significant difference in mean response for each category). There are some differences in the importance of skill categories between IT User firms and IT Vendor firms. Large firms place significantly more importance on general skills for entry-level talent than SME's (statistically significant difference in mean response). General and business skills for mid-level IT professionals appear more important to large firms than SME's (mean response difference approaching statistical significance)

Analysis by firm type
Respondents in both categories want a combination of technical, general and business skills (no significant difference in mean response for each category). There are differences in the importance of skill categories between IT User firms and IT Vendor firms. IT User firms appear to consider Business skills more important for entry-level talent than IT Vendors (mean response difference approaching statistical significance). Business skills for mid-level IT professionals are significantly more important to Users than Vendors (statistically significant difference in mean response). General skills for mid-level IT professionals appear to be more important to IT User firms than to Vendor firms (mean response difference approaching statistical significance).

Figure C-1: Definition of IT Skills

Skill Category	Definition
1. Technical skills	**The depth and breadth of IT technical specialties**
• System Analysis and Design	Methods of analyzing user requirements and designing of information system
• Programming	Process of writing, testing, debugging/troubleshooting, and maintaining the source code of computer programs
• System Testing	Process of testing of the information system to ensure that it performs as expected and required
• System Integration	Process of linking together different computing systems and software applications physically or functionally
• Web-based Technologies and Internet Computing	Knowledge of technologies used for web development, web production, design, networking, and e-commerce, internet programming, website maintenance
• Database Design/ Management	Design and management of set of software programs that control the organization, storage, management, and retrieval of data in a database
• Data Warehousing / Business Intelligence	Methods for management and analysis of organization's electronically stored data
• IT Architecture	Development and management of an enterprise information system architecture
• Telecommunications	Installation, management and maintenance of network and telecommunication services for firm
• Security	Methods to protect hardware, software, data and information assets in a firm
• Mainframe/ Legacy	Managing mainframe environments and/or maintaining legacy software code
• IT Operations	Managing functions provisioned and/or consumed by IT staff of the firm
• Desktop Support/ Helpdesk	Providing support for users of computers services in an organization
• Interactive Media	Ability and knowledge to create and deploy interactive media products e.g. computer games, or interactive content for mobile devices, for use within web sites and for video DVDs

• User Experience Design	Ability to design, develop and deliver devices or software by effectively incorporating user interactions
• Social Networking Services	Knowledge and experience in designing, developing, and maintaining online, interactive social networks
2. Business skills	**Knowledge of various business functions and ability to understand business environment**
• Industry Knowledge	Knowledge of specific industry facts and practices
• Company Specific Knowledge	Knowledge of specific company facts and practices
• Functional Area / Process Knowledge	Knowledge of business operations and processes, Knowledge of business goals and functions
3. General skills	**Ability to communicate effectively with users and to work in a collaborative environment**
• User Relationship Management	Ability to work closely with users or clients and maintain productive relationships
• Project Management	Ability to plan, organize and execute projects
• Project Integration / Program Management	Ability to coordinate multiple projects and allocate resources across them
• Working globally	Ability to interact with coworkers through temporal, spatial and cultural differences
• Teamwork	Ability to work effectively with team members
• Analytical	Ability to decompose an artifact, a construct or a structure into elements
• Oral Presentation	Ability to develop and deliver effective, informative and persuasive oral presentations
• Written Communication	Ability to plan, organize & write clear, concise, and effective memos, reports and documentation
• Negotiation	Ability to resolve disputes across multiple stakeholders
• Internship Experience	Level of hands-on, actual business experience during higher education