

Chapter 2
Information Technology Jobs and Skill Standards

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Technology Everywhere
A Campus Agenda for Educating and Managing
Workers in the Digital Age

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Information Technology Jobs and Skill Standards

Neil Evans

The shift in the United States to an information economy requires a high level of foundation and technical skills in the workforce. Educational and training institutions must restructure themselves to better prepare this new workforce. One effective tool for this restructuring is application of information technology (IT) skill standards.

IT skill standards define the professional job-related knowledge, skills, and abilities required to succeed in the digital-age workplace. They can be used as a foundation tool for developing educational curriculum, profiling jobs, recruiting and evaluating employees, and designing academic and professional certification. They can be used alone or in conjunction with other input, such as that from a subject-matter expert, industry advisory committee, professional organization, existing academic or vendor-specific curriculum, or accrediting organization.

IT skill standards create a common-language framework for educators, industry, and other stakeholders to develop the educational and training tools necessary to prepare students and incumbent workers for today's workplace challenges as well as those that lie ahead. Skill standards can be used for a number of purposes:

- Improving the education and training of the information technology workforce

- Increasing cooperation between education and business
- Improving academic mobility by facilitating development of an articulated curriculum that continues from high school through community or technical college and on to a four-year institution and graduate work
- Establishing criteria and standards for assessment, certification, compliance, and degrees

The National Workforce Center for Emerging Technologies (NWCET), located at Bellevue Community College in Bellevue, Washington, has identified and described skill standards for eight IT career clusters in the publication *Building a Foundation for Tomorrow: Skill Standards for Information Technology*. The millennium edition of this work is the end result of a national review and update of the IT skill standards, with input from expert panels around the country for new and changing skills, work functions, technical knowledge, and related employability skills.

Why Skill Standards?

Most competitive industrialized nations have evolved a well-established professional skill standards system. Applying skill standards to development of curriculum results in courses and programs whose outcomes can be assessed across a range of contextual technical and foundation performance criteria. This results in employees who are prepared to function effectively in the technology- and information-based workplace.

There are numerous benefits to IT skill standards. Companies communicate their performance expectations to their employees, educational institutions reform their curriculum to match workplace needs, and the skills gap between workplace expectation and student preparation can be closed. Among the major stakeholders ben-

efiting from IT skill standards are businesses, IT professionals, students, educators, and government policymakers.

For IT skill standards to be effective, they must reflect the consensus of the industry professionals in the IT career field. To ensure the integrity, quality, and continuity of the skill standards, several principles have guided development:

- Experienced IT workers, who are the experts in their career field, must be used to identify the work performed and the skills, knowledge, and abilities required to be successful.
- Business and education must work together as partners to ensure the link between work expectations and curriculum.
- Skill standards must represent broad career clusters rather than narrowly defined jobs.
- Standards must be flexible and portable and should be updated continually.
- Integrated skill standards must define work duties in the context of the work setting.

Career Clusters

A career cluster is a grouping of representative job titles, related by close association with a common set of technical skills, knowledge, and abilities. The career cluster approach closely reflects how work is organized today, especially in illustrating mobility and progression among representative job titles.

There is a range of IT careers and career progressions within the profession. The IT career clusters identified by NWCET have been broadly adopted by industry, education, and government policymakers as a standard framework for classifying IT jobs and careers

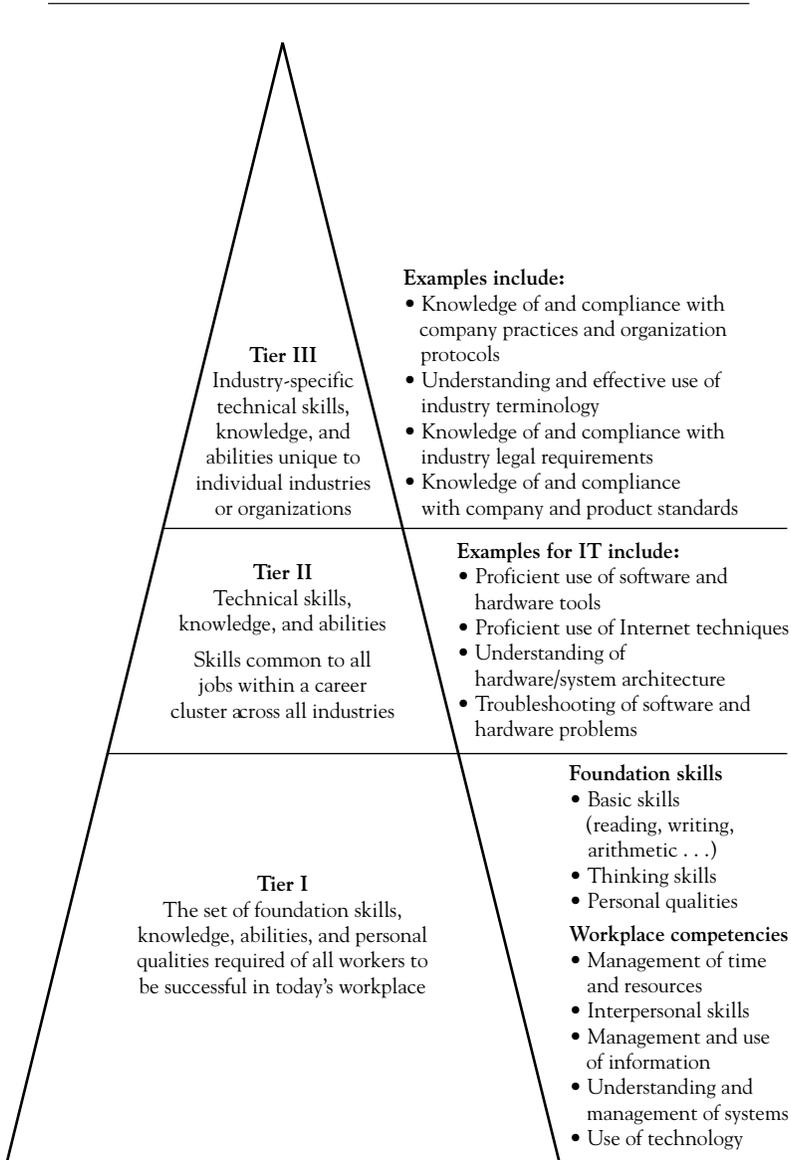
The IT Skills Pyramid

The three-tiered pyramid depicts IT skill standards in three broad IT competency categories: foundation and employability skills, common technical skills, and industry-specific technical skills and organizational knowledge.

Tier 1 is the set of foundation and employability skills, knowledge, and abilities that are required of all information worker employees. These are the universal skills—problem solving, team skills, and flexibility—that are needed to apply technical knowledge and tools effectively.

Tier 2 is the set of technical skills, knowledge, and abilities common to all IT positions within an IT career cluster. For a programmer, for example, knowledge of the principles of programming applies across all industries.

Tier 3 is the set of industry-specific technical skills, knowledge, and abilities that are unique to individual clusters and that are the most susceptible to change. For example, a programmer's required knowledge of data communications and network protocols may differ across companies and industries.



and for quantifying their supply and demand. These are the eight NWCET IT career clusters:

1. Database development and administration
2. Digital media
3. Enterprise systems analysis and integration
4. Network design and administration
5. Programming and software engineering
6. Technical support
7. Technical writing
8. Web development and administration

These career clusters represent a broad range of job titles, from entry level through senior management. They are designed to be usable to educators at every level, and to human resource professionals; training, certification, and assessment developers; students and job seekers; and organizations and individuals conducting research into information technology workforce issues.

Common Elements Across Clusters

Several elements are common across all clusters. This commonality reflects the desire, among virtually all employers, to find employees with a set of common qualities that support specific technical knowledge and skills. These common categories are project management, task management, and problem solving and troubleshooting. Either explicitly or implicitly, certain other process skills appear repeatedly across all eight clusters (analysis, design, development, testing, implementation, and documentation).

The nature of each of these IT skills differs with the job level and from cluster to cluster. By inference, however, employers want employees who can

- Apply a systematic, methodical approach to solving a problem
- Research to see who else knows about the problem
- Develop a rational set of possible solutions
- Test the solutions cost-effectively and efficiently
- Verify that the problem is truly solved
- Document the solution for others

Technical Skills

In addition to these common elements, specific items of technical knowledge, skills, abilities, attributes, and use of tools are associated with a function or task. These are represented at a high level and avoid reference to a specific vendor, version, or piece of equipment. This allows maximum flexibility in adapting the skill standards to local specifications while preserving the employer's general requirements for specific skills.

Employability Skills

Finally, there are employability skills—general requirements associated with a function or task. Input from industry clearly shows that without solid mastery of employability skills, an employee cannot succeed in the highly competitive environment of today's technology company. Employers often say that “technical skills may get you the job, but foundation skills make you a valued employee and significantly increase career advancement.” For our purposes, let us identify seven types of employability skills:

- *Communication skills.* Effective information flow throughout the organization is a critical element in organizational success. Communication with team members, supervisors and subordinates,

and customers and clients as well as between groups must be timely and appropriate. Some jobs rely heavily on written communication, while others depend primarily on verbal communication. Communication in a high-technology organization takes on many forms: informal or formal presentations, technical logs, complex reports, proposals, and so on. No matter the form, communication is vital to individual and team effectiveness.

- *Organizational skills.* As employees are asked to handle more parallel tasks with an increased level of complexity, good organizational and planning skills become important. Depending on the job, the complexity of the organizational task may vary from scheduling and prioritizing multiple tasks or requests to planning and tracking complex and capital-intensive projects involving many people and teams. Regardless of the size of the project, the ability to identify and define tasks, track milestones, recognize when a project timeline is running into problems, and take appropriate action is crucial to ongoing success in a technical job.

- *Team contribution and leadership.* Most organizations are relying increasingly on teams to accomplish projects. This is particularly true in high-tech environments where the success of a project depends on the contribution of many individuals with varied expertise. The ability to work with team members with diverse backgrounds and communication styles is highly valued and rewarded in most environments. Being able to read the needs of the team as a whole and the needs of individual team members, and to adjust one's role to increase team effectiveness, is essential to the success of the team process.

- *Professionalism.* Dealing with problematic employee issues, attitudes, and behaviors consumes much time in any organization, and it can be quite detrimental to overall morale. Employees with good work ethics, who show up on time, who understand and follow company procedures, and who relate to coworkers and customers with respect are usually the ones selected for a position with an increased level of responsibility and reward.

- *Critical thinking and decision making.* As an organization becomes leaner in management, the employee is expected to assume increased responsibility. An employee's ability to correctly analyze a situation, understand tradeoffs, offer good recommendations, and make the right choice is often rewarded with increased freedom to self-manage, and with the opportunity to engage in more interesting and challenging projects.

- *Customer relations.* Customers can wear many faces. An internal customer is the department down the hall or an offshore division. An external customer is a supplier, client, or end user. The ability to solicit and listen to customer feedback and to effectively address customer issues and concerns is required to qualify for certain positions, such as a technical support job. Customer interaction skills are necessary in every job, whether or not its description formally includes "customer relations."

- *Self-directed and continuous learning.* In the high-technology industry—especially in an information technology environment—technologies and practices change rapidly and sometimes radically. To keep up with technology change, employees must constantly engage in self-assessment against the technological landscape of skills and knowledge and then take proactive steps toward enrolling in continual training for their trade. The employer expects employees to be current in their technical skills. Most organizations provide the necessary resources for continual training. However, it is often seen as the employee's responsibility to identify personal gaps in knowledge and take actions to fill these gaps.

How can one learn employability skills? Most professional or technical and academic programs include some requirement for practicing foundation skills. However, many lack the emphasis that employers would like to see. Being aware of the importance of such skills can help students and employees enroll in a program that emphasizes using, practicing, and coaching foundation skills in the learning process, class activities, and projects. Educators must be

aware of the importance of these skills to the long-term success of graduates; they must create ample opportunity for holistic and contextual practice as well as authentic assessment.

Future Trends in IT Skill Standards and Emerging Careers

Some of the trends in an IT career that may be of interest to users of skill standards are e-commerce and e-business, outsourcing, specialization, certification, and nontraditional degree pathways.

E-Business and E-Commerce Careers

E-commerce and *e-business* are often used interchangeably. Arguably, no application of information technology will be more pervasive in the foreseeable future than electronic commerce. Various aspects of electronic commerce affect firms of every type and size, from the home-based proprietor to the global enterprise.

In general terms, electronic commerce is the intensive application of information technology to enable, enhance, and facilitate business transactions. The most obvious examples are consumer-oriented businesses selling directly to end users via the Web. Although these activities have garnered a large share of media attention, the total value of their transactions pales in comparison to business-to-business commercial activity.

E-business is the intersection of Internet technology with critical enterprise applications. Thoughtful application of Internet, intranet, and external technologies either to existing or to reengineered systems can create an electronic continuum of business processes, from marketing promotion to a sales transaction through order processing, logistics, manufacturing, billing, shipping, customer support, and cross-selling. The resulting environment extends significantly beyond a simple commerce phase to create a continuous Internet customer life cycle. The term *e-commerce*, then, is generally limited to using Internet technology in the selling process only.

There are other legitimate interpretations of what distinguishes e-business from e-commerce. One common distinction is that e-commerce describes Internet sales to end users (retail purchases) while e-business defines enterprise-level transactions that may occur between distributors, between business divisions, or between a manufacturer and a vendor, a manufacturer and a distributor, or a supplier and a retailer.

E-commerce will certainly revolutionize how business is done. Entities that may be competitors may find they benefit from “co-opetition”—the coined word describing cooperative competition. The considerations surrounding conduct of business, data integrity, security, rights, access, restrictions, and interoperability are substantial.

IT Outsourcing, Contracting, and Consulting

The trend toward focusing on core business and core competencies that started with large firms is being adopted by smaller firms and educational institutions as well. For information technology, this trend has resulted in an increasing number of long-term contract positions at the technician level and large growth in consulting services at the professional level.

Firms for whom information technology is not a core competency may contract for computing infrastructure, hardware, maintenance, Web site hosting, transaction processing, data warehousing, and employee training in use of technology. This trend has created opportunities for full-time employment with the contractor supplying the service, rather than with the end user of the service. Contract workers often do not have permanent status. Although many assignments extend for the duration of the contract (and are therefore considered long-term), they are temporary because there is no assurance the contract will be renewed or extended. Because of the explosive growth of the information technology industry and the shortage of skilled workers, relatively few proficient individuals have experienced a period of unemployment, and this is expected to be the case for the foreseeable future.

Many firms also employ consultants in short- and long-term positions to help with implementation and integration guidance and to research and offer strategic input (especially in technology forecasting and deployment). Large and small firms also seek consultants with specific skills in current or emergent technologies as they apply to their business needs. A consultant may work independently but is often part of a skilled group whose services are arranged through a large firm specializing in consulting services. People working for these firms often acquire a valuable worldwide enterprise perspective as they work through their assignments, bringing their technical expertise and aggregated experience to each new assignment.

Some educational institutions are also following the IT outsourcing trend, focusing on their core competency (instruction delivery) and their core service (student services delivery). These institutions are usually outsourcing in the areas of internal computing and network infrastructure or Internet access and Web site hosting with Internet service providers (ISPs). Some institutions have even outsourced their entire IT department to a vendor that hires the incumbent IT staff, which allows retention of the staff's knowledge of current operations and business processes. Another emerging outsourcing trend among higher education institutions is contracting out their business or student services application to an applications service provider (ASP).

IT Specialists Versus Generalists

An interesting divergent trend seems to be emerging in the structure of the information technology workforce in large companies as opposed to small ones. Larger firms seem to gravitate toward specialization at both the technical and management levels. Some technical workers support relatively small groups dedicated to one project that is narrow in scope. As a result, there is a tendency to develop extreme experts in a tightly focused area.

Interestingly, educational institutions and some larger companies for which IT is not a core business express strong interest in finding individuals with a range of skills, knowledge, and abilities. This implies that the employee is able to determine when the firm needs to seek external resources and to make the case for justifying their use when necessary. It also means the employee is more effective when able to communicate not just laterally but to all organizational levels. Since students and recareering adults often start with small concerns, this trend implies that educational and training efforts should include activity and assessment that build the student's ability to integrate a range of skills and abilities.

Nontraditional IT Degree Paths and Certifications

The nature of information technology work and the explosive growth of the field have created opportunities for rapid career progression and salary advancement. The iterative and project-based nature of the work means an experienced person has increasing responsibility in project management, planning, and coordination. There is a trend toward upside-down degrees, where someone at the technician level acquires additional business education by which he or she becomes qualified for increasing management responsibility.

A four-year college, especially one catering to working adults, is often willing to evaluate technical education and professional development in partial fulfillment of academic degree requirements, and increasingly willing to offer individualized study and flexible cohort-based learning groups to facilitate degree completion.

Information technology workers at all levels value their education, strive to stay current, and are often among the employees most eager to take advantage of professional development and career advancement opportunities. This trend implies that employers must continue to offer professional development and career advancement opportunities; it also suggests that there will be continued growth

in nontraditional undergraduate and graduate education for information technology workers.

Conclusion

IT skill standards constitute a common-language framework for educators, employers, and corporate trainers to develop the educational and training tools necessary to prepare students and incumbent workers for today's workplace challenges. Both IT educators and HR professionals are realizing that these standards can be used effectively as a foundation tool for developing educational curriculum, profiling jobs, recruiting and evaluating employees, and designing academic and professional certification. All major stakeholders in IT workforce development—business, IT professionals, students, educators, government policymakers—benefit from IT skill standards.

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