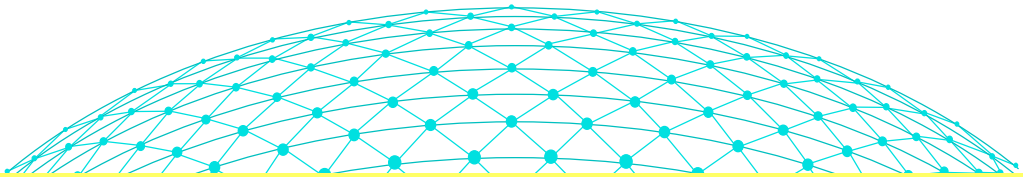
Developing, Integrating and Assessing Skill Standards—
What are Skill Standards?
Why do Skill Standards Matter?
What is the Recommended Process for Developing Skill Standards?
How are Skill Standards Integrated, Assessed and Used?



Guidebook Volume I
SKILL STANDARDS

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Guidebook Volume I—*SKILL STANDARDS*

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Guidebook Volume I—*SKILL STANDARDS*

—Introduction

This guidebook grows out of the work of several skill standards projects funded by the School-to-Work Opportunities Act involving Washington State Community and Technical Colleges and industry partnerships. When presented with the opportunity to develop industry-based skill standards, development teams found themselves researching best practices and preferred processes to determine their plan of action. This task was frequently frustrating due to the lack of standardization of both the content and process of skill standard development; often delaying progress for several months.

Development team questions usually began with "What are Skill Standards? Why do they matter?" followed by "What work has been done? What are the best practices? What is the role of industry, labor, and education?" and finally "How do we accomplish our goal of creating validated skill standards?" While this guidebook does not provide all of the answers regarding skill standards, it will give you a "standardized" yet flexible approach with a recommended skill standard development process and several state and national models. Additionally, a computer template of the process is included to allow for convenient and consistent formatting of your data.

This guidebook is a combination of background readings, models of skill standards, a preferred development process, a definition of terms, validation information, and a bibliography including assessment issues and Internet resources. The materials have been compiled and edited by RoseAnn Stevenson, Manager, Skill Standards for the State Board for Community and Technical Colleges on loan from The Boeing Company; and Michele Royer, President, Transitional Consulting and a team member for Bellevue Community College's Information Technology Skill Standards development. Kate Michael from the Center for Learning Connections designed and formatted the document.

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It is through the time and effort of all of these people that this guidebook has been launched, improved, and updated.

Guidebooks are available from the Center or Learning Connections (formerly The Center for Career and Work-Related Education), Highline Community College, Omni Executive Center Suite 300, PO Box 98000, Des Moines, WA 98198-9800. You may phone 206-870-3759; fax 206-870-3787; or E-mail Guidebook requests to ablackst@hcc.ctc. The following Web site will be maintained with current Skill Standards information—http://www.wa-skills.com.

Guidebook Volume I

SKILL STANDARDS

Section I

What Do We Need to Know About Skill Standards?

Guidebook Volume I—SKILL STANDARDS

What Do We Need to Know About Skill Standards?

—What are Skill Standards?

Skill standards are performance specifications that identify the knowledge, skills and abilities an individual needs to succeed in the workplace. They are critical to improving the skills of employees, raising standards of living and improving the competitiveness of the U.S. economy. Skill standards provide a common vocabulary to enhance communication between:

- ***Employers and Employees or Job Seekers***—by specifying the knowledge, basic skills, technical skills, aptitudes and attitudes required for recruitment, hiring, education and training, promotion and retention in a company or within an industry.

- ***Employers and Schools or Job Training Programs***—by encouraging the alignment of school curricula with industry requirements, by updating educational objectives as workplace demands change, and by ensuring a better return on public and private education and training investments.

- ***Employees or Job Seekers and Schools or Job Training Programs***—by helping employees and job seekers make sound decisions about their own education and training needs in a changing marketplace.

Skill standards answer two critical questions: What do workers need to know and be able to do to succeed in today's workplace? And how do we know when workers are performing well? Without this fundamental information, employers do not know whom to hire or where to focus their limited training dollars; employees and new entrants to the workforce do not know what they need to do to improve their performance; and educators do not know how to prepare students for the challenges of the workplace.

—Why Do Skill Standards Matter?

In most successful workplaces the only constant is change. Jobs that once were relatively simple now require high performance work processes and enhanced skills. Because skill standards reflect changing workplace realities, they help applicants and employees enjoy greater career opportunities and achieve higher standards of living and economic security.

Updating skills and knowledge is now a lifelong endeavor, causing many employers and employees to spend more effort, time and money on education and training. Skill standards provide benchmarks for making education and training decisions, shaping curricula, and directing funds toward highest value education and training investments.

Skill standards will help employers:

- Boost quality, productivity, time-to-market, innovation, and competitiveness
- Obtain a better return on their training investment
- Gain access to the industry's best bench-marking data, skills analysis tools, and training srategies
- Reduce costs of remedial training, skill assessment, and verification
- Improve employee retention by giving workers a clearer picture of what is expected of them
- Develop a more flexible workforce
- Improve hiring practices and draw from an increased pool of skilled workers

Skill Standards will help workers:

- Understand what they need to know to succeed in their careers
- Communicate more effectively to current and future employers what they know and can do
- Make better training decisions—not just for their next job but for the rest of their careers
- Move more easily between work roles, helping to ensure their long-term employability
- Know how to spend limited training time and money
- Achieve higher levels of performance and contribute to their company's success

Skill standards will help educators and trainers:

- Gain a greater under-standing of the skills workers need
- Develop appropriate curriculum and programs
- Understand the work readiness skills that high school and college graduates need for employment in high-skill, high-wage jobs
- Speak a "common language" with industry about education needs
- Strengthen their relationships with local businesses and labor unions
- Provide students with realistic career advice
- Update courses to meet changing needs

What Is the National Skill Standards Board?

—The National Skill Standards Board

The National Skill Standards Board, established in 1994, is chaired by James R. Houghton, retired CEO, Corning Incorporated; and is composed of 28 members representing business, labor, education, government, consumers, and civil rights organizations. Created by Congress, the Board's charge is to:

- Identify broad clusters in which skill standards will be developed.
- Promote the establishment of voluntary partnerships to develop skill standards.
- Research, coordinate, and disseminate information on the development of skill standards.
- Endorse skill standards that are created by voluntary partnerships.
- Develop a national framework to support skill standards.

What Is Its Purpose and Function?

—Mission Statement of the National Skill Standards Board

The mission of the National Skill Standards Board is to encourage the creation and adoption of a national system of skill standards which will enhance the ability of the United States to compete effectively in a global economy. These voluntary skill standards will be developed by industry in full partnership with education, labor and community stakeholders, and will be flexible, portable and continuously updated and improved.

This national skill standards system is intended to do the following:

- Promote the growth of high performance work organizations in the private and public sectors that operate on the basis of productivity, quality and innovation, and in the private sector, profitability.
- Raise the standard of living and economic security of American workers by improving access to high skill, high wage employment and career opportunities for those currently in, entering, or re-entering the workforce.
- Encourage the use of world-class academic, occupational and employability standards to guide continuous education and training for current and future workers.

—What Principles Guide Skill Standards Work?

- The skill standards must be voluntary. The system will only work if the final product is relevant to employers, unions, educators and employees.

- The process is typically business-led in full partnership with education, labor and community stakeholders.

- The skill standards must be flexible, portable and continuously updated and have equal relevance to both the public and private sector.

- The skill standards work needs to be integrated with relevant, cutting edge work already being done by employers, states, unions and the education systems.

- Skill standards must be dynamic and geared toward the future with an emphasis on the process of continuous improvement.

- The standards must be consistent with existing civil rights laws and practices.

- Industry, labor and education must work together to ensure that work-related education prepares people for requirements of real-life work.

- Experienced workers are the experts in their jobs and can identify the work performed in their occupations and required skills, knowledge, and abilities.

- Workers should be prepared for a broadly-defined occupation, which encompasses skills and knowledge needed for a number of related occupations throughout the industry. This opens up a broad range of work opportunities and makes people more adaptable for various jobs in an organization.

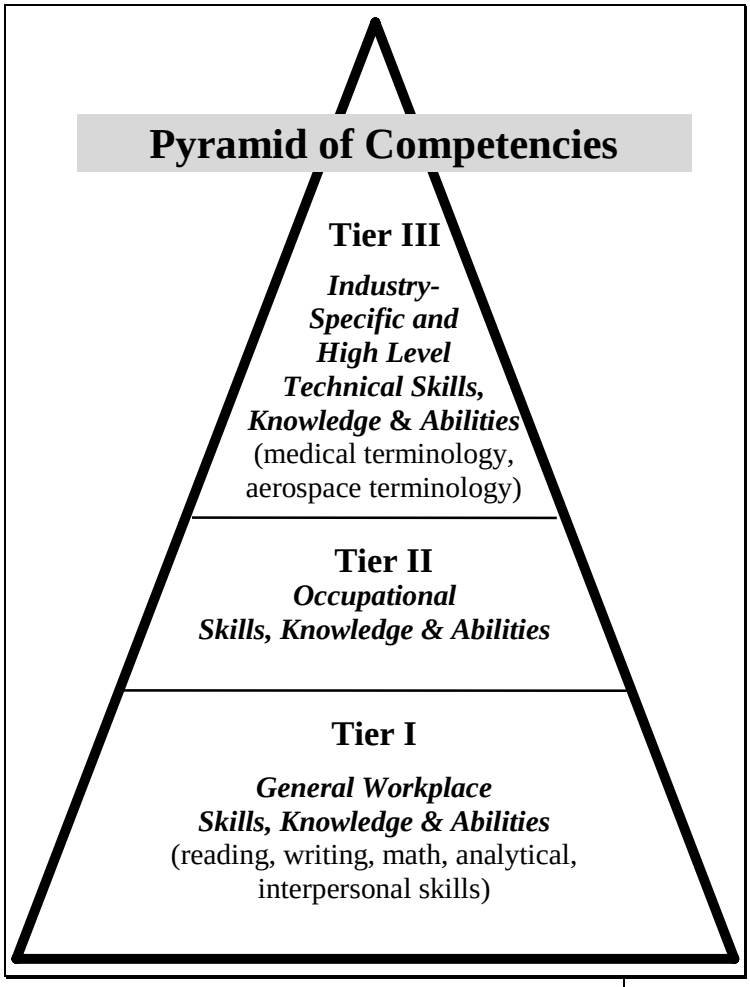
- Integrated skill standards, rather than compartmentalized skill standards, are needed to prepare for real-life work. Integrated skill standards place duties and tasks, and the know-how needed to perform them, in the context of real-work scenarios which require decision-making and problem solving.

- Skill standards include critical work functions and tasks; academic skills and knowledge, foundational or employability skills and occupational or technical skills and knowledge. They must include clear performance criteria related to successful on-the-job performance.

—What Conceptual Frameworks Exist?

A Three-Tier Skill Standards System

Imagine that the United States develops a comprehensive qualifications system with three levels or tiers.



At the top of this qualifications system, call it Tier III, are standards for individual jobs—jobs like that of a welder of specialty alloys, or dental assistant, or the operator of a machine that performs lithographic functions in the semiconductor fabrication business. The standards are set by individual firms for the way work is to be done in that firm—for example, the standards Boeing sets for the tolerances and failure rates in the construction of its new 777 airplanes.

At the next level of the qualifications system, Tier II, are skill standards for clusters of occupations requiring broadly similar skills. Because each of these groupings include many occupations—there might be a grouping, say, for manufacturing specialists, encompassing a great variety of types of manufacturing jobs—there might eventually be no more than thirty of these categories covering most of the front-line jobs in the nation. The actual standards for what one would have to know and be able to do in each category and how well one would have to be able to do it are defined by the requirements of high performance work-organizations, in which one is expected to think and to contribute a lot to the value and improvement of the product or service.

The third level, Tier I, encompasses a set of standards for what everyone in the society ought to know and be able to do to be successful at work, as a citizen, and as a family member. This tier incorporates standards calling for deep understanding of the core subjects in the curriculum as well as the capacity to apply that knowledge to complex real-world problems. And it incorporates the generic skills required to succeed in high-performance work environments, regardless of the particular job one is doing—skills such as problem-solving ability, the capacity to learn quickly, and the ability to work well with others in groups.

Adapted from *"Skill Standards, Qualifications Systems, and the American Workforce."* Marc S. Tucker. 1996.

A Conceptual Framework for Industry-Based Skill Standards

Center*Focus* *Newsletter April 1996*
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A Conceptual Framework for Industry-Based Skill Standards

The United States has entered "the age of the standard." Although there is little empirical proof of their benefits (GAO 1993), many believe that developing a national system of standards is one key to strengthening the country's economy. Supporters contend that standards can promote flexibility and portability of workers' skills across occupations, industries, and geographic areas and improve the fit between what is learned in school and what is needed on the job. (Ganzglass and Simon 1993; Commission on the Skills of the American Workforce 1990).

This paper presents two models of skill-standards development and skill certification—the professional model and the skill-components model. We have developed these models after analyzing the skill standards movement and the 22 Departments of Labor and Education pilot projects that are developing skill standards for various U.S. industries. A detailed description of the two models, the pilot projects, and the conditions that have encouraged the skill standards movement in general are provided in the National Center for Research in Vocational Education (NCRVE) report, ***Making Sense of Industry-Based Skill Standards*** (Bailey and Merritt 1995).

Models of Skill and Skill Certification

Reformers of mainstream education and the workplace are challenging the series of dualities that have traditionally existed between mental and physical (head and hand) theoretical and practical, and academic and vocational activities. For example, educational reform strategies emphasize the pedagogical benefits of linking structured work experience to academic or classroom work (Grubb 1995). Likewise, workplace reform, focusing on aspects of the "high performance workplace," has sought to minimize the distinction between the activities of nonprofessional and professional workers—the "doers" and the "thinkers." Production workers formerly engaged in routine tasks initiated and directed by their superiors are increasingly being given more responsibility to solve problems, make improvements in workplace procedures, and engage actively with their co-workers.

The distinction between an approach to skill standards based on traditional dualities and one based on a more integrated perspective can be illustrated by two broad models that we have developed—the *skill-components model* and the *professional model*. These two models differ along two critical dimensions, the conceptualization of skill and the role that workers play in the development and governance of the skill-standards system.

The Skill-Components Model

The skill-components model is based on the limited, passive roles that workers are expected to assume in traditional hierarchical organizations. As Rosenbaum, Kariya, Settersten, and Maier (1990) point out, "...although college graduates are hired based on their ability to be self-directed, non-college-bound youth are hired based on their rule-following behaviors: effort, deportment, attendance, and punctuality" (p. 266). Stripped of autonomy by the narrow skills that define them, employees perform a series of rote functions that have been explicitly established for them. Since workers are not expected to make complex independent decisions, the conceptual skills that could be used as a basis for making those decisions are not considered necessary.

Workers are expected to have basic academic skills—literacy and numeracy—but a sharp distinction is maintained between academic and vocational learning. Academic skills are learned prior to specific vocational skills and are useful to the extent that they help workers master the required list of tasks. But with the typical approach to teaching and the types of tasks that workers are asked to carry out, workers are not encouraged to, and do not, transfer these enabling competencies to their applications (Stasz, McArthur, Lewis, and Ramsey 1990). That is, workers are trained to perform tasks that are defined by their supervisors, but they are not expected to know when to do them, how they fit into related tasks, how they relate to a final product, or how they can be improved or applied to different situations (Bailey 1989).

The conception of skill found in the skill-components model has two important implications. First, the effectiveness of a worker can be characterized by how well the worker carries out a list of individual tasks, the principal difference between skilled and unskilled workers being the length of the list of tasks that they can perform. Second, since the skills of workers are a collection of tools at the disposal of managers, it is reasonable that the managers, not the workers, will have control over the process of developing skill standards and their certification.

The Professional Model

The concept of pro-fessionalism assumes that workers have the ability to apply general knowledge to a variety of non-routine circumstances or situations (Wolfson, Trebilcock, and Tuohy 1980). Professionals are rewarded for autonomous, proactive, non-routine behavior and are expected to make important decisions on a client's behalf.

But professional must also be able to carry out specific tasks. Nevertheless, two professionals, equally adept at carrying out specific tasks, could differ profoundly in their effectiveness as professionals. As Hoachlander (1995) points out, a pilot's job is much more complex and nuanced than a list of pilot skills or tasks would indicate. No pilot certification system could be

considered adequate if it did not require pilots to accomplish specific tasks such as landing a plane. However, Hoachlander argues, pilots who can hit the landing path consistently will crash if they use poor judgment in non-routine situations.

In the professional model, technical **and** academic skills are the foundation or enablers for more complex general functions such as problem-solving, reasoning, or using judgment. In contrast, in the skill-components model, the broader academic skills are the foundation or enablers of specific tasks and technical skills. Thus tasks are the ultimate activity for nonprofessional workers, while, for the professional, tasks are necessary (but not sufficient) to carry out the broader core activities of the occupation.

Skill-Standards Development Under the Two Models

One of the crucial distinctions between skill standards as conceived under these two models is the ultimate purpose of the skill. In the skill-components model, a list of skills indicates a set of specific tasks to be directed by someone other than the worker. In the professional model, a list of skills indicates a set of "enablers" that will enhance the worker's ability to effectively carry out broader, autonomous responsibilities. Given this distinction, those who develop standards based on the skill-components model need merely list a set of abstract domain-free skills. But those who are developing standards following the professional model must supply more context for the work performed and describe the kinds of interactions that occur among individuals involved in the work process. Analyzing skill-standards systems, we thus focus on two dimensions: (1) the extent to which academic and vocational skills are integrated and (2) the extent to which the workplace is integrated into the standards.

Academic and vocational integration. The skill-components model fundamentally separates academic and vocational skills. Academic skills are taught in school settings for abstract or unspecified purposes. Vocational skills, in contrast, are taught for work—often at work or in work-like settings. There is little, if any, connection or application drawn between academic and vocational skills. An academic skill for a laboratory technician might be the ability to write in complete, meaningful sentences. A lab technician's vocational skill might involve placing entries into a log book. Although these two skills are interdependent, in the skill-components model they are thought of as separate.

The professional model, on the other hand, minimizes the distinction between the types of skills—academic or vocational—that workers possess and concentrates on how the skills are combined to achieve a workplace-related goal. The fact that a lab technician can write complete sentences in a paper for a science course may be of little use in the workplace; for the skill to have any value, the technician must be able to utilize, transfer, or apply this "academic" ability as written communication in a "real" setting.

Workplace Integration. The workplace also plays a different role in the two models. In the skill-components model, skills (whether academic or vocational) are generic and have no solid workplace applications. It is assumed that the ability to log lab information goes no deeper than filling in a log book in some pre-determined fashion involving no judgment calls or decision making on the part of the worker. The worker is limited to a pre-established set of responses related to the most appropriate technical skills; no application of other perhaps distantly related skills or judgments are necessary.

In the professional model, however, what is critically important is the worker's ability to apply a variety of skills in the context of the workplace. For example, using a log book involves the worker's discretion about the importance of relaying information to colleagues as well as the ability to communicate the information that the organization needs now and in the future. An independently functioning lab technician (similar to a physician logging information onto a patient's chart) must be able to assess a situation, decide what information is important enough to include in a log book, and document that information in an under-standable fashion.

Current Skill Standards Development—The 22 Pilot Projects

In 1992 an 1993, the U.S. Departments of Labor and Education accepted the proposals of 22 organizations to develop and pilot-test skill-standards systems in various U.S. industries. The funded projects were responsible for developing cooperative alliances among employers, unions, and educators and increasing the knowledge and understanding of how skill standards and certification are developed, implemented, recognized, accepted, and used. By early 1995, all projects had completed the development of content standards, and almost two-thirds had completed the validation of the content standards as well as the development of performance standards.

The empirical basis for the analysis in this paper is an examination of 21 of the pilot projects.[1] In the dimension of academic and vocational integration, the pilot projects can be differentiated in three groups. In the first group, there is no integration between skill types; academic and vocational skills are listed separately. In the second group, academic skills are differentiated from vocational skills but are applied to a generic workplace setting or task that illustrates their use in the workplace. In the last group, academic skills are embedded or integrated in the technical functions (vocational skills) required in the occupation.

With respect to workplace integration, there again are three kinds of groups. The largest group follows the skill-components model: skills are listed with no workplace application relevant to the specific occupation or industry. The second group provides specific workplace applications to indicate how skills may be used. The smallest group of projects follows the professional model: their list of skills includes the organizational and industry dynamics as critical aspects of the skills; that is, they indicate how workers are expected to operate in their surroundings.

Combining the two dimensions, we were able to distinguish three categories of projects.[2] The accompanying chart displays the two-dimensional categorization of the standards created by the 21 projects.

We refer to the six projects that maintain a distinction between academic and vocational skills and offer no workplace context as having *compartmentalized* stan-dards. Four projects combine academic and vocational skills and integrate the standards into critical workplace functions. We refer to these as *consolidated* standards. The eleven remaining projects, an intermediate group that we refer to as contextualized, use workplace tasks or vocational activities to provide examples of the usefulness of particular skills but do not integrate the workplace or the types of skills into the standards.

Compartmentalized

In the compartmentalized projects, technical and academic skills are fundamentally separated. Technical skills are for the workplace; academic skills are for the classroom, and there is little overlap between the two. The role of trainees in the workplace is distinguished from the role of learners in the classroom.

In these compartmentalized projects, all skills are narrowly defined. The technical skills are a list of explicit abilities necessary to perform industry-specific or occupational-specific tasks and duties. The academic skills are the foundation of basic competencies that an employee needs **before** gaining technical skills. So-called employability skills such as the ability to follow schedules, when included, form a third, separate listing of skills, which are usually appended to the skill framework.

Just as types of skills are disconnected from each other, they are also disconnected from any workplace context or application. This lack of skill application is especially apparent for academic skills. In the compartmentalized projects, standards do not indicate how, for example, mathematics skills such as the conversion of fractions into decimals or percentages must be used by technicians in the performance of their jobs. The required skill is simply listed, and the tasks that will utilize this skill are listed separately and generically.

For example, one project identified skills in three categories—technical, employability, and related academic—and listed them sep-arately. "Technical Skills" include appropriate safety procedures and keeping work areas free from clutter. "Employability Skills" in-clude following schedules and practicing self-starting techniques. "Related Academic Skills" include algebra, interpreting ratios and solving linear equations.

Consolidated

The consolidated projects build skill standards on a framework of broad-based workplace respon-sibilities and interactions rather than specific worker tasks. This approach is more in line with the less structured and more autonomous professional view of work. The list of skills is more firmly grounded in the workers' purpose within the organization and not on a set of isolated tasks that they perform. The focus is on the worker's responsibility to the customer or to the overall mission of the organization rather than primarily on the narrow context in which employers define an employee's tasks and duties. The worker's role as worker is not differentiated from the worker's role as learner.

Because it does not adhere so strictly to labeling skills, use of the professional model promotes the expansion of worker roles within the organization. In this approach, identifying a list of skills is less important than understanding the underlying aspects of worker roles and responsibilities. As one project staff member commented, standards center around what the work actually looks like and its relation to the organizational or industry mission. The knowledge, skills, attributes, and task competencies required of workers are seen as "enabling" the performance of broad organizational roles.

Contextualized

While the compartmentalized projects create standards that produce an abstract list of skills, the contextualized projects use work-place examples to make the list of skills more meaningful. Skill-stan-dards projects that take this contextual approach create a closer link between worker and learner roles than the compartmentalized projects, but academic and vocational skills are not integrated, and skills are still not defined in relation to the broader role of the worker in the organization.

1 Standards from one of the 22 projects were not made available to us.

2 This categorization refers only to the content of the standards. The governance structure of the standard-setting process, which is not addressed in this ***CenterFocus*** but is addressed in detail in the longer report, is also a crucial element that distinguished the two models. None of the pilot projects included workers in the policy-setting activities; workers were involved only after project directions had been determined by traditional decision-makers.

CATEGORIZATION OF SKILL STANDARDS

Workplace Integration

Academic and Vocational Integration

	Skills are Listed Generically with No Workplace Application Relevant to the Specific Occupation and/or Industry	Workplace Applications Are Provided as Examples to Indicate How Skills Are Used	Critical Aspects of the Job and Organizational and Industry Contexts Are Integrated
Academic skills are differentiated from vocational/ technical skills	**COMPARTMENTALIZED 6 projects**		
Academic skills are applied to a generic workplace setting but remain distinct from vocational skills	**CONTEXTUALIZED 5 projects**	**CONTEXTUALIZED 4 projects**	
Academic and vocational skills are integrated		**CONSOLIDATED 2 projects**	**CONSOLIDATED 4 projects**

Conclusion

Our analysis of the pilot projects revealed a wide variation in practice. Too many of the current projects remain rooted in past notions of skills. Many projects simply used standards that already existed. But even those that developed new standards based them on a skill-components perspective—maintaining the traditional dualities between learning and doing that education reforms have challenged. In the dimensions of academic and vocational integration and workplace integrations, only a minority of the projects came close to creating standards in line with the professional model.

If skill standards are to contribute to a broad reform of schools and workplaces, employers must be convinced that their workers need new types of skills; skill-standards projects need to base their job analyses and assessments on the professional model; and schools must have the capacity to educate students up to those broader, more sophisticated standards.

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This ***CenterFocus*** was developed at the Institute on Education and the Economy, Teachers College, Columbia University, which is part of the National Center for Research in Vocational Education (NCRVE). It is a distillation of a report entitled, Making Sense of Industry-Based Skill Standards, by Thomas Bailey and Donna Merritt, 1995. This report is available from NCRVE at 1-800-637-7652, reference number MDS 777.

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—What Work Has Been Done?

Although the term 'Skill Standards' is relatively new, many states and local communities have established craft or technical committees related to their vocational education program development to identify skills needed by workers in their industries.

In tandem with establishing the 22 demonstration projects, the federal government through the Department of Education, took the lead in funding a baseline study of how skill standards are developed and used in the United States. The study, conducted by the Institute for Education Leadership (IEL), found a great deal of effort underway and serious gaps in current practice.

—Current Practices

Skill standards covering a wide range of occupations have been extensively used in this country since before the turn of the century. Skilled trades, medicine, law, social work, and real estate areas are but a few of the occupational areas that have established collective, but self-imposed, criteria for recognizing workers as capable of practicing their chosen crafts.

In the U.S. most occupational credentials are awarded by non-public organizations. Even in this country, however, government has become more involved in oversight of many occupations through state and federal licensure requirements, resulting in a complex web of relationships between licensing and voluntary credentialing systems.

Two distinct communities of interest—industry and education—have created and sustained skill standards activity.

Approximately 400 professional societies and industry-based associations are involved in the promotion and issuance of some form of skills-based credential. Approximately 150 of these organizations focus on occupations that do not require at least a bachelor's degree to earn the credential. Credentialing activities can include: prescribing education and experience qualifications for certification candidates; establishing for potential accredited institutions qualifications for curriculum, faculty, and facilities; administering competitive exams; and conducting assessment visits.

The IEL study found that approximately 700 committees using industry volunteers exist across the country to assist state educators and business associations in develop skill standards. Despite these extensive efforts, no one set of skill standards has been established for all states or is used by every state. Only 26 to 32 states use a common set of standards for any one occupation.

The IEL study identified common patterns in the certification systems.

- No programs offer a career path from novice through masters' level in broad occupational areas;
- In almost all programs, eligibility for certification is linked to time in a job/industry;
- Education is credited against time spent in the workplace to qualify for eligibility or certification;
- The great majority of programs assess through paper-and-pencil tests;
- Most programs have some form of required re-certification; and
- Most programs have developed a core body of knowledge that a candidate must have in order to qualify for consideration.

The Ideal Skill Standards System

According to the IEL baseline study, the ideal skill standards system would center around the needs of individuals and employers and would incorporate the following characteristics:

- It would be widely accessible to students and workers regardless of age;
- It would respond to changes and differences in local and individual needs through flexibility in education and training provided (e.g., types of institutions, full-time versus part-time);
- It would be able to meet the needs of individuals regardless of the types of education and training they are pursuing (e.g., initial preparation, continuing, upgrading, or remedial);
- It would allow career paths within and between industries;
- It would be explicit, so that firms, educators, training providers, and individuals know what the standards are and where information about them can be obtained;
- It would be competency-based;
- It would formally assess and certify that an individual's skills have been documented by a third party;

- It would be progressive, so that people can build upon blocks of competencies and adapt to technological, organizational and market changes to improve their prospects or to explore their potential;

- It would have a common framework and use common language when describing skill levels across industries and occupations, so that both individuals and employers can easily understand workplace expectations. The framework should progress from initial (entry) qualifications through several levels to mastery and/or specialization recognition (IEL, 1993, Vol. I).

—Demonstration Projects and Contacts

Federal Skills Standards Projects

Industry	Funded By	Grantee
Advanced Manufacturing	Dept. of Ed. 8/93	**Foundation for Industrial Modernization**, 1331 Pennsylvania Ave. N.W., Suite 1500, North Tower, Washington, DC 20004. (202) 662-8970—Contact—Sally O'Dowd.
Agriscience and Biotechnology	Dept. of Ed 10/92	**National FFA Foundation**, 5632 Mt. Vernon Highway, Box 15160, Alexandria, VA 22309. (703) 360-3600—Contact—Jeff Moss.
Air Conditioning, Refrigeration and Power	Dept. of Ed. 10/92	**Southern Association of Colleges and Schools, VTECS**, 1866 Southern Lane, Decatur, GA 30033. (800) 248-7701—Contact—Victor Harville.
Automotive, Auto Body, and Truck Technologies	Dept. of Ed. 10/92	**Vocational Automotive Technical Education Foundation,** 13505 Dulles Technology Drive, Herndon, VA 22071. (703) 713-3800—Contact—Pat Lundquist.
Biotechnical Sciences	Dept. of Ed. 10/92	**Education Development Center,** 55 Chapel St., Newton, MA 92160. (617) 969-7100—Contact—Judith Leff.
Chemical Process Industries	Dept. of Ed. 8/93	**American Chemical Society/EDC,** 1155 16th St., N.W., Washington, DC 20036. (202) 872-8734—Contact—Kenneth Chapman.
Computer-Aided Drafting (CAD) and Design	Dept. of Ed. 10/92	**Foundation for Industrial Modernization,** 1331 Pennsylvania Ave. N.W., Suite 1500, North Tower, Washington, DC 20004. (202) 662-8970—Contact—Jane Beardsworth.
Electrical Construction	Dept. of Labor 12/92	**National Electrical Contractors,** 3 Bethesda Metro Center, Bethesda, MD. (301) 657-3110—Contact—Charles Kelly.
Electronics	Dept. of Labor 12/92	**American Electronics Association,** 5201 Great America Parkway, Santa Clara, CA. (408) 987-4200—Contact—Cheryl Fields Tyler.
Electronics (Consumer)	Dept. of Ed. 10/92	**Electronics Industries Association,** 919 18th St. N.W., Washington, DC 20006. (202) 955-5814—Contact—Irv Kaplan.
Food Marketing Industry (Supermarket)	Dept. of Ed. 8/93	**National Grocers Association,** 1825 Samuel Morse Drive, Reston, VA 22090. (703) 437-5300—Contact—James Williams.

Federal Skills Standards Projects *(cont'd)*

Industry	Funded By	Grantee
Hazardous Materials Management Technician	Dept. of Ed. 8/93	**CORD**, 601C Lake Air Drive, P.O. Box 21689, Waco, TX 76710. (817) 772-8756—Contact—Dan Hull.
Health Sciences and Technology	Dept. of Ed 10/92	**Far West Laboratory**, 730 Harrison St., San Francisco, CA 94107. (415) 565-3070—Contact—Sri Ananda.
Heavy Highway/Utility Construction	Dept. of Ed. 8/93	**Laborers-AGC Ed. & Training Fund**, 37 Deerfield Road, P.O. Box 37, Pomfret Center, CT 06259. (203) 974-0800—Contact—James Warren.
Human Service Occupations	Dept. of Ed. 8/93	**Human Services Research Institute/EDC,** 2336 Massachusetts Ave., Cambridge, MA 02140. (617) 876-0426—Contact—Valerie Bradley.
Metalworking	Dept. of Labor 12/92	**National Tool and Machining Association,** 9300 Livingston Road, Ft. Washington, MD 20744. (301) 248-6200—Contact—William Ruxton.
Photonics Technician	Dept. of Ed. 8/93	**CORD,** 601C Lake Air Drive, P.O. Box 21689, Waco, TX 76710. (817) 772-8756—Contact—Dan Hull.
Printing	Dept. of Ed. 10/92	**The Graphic Arts Technical Foundation,** 4615 Forbes Ave., Pittsburgh, PA 15213. (412) 621-6941—Contact—John Burgess.
Retail Trade	Dept. of Labor 12/92	**National Retail Federation,** Washington, DC 20004. (202) 783-7971—Contact—Robert Hall.
Tourism, Travel, and Hospitality	Dept. of Labor 12/92	**Council on Hotel, Restaurant, and Institutional Education,** 1200 17th St., N.W., Washington, DC 20036. (202) 331-5990—Contact—Doug Adair.
Uniform Services and Textiles	Dept. of Ed. 12/92	**Uniform Services and Textiles Association,** 1730 M St., N.W., Washington, DC 20036. (202) 296-6744—Contact—Geoffrey Northey.
Welding Occupations	Dept. of Ed. 8/93	**American Welding Society,** 550 N.W. Lejeune Road, Miami, FL 33126. (305) 443-0353—Contact—Nelson Wall.

Guidebook Volume I

SKILL STANDARDS

Section II

What Are Some Good Examples of Skill Standards Projects?

What Are Some Good Examples of Skill Standards Projects?

—Examples of National Standards

In this section, a list and comparison matrix of the elements included in four recently-developed National Skill Standards projects are charted. Following the charts, excerpts from selected project reports are included to provide samples demonstrating different approaches. Complete reports can be obtained by calling directly the organizations in charge of each project (phone numbers are included in the National Skills Standards Project chart in the previous section).

TITLE OF DOCUMENT	Gateway to The Future Skill Standards for the Bioscience Industry	Setting The Standards A Handbook on Skill Standards for the High-Tech Industry	CADD - Computer Aided Drafting and Design National Occupation Skill Standards	Project Smart Local Manufacturing Industry Skill Standards
DATE PUBLISHED	April 95	1994	1994	April 96
FUNDED BY	DOE	DOL	DOE	National Youth Fair Chance
LEAD ORGANIZATION	Education Development Center, Inc. (EDC)	American Electronics Association	Foundation for Industrial Modernization (FIM)	Education Development Center, Inc. (EDC) Youth Opportunities Unlimited, Inc. (YOU)
PROCESS	Modified DACUM	Modified DACUM	Not mentioned	Modified DACUM
OCCUPATIONAL AREAS	Beginning Level Bioscience Technical Specialists - For Technical Workers in Pharmaceutical Companies, Biotechnology Companies, and Clinical Laboratories.	Manufacturing Specialist, Administrative/Information Services Support, Pre/Post Sales.	Entry level CADD users.	Manufacturing Technician I Learning Occupation (composite of a range of related real-life manufacturing occupations that share a common core of work tasks, and skill and knowledge requirements).
SCENARIOS	34 scenarios are developed describing a real work situation, including a routine procedure and an anticipated problem. For each scenario there is a description of: - Workplace settings; - Key competency areas demonstrated in the scenario; - Tasks for performing routine procedures in the context of the scenario; - Tasks for solving the problems involved; - Skills, knowledge and attributes used in the scenario.	Not developed at time of publication.	Not developed at time of publication.	40 scenarios represent real problems faced by workers within the first few years of employment in a variety of related manufacturing occupations. For each scenario there is a list of duties, tasks, industry skills, knowledge and attributes needed to address the specific problem.

TITLE OF DOCUMENT	Gateway to The Future Skill Standards for the Bioscience Industry	Setting The Standards A Handbook on Skill Standards for the High-Tech Industry	CADD - Computer Aided Drafting and Design National Occupation Skill Standards	Project Smart Local Manufacturing Industry Skill Standards
SKILL STANDARDS	- Key purpose of occupation Job functions and tasks for a Bioscience Technical Specialist; - Key competency areas used in each scenario (summary chart); - Specific tasks used in each scenario (summary chart); - General work skills used in each scenario (summary chart); - Industry-related knowledge used in each scenario (summary chart); - Industry-related skills used in each scenario (summary chart); - Attributes used in each scenario (summary chart); - Assessment methods recommended for each task (summary chart); - Performance criteria (not developed at the time of publication).	- Key purpose of occupation; - Critical functions and activities for each occupation; - Performance criteria for each activity; - Underlying knowledge, skills and understanding (not available at time of publication).	- List of Fundamental Drafting Skills, Fundamental Computer Skills, Basic CADD Skills and Advanced CADD Skills; (each technical skill is related to the necessary academic skills); - List of Related Academic Skills and Knowledge; - List of Employability Skills; - List of Tools and Equipment for CADD Training; - Performance Criteria (under development at time of publication).	- Duties, tasks, skills and attributes of the manufacturing Technician I Learning Occupation; - Indicators of "Failure to Master" for each task; - Indicators of "Mastery" for each task.
VALIDATION	First validation was a survey of the job functions and tasks, and the skills, knowledge and attributes required to master the tasks; Second validation was through a series of workshops to confirm broader agreement with the scenario development.	Validation of critical functions, activities and performance criteria was validated through a national survey.	The standards were verified by CADD users.	None mentioned in report.

Gateway to the Future Information...(Insert copied pages of information here)

Setting the Standard (Insert AEA Copies pages of information here)...

CADD (Insert Copied pages of information here)...

Project Smart (Insert Copied pages of information here)...

—Bellevue Community College Information Technology Skill Standards

The NorthWest Center for Emerging Technologies (NWCET) and the Regional Advanced Technology Education Consortium (RATEC), funded by the National Science Foundation and the Washington State Board for Community and Technical Colleges, identified skill standards for information technology careers.

A progress report summarizing functions and tasks for the following eight career clusters was published in May 1996.

- *Database Administration Associate*
- *Information Systems Operator/Analyst*
- *Interactive Digital Media Specialist*
- *Network Specialist*
- *Programmer Analyst*
- *Software Engineer*
- *Technical Support Representative*
- *Technical Writer*

A final report presenting the complete skill standards for these eight information technology career clusters was published in November 1996. To obtain copies of the final report, please contact Michele Royer, NWCET, at 206-641-2066, mroyer@bcc.ctc.edu.

The following charts present the skill standard information for the Technical Writer career cluster.

Skill Standards for Technical Writers

Critical Functions Specific to this Job

A. Analysis
B. Research
C. Design
D. Development and Writing

Core Functions needed in a wide range of Professional Jobs

Project Management
Task Management
Problem Solving/Troubleshooting

The Skill Standards Charts presented in the following pages were developed by the NorthWest Center for Emerging Technologies/ This project was funded by the Washington State Board for Community and Technical Colleges and the National Science Foundation.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: A. Analysis

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
A1. Gather data to identify customer requirements.	• Sources and methods for gathering requirements are affordable and relevant. • Information is accurate and complete. • Information gathering interviews follow appropriate company practices. • Information sources are reliable and current. • Target audience/user group is a key information source.	• Ability to identify key sources of information. • Ability to interview knowledgeable customers. • Ability to apply information gathering methods. • Ability to decide when enough information has been gathered. • Knowledge of workplace and industry vocabulary.	• Ability to pose critical questions. • Ability to compile and analyze multiple viewpoints. • Ability to identify and prioritize the need for data. • Ability to encourage cooperation and keep an open mind to new data and opinions.
A2. Interpret , evaluate and confirm requirements.	• Customer needs are clearly defined and prioritized. • Conflicting requirements are identified and completely resolved. • Complete set of requirements has been communicated to and approved by customer. • Final requirements are documented.	• Ability to obtain customer approval of requirements. • Ability to define requirements in appropriate business terms.	• Ability to relate intent to desired results. • Ability to analyze information for accuracy and consistency. • Ability to recognize information most relevant and important to a situation.
A3. Define scope of work to meet customer's requirements.	• Project objectives are identified and agreed upon. • The size and the specifics of the work involved are accurately identified. • Criteria for successful completion of the work involved is accurately identified. • Major project tasks and interdependencies are accurately identified. • Estimate of time, materials, and capabilities needed to meet customer requirements is accurately identified. • Schedule is based on resource availability and project timeline. • Scope of work is completely and concisely documented.	• Ability to visualize task sequentially. • Ability to identify interdependencies. • Ability to evaluate work procedures for effectiveness and efficiency. • Ability to estimate required resources and schedule.	• Ability to create detailed supporting document. • Ability to predict outcomes/results based on experience/prior knowledge. • Ability to negotiate alternatives. • Ability to prioritize conflicting work demands. • Ability to identify the theme, purpose and scope of the assignment.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: A. Analysis

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
A4. Identify time, technology and resource constraints.	• The constraints are accurately identified, communicated, and documented. • Contingency plans are developed with plausible alternatives.	• Ability to identify and plan resources. • Ability to identify key sources of information. • Knowledge of technology constraints.	• Ability to create detailed supporting documents. • Ability to predict outcomes/results based on experience/prior knowledge. • Ability to understand constraints, generate alternatives, consider risks and evaluate options.
A5. Identify gaps in information.	• Inconsistencies, contradictions and discrepancies between the information given and needed information are accurately identified. • Gaps are communicated to appropriate people in a timely manner.	• Ability to determine when new information needs to be created or acquired. • Ability to identify and consult subject matter experts. • Ability to examine available information sources for current relevance.	• Ability to evaluate consistency of written material. • Ability to verify data accuracy. • Ability to summarize information and requirements. • Ability to select possible information and evaluate it's appropriateness.
A6. Clarify product, application or procedure.	• The end user, task set, features, and strengths and weaknesses of the product, application, training, or service are clear. • The product's place in the market place is clear and focused.	• Ability to analyze and synthesize information. • Ability to learn product, application, or procedure quickly. • Ability to understand workplace and industry vocabulary.	• Ability to interpret and apply new knowledge and experiences. • Ability to identify relevant details, facts, and specifications. • Ability to contrast conflicting data. • Ability to research to gain knowledge and information.

Information developed by the NorthWest Center for Emerging Technologies.
Project funded by the Washington State Board for Community and Technical Colleges, and the National Science Foundation.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: B. Research

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
B1. Frame research question	• Research questions are clearly focused and succinctly defined. • Research questions are relevant to project and customer requirements.	• Ability to synthesize information into a clear research question. • Knowledge of the principles of research framing.	• Ability to generalize information. • Ability to compare multiple viewpoints. • Ability to pose critical questions. • Ability to understand goals and focus questions.
B2. Identify and evaluate sources of information.	• Sources of information are credible and can provide relevant information. • Sources of information include subject matter experts, the target audience, and appropriate documents. • Sources of information are evaluated based on needed criteria.	• Ability to evaluate relevancy of sources of information. • Ability to be creative in resource identification. • Knowledge of research methods.	• Ability to pose critical questions. • Ability to identify and prioritize the need for data. • Ability to identify the need for information.
B3. Gather background information.	• Priorities are determined for what information should be gathered. • Information gathered is relevant, accurate and complete. • Information provides the contextual background needed. • Information gathering processes follow appropriate company practices.	• Ability to use a variety of research tools and technologies. • Knowledge of research methods. • Ability to integrate various information technologies. • Knowledge of company policies and procedures.	• Ability to pose critical questions. • Ability to identify and prioritize the need for data. • Ability to identify the need for information. • Ability to analyze and synthesize information.
B4. Interview subject matter experts and target audience.	• Interview questions are relevant, succinct and directed to appropriate contacts. • Information interviews are conducted in a cost-effective manner. • Information gathering interviews follow appropriate company practices. • Those interviewed clearly understand the purpose and process of the interview**.**	• Knowledge of research interview methods. • Ability to interview a diverse population. • Knowledge of workplace and industry vocabulary.	• Ability to identify and prioritize the need for data. • Ability to encourage cooperation. • Ability to summarize information. • Ability to ask analytical questions to determine specific informational needs. • Ability to listen, interpret and respond to verbal messages.

Information developed by the NorthWest Center for Emerging Technologies.
Project funded by the Washington State Board for Community and Technical Colleges, and the National Science Foundation.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: C. Design

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
C1. Define purpose, standards and use of documentation.	• Definition of purpose meets the customer requirements for delivering useful content to end users. • Standards include critical success criteria.	• Ability to clarify project purpose. • Ability to confirm documentation's use and purpose.	• Ability to compare and analyze multiple viewpoints. • Ability to pose critical questions. • Ability to demonstrate sensitivity to customer concerns and interests. • Ability to negotiate.
C2. Identify delivery options.	• Delivery options meet customer standards and specifications. • Delivery options are cost effective.	• Knowledge of various delivery options. • Knowledge of industry standards.	• Ability to consolidate a variety of options. • Ability to demonstrate resourcefulness in using ideas and resources. •
C3. Select tools.	• Tools selected meet the task purpose. • Tools selected are cost effective and accessible.	• Knowledge of required tools. • Knowledge of company practices.	• Ability to resolve technical issues. • Ability to know when to consult others for advice or approval.
C4. Plan information flow.	• Appropriate information is in a logical sequence. • Information is complete and concise. • Flow is formatted to meet customer requirements.	• Knowledge of subject matter. • Ability to organize information in different ways to meet different user needs.	• Ability to organize and focus information to meet user needs. • Ability to demonstrate creative thinking process. • Ability to select & synthesize pertinent information.
C5. Select style and tone.	• Style and tone are appropriate for purpose, medium, and audience level. • Style and tone conforms to customer requirements.	• Knowledge of different writing styles. • Knowledge of audience characteristics. • Knowledge of strength and limitations of the media.	• Ability to demonstrate sensitivity to fears/concerns of diversity. • Ability to communicate appropriate verbal/non-verbal messages. • Ability to recognize audience/purpose. • Ability to present information persuasively and objectively.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: C. Design

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
C6. Determine level of detail.	• Appropriate level of detail is determined for purpose. • Level of detail meets customer expectations.	• Knowledge of customer expectations. • Ability to adjust level of detail appropriately.	• Ability to use logic to draw conclusions. • Ability to predict outcomes.
C7. Identify appropriate visuals.	• Visuals conform to customer requirements. • Visuals enhance message. • Visuals are appropriate for style and tone. • Visuals are cost effective.	• Knowledge of media choices. • Ability to communicate visually. • Ability to think abstractly and to understand how visuals relate to the whole.	• Ability to use imagination to visualize events and activities. • Ability to select or apply learning tools. • Ability to understand goals and constraints. •
C8. Provide feedback to development team/individual.	• Feedback is clear and concise. • Feedback includes recommendations for improvement. • Feedback is documented and distributed appropriately.	• Knowledge of continuous quality improvement principles. • Knowledge of company documentation procedures.	• Ability to relate intent to desired results. • Ability to value differences of opinion. • Ability to ensure work quality. • Ability to assess performance of others and provide constructive feedback.

Information developed by the NorthWest Center for Emerging Technologies.
Project funded by the Washington State Board for Community and Technical Colleges, and the National Science Foundation.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: D. Development and Writing

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
D1. Select, synthesize, organize and focus pertinent information to meet user needs.	• Information is selected for relevance and appropriateness. • Information is accurate. • Information is synthesized and organized appropriately.	• Knowledge of user requirements. • Ability to use computers to process information, including entering, modifying, retrieving, storing and verifying data. • Ability to analyze organization of information.	• Ability to integrate multiple items. • Ability to validate appropriateness of information. • Ability to evaluate relevance of data.
D2. Create content of document	• Content presented in a clear and concise way to the appropriate audience level. • Technical terminology is translated to understandable terms. • Appropriate presentation tools are used. • Style is consistent. • Content is presented to proper media. • The document meets customer and company standards, and communicates necessary information.	• Knowledge of the principles of technical writing and presentation. • Knowledge of company standards and specifications. • Knowledge of technical writing tools, methods, and delivery options. • Ability to translate technical terminology and concepts.	• Interprets and summarizes research information. • Ability to create original documents. • Ability to analyze and synthesize information. • Ability to write clearly and concisely. • Ability to use appropriate language, style, organization, format**.**
D3. Obtain feedback on information and technical accuracy.	• Subject matter experts provide appropriate and timely feedback. • The review/revision process follows company procedures. • Feedback is requested in a timely manner.	• Ability to create data gathering processes. • Knowledge of information resources.	• Ability to ask for and accept constructive feedback. • Ability to demonstrate composure. • Ability to listen attentively. • Ability to evaluate relevant feedback. • Ability to coordinate customer reviews to verify accuracy and relevance.
D4. Edit for readability, grammar, and usage.	• Document is free of grammatical errors. • Document meets customer expectations for readability and usage.	• Knowledge of grammar and readability standards. • Ability to foresee usage potential.	• Ability to evaluate consistency of written material. • Ability to judge the accuracy, appropriateness and style of document.

Occupation Cluster: TECHNICAL WRITER
Function or Job Duty: D. Development and Writing

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
D5. Publish document.	• Publishing is coordinated with appropriate people. • Document is published and distributed in a timely manner.	• Knowledge of company policies and procedures. • Knowledge of publishing options. Knowledge of distribution options.	• Ability to set decision making parameters. • Ability to persist in achieving goals.
D6. Test for usability.	• Testing is coordinated with appropriate people. • Criteria for usability is clearly established. • Testing is completed in a timely manner.	• Knowledge of usability testing procedures. • Knowledge of company policies and procedures.	• Ability to judge effectiveness/ efficiency of usability test. • Ability to encourage cooperation. • Ability to value differences of opinion.

Information developed by the NorthWest Center for Emerging Technologies.
Project funded by the Washington State Board for Community and Technical Colleges, and the National Science Foundation.

Core Functions Standards

- **Project Management**
- **Task Management**
- **Problem Solving/Troubleshooting**

Core Function: Project Management

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
1a. Define scope of project.	• The project's contribution to overall business needs is explicit. • Criteria for satisfying customers' needs are identified. • The size and the specifics of the project are documented accurately and completely. • Applicable standards, regulations, and laws are identified.	• Ability to use appropriate project management planning tools. • Ability to create project scenarios. • Knowledge of applicable standards, regulations, and laws.	• Ability to analyze situation and formulate plan of action. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to visually analyze relationship between parts/whole and integrate processes.
1b. Identify stakeholders, decision-makers and escalation procedures	• Appropriate people are identified in a timely manner. • Escalation procedures are clearly identified and agreed upon.	• Knowledge of company policy and procedures. • Knowledge of systems organization and hierarchy.	• Ability to consider risks and implications. • Ability to use logic to draw conclusions from available information. • Ability to demonstrate sensitivity to stakeholders' concerns and interests.
1c. Develop detailed task list (work breakdown structures)	• The size and the specifics of the project are identified and documented. • Each task is sized individually. • Environment is documented accurately and completely.	• Ability to use appropriate project management planning tools. • Knowledge of work processes.	• Ability to formulate plan of action. • Ability to create comprehensive model. • Ability to identify important aspects of the situation.
2. Estimate time requirements	• Time requirements are realistic. • Time estimates accommodate the management approved level. • Contingency plans are included in the time estimates.	• Ability to create project scenarios. • Ability to visualize project time requirements at the task level.	• Ability to analyze situation and formulate a schedule. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to visually analyze relationship between parts/whole and integrate processes.
3. Develop initial project	• Activities contingent on other activities are	• Ability to use appropriate project	• Ability to analyze situation and

Core Function: Project Management

TASK	*Performance Criteria* How do we know when the task is performed well?	*Technical Knowledge* Skills, Abilities, Tools	*SCANS Skills and Personal Qualities* Foundational Abilities
Gantt/PERT chart	sequenced appropriately. • Approval points, milestones, and "go" "no go" decision points are defined to allow for project review, evaluation, postponement, and cancellation. • Tasks requiring long lead times are clearly identified to avoid project delays. • Task priorities are assigned.	management flow charting tools. • Ability to create project scenarios. • Ability to visualize task sequentially.	formulate a plan of action. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to visually analyze relationship between parts/whole and integrate processes.
4. Identify required resources and budget	• Resource and budget estimates are supported with data. • Rationale for recommending specific resources is clearly defined. • Recommendations are thoroughly documented.	• Ability to project resource and budgetary needs. • Ability to visualize project resource requirements at the task level. • Knowledge of company operating procedures regarding resource allocations.	• Ability to analyze situations and forecast conclusions regarding resource needs. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to create detailed supporting documents.
5. Evaluate project requirements	• Conflicting or overlapping requirements are clearly identified. • Evaluation includes feedback from key customers, management and peers. • Evaluation is concisely documented.	• Ability to non-defensively critique project plan. • Knowledge of company operating procedures regarding project plan evaluations.	• Ability to request feedback, both written and oral. • Ability to judge project effectiveness/ efficiency. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to create detailed supporting documents.
6. Identify and evaluate risks	• Risk identification is complete and considers impact on whole system. • Risk evaluation includes feedback from key customers, management and peers. • Risks are accurately documented.	• Ability to project potential risk scenarios. • Ability to non-defensively evaluate risks. • Knowledge of potential impact on whole system.	• Ability to determine system components to be modified or improved. • Ability to predict potential risks based on experience/prior knowledge. • Ability to create detailed supporting documents. • Ability to compare multiple viewpoints.
7. Prepare contingency	• Alternative ways to accomplish the goals are	• Ability to create alternatives.	• Ability to pose critical questions.

Core Function: Project Management

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
plan	identified (options analysis). • Limitations and tradeoffs are explicit. • Attention is directed to areas of concern and risk. • Contingency plan is well documented.	• Ability to forecast potential pitfalls. • Knowledge of potential impact on whole system.	• Ability to identify contingencies based on experience/prior knowledge. • Ability to create detailed supporting documents.
8. Identify interdependencies	• Interdependencies are completely and accurately identified. • Appropriate information is gathered from other parts of the system. • Interdependencies are clearly documented and communicated to those impacted by the project.	• Ability to see the "big picture". • Ability to diagram or document interdependencies. • Knowledge of potential impact on whole system.	• Ability to identify interdependencies based on experience/prior knowledge. • Ability to evaluate information for accuracy. • Ability to integrate multiple items of data and reconcile conflicting information.
9. Identify and track critical milestones	• Milestones and schedules are clearly identified and communicated. • Appropriate information is gathered from other parts of the system. • Milestones are adjusted appropriately. • Documentation provides comprehensive and understandable information for others.	• Ability to use appropriate tracking and milestones tools. • Ability to evaluate project progress. • Knowledge of potential impact on whole system. • Ability and willingness to adjust plans and milestones to changing priorities or customer requirements.	• Ability to formulate and organize processes. • Ability to identify milestones based on experience/prior knowledge. • Ability to evaluate information for accuracy.
10. Participate in project phase review	• Project reviews are timely and include the appropriate team members. • Appropriate information is gathered from other parts of the system. • Review is complete and follows operating procedures.	• Ability to participate in a group review process. • Ability to evaluate project progress. • Knowledge of potential impact on whole system.	• Ability to examine information for relevancy and accuracy. • Ability to actively participate based on experience/prior knowledge. • Ability to interpret and clarify communication.

Core Function: Project Management

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
11. Secure needed resources	• The use of the resources is optimized. • Resources are obtained so that tasks and activities occur as planned. • People, equipment, supplies, and services are available when needed. • The need for substitutions is identified and arranged.	• Ability to request resources, both written and oral. • Knowledge of company operating procedures regarding resource availability. • Knowledge of industry standards and constraints.	• Ability to integrate systems technology resources. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to create detailed supporting documents.
12. Manage the change control process	• Necessary changes are identified and evaluated. • Appropriate information is gathered from other parts of the system. • The impact of the change is factored into project schedule and budget. • Appropriate parties are notified of the impact of the changes. • Changes are contemplated and approved in a timely manner. • Required changes are clearly documented and implemented.	• Ability to evaluate impact of changes on project plan. • Knowledge of the standard operating procedures regarding project changes. • Knowledge of potential impact on whole system.	• Ability to examine changes for relevancy and appropriateness. • Ability to actively participate based on experience/prior knowledge. • Ability to interpret and clarify communication. • Ability to adapt to changes.
13. Evaluate and Report project status	• Project outcomes are evaluated against goals. • Complete project phase results are documented and clearly communicated. • Lessons learned are clearly documented and communicated. • Performance metrics associated with the process are captured and documented. • Significant problems are reported immediately. • The style and format of the project status document conforms to company requirements.	• Ability to evaluate project status and outcomes non-defensively. • Knowledge of the standard operating procedures regarding project reviews. • Knowledge of the potential impact on whole system.	• Ability to accept responsibility for own outcomes. • Ability to actively participate based on experience/prior knowledge. • Ability to interpret and clarify communication. • Ability to present information in a clear, concise and objective manner.

Core Function: Problem Solving/Troubleshooting

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
1. Define scope of work to achieve individual and group goals	• The task's contribution to overall business needs is explicit. • The size and the specifics of the task are identified accurately. • Criteria for successful completion of the task are identified. • Multiple tasks are planned simultaneously. • Potential problems are identified, contingency plans developed.	• Ability to visualize project scope requirements at the task level. • Knowledge of applicable standards, regulations, and laws. • Ability to clarify group and individual goals.	• Ability to analyze situation and formulate a task sequence. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to visually analyze relationship between parts/whole and integrate processes.
2. Develop time and activity plan to achieve objectives	• Plan is developed and coordinated with team, cross-functional groups, or individuals. • Tasks are prioritized according to business needs, urgency and importance. • Realistic contingency plan is developed.	• Ability to visualize project time and activity requirements at the task level. • Ability to use appropriate time and resource management methods. • Knowledge of system procedures and constraints. •	• Ability to analyze situation and formulate a task strategy. • Ability to visually analyze relationship between parts/whole and integrate processes. • Ability to devise and implement plans of action.
3. Design and develop work processes and procedures	• Work processes or procedures reflect customer needs and cost specifications. • Work processes or procedures are developed on time. • Work processes or procedures are documented clearly and concisely. • Work processes or procedures reflect potential risks and dependencies.	• Ability to design and develop work flows. • Ability to identify impacts on work processes. • Ability to see the "whole picture.". • Knowledge of standard company work processes and procedures.	• Ability to analyze situation and create work plan. • Ability to predict outcomes/result based on experience/prior knowledge. • Ability to analyze work assignments. • Ability to document work processes.

Core Function: Problem Solving/Troubleshooting

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
4. Identify and obtain tools and resources to do the job.	• Necessary supplies and tools are available when needed. • Budget guidelines for tools and resources are followed. • Documentation for use and maintenance of hardware and software is secured, current and accessible. • Material request procedures are followed.	• Ability to forecast tools and resources needed. • Ability to access needed tools and resources. • Knowledge of material request procedures. • Ability to analyze cost and benefit of various tools and resources.	• Ability to analyze situation and create a list of required tools and resources. • Ability to predict outcomes/results based on experience/prior knowledge. • Ability to coordinate acquisition, storage and distribution of software and hardware**.**
5. Coordinate and implement work processes and procedures	• All affected parties are informed and updated. • Implementation is in accordance with all relevant policies and procedures. • Implementation conforms to business decision process. • Implementation is completed within established time frame. • Technical issues are resolved in a timely and efficient manner.	• Ability to coordinate with others to meet deadlines. • Knowledge of task-related work processes and procedures. • Knowledge of the business decision process.	• Ability to stay focused on desired outcomes. • Ability to actively participate in team tasks. • Ability to implement process plan. • Ability to resolve and negotiate issues with others.
6. Monitor, analyze, and evaluate work processes and procedures	• Appropriate monitoring and evaluation systems are utilized. • Processes and procedures are reviewed by appropriate customer and manager. • Recommendations for improvements in process and procedures are made to customer and management on a continuous basis.	• Ability to use standard monitoring and evaluation systems. • Ability to schedule process reviews following standard company practices.	• Ability to determine quality and quantity of workload. • Ability to continually improve processes. • Ability to assess individual development and improvement needs. • Ability to monitor efficient and effective utilization of materials and tools.

Core Function: Task Management

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
7. Generate and maintain task status report	• Documentation/information is accurate, clear, and concise. • Document/information is available on time. • The style and format of the documentation conforms to customer and management requirements. • Information/documents are stored in a timely manner. • Storage systems are easily accessible.	• Ability to evaluate task outcomes non-defensively. • Knowledge of documentation requirements of customer and management. • Knowledge of document storage and retrieval tools.	• Ability to accept responsibility for own outcomes. • Ability to make process improvements based on report outcomes. • Ability to evaluate relevance of data needed in report. • Ability to create concise report.

Information developed by the NorthWest Center for Emerging Technologies.
Project funded by the Washington State Board for Community and Technical Colleges, and the National Science Foundation.

Core Function: Problem Solving/Troubleshooting

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
1. Define the problem	• The problem is defined with facts and data. • Human and system resources are used effectively to determine the problem. • The problem definition defines a clear gap in expectations. • Symptoms and background of the problem are accurately identified. • Problem definition is clearly and concisely documented.	• Knowledge of system norms and operations. • Knowledge of problem isolation tools and procedures. • Ability to document abnormal events in detail.	• Ability to summarize/generalize information. • Ability to understand system discrepancies. • Ability to examine information/data for relevance and accuracy. • Ability to distinguish between problem symptoms and problem causes. • Ability to clarify and frame problems.
2. Perform appropriate analysis to identify problem cause	• Appropriate analysis technique is determined. • Analysis is complete and documented. • Cause(s) of the problem and ramifications are identified and documented. • Scope of impacts are identified and documented.	• Ability to create and test a theory. • Ability to perform causal analysis. • Ability to identify the impact of the problem on the whole system. • Ability to decompose the problem.	• Ability to think creatively while analyzing problem. • Ability to apply appropriate principles/laws/theories to situation. • Ability to analyze information and identify interdependencies.
3. Identify/test possible solutions	• Solutions reflect concern for cost, schedule, and long-term implications. • Measurement criteria for evaluating solutions are established. • Tests are in compliance with legal requirements, company policy, operating procedure and customer specifications. • The appropriate solution is clearly identified/ documented. • The appropriate action is determined (escalate, fix, or resolve).	• Ability to develop experiments to test a theory. • Ability to develop and test alternative solutions (fix the fix). • Knowledge of company operating procedures regarding testing procedures.	• Ability to apply reasoning skills to identifying potential solutions. • Ability to generate/evaluate solutions with others. • Ability to analyze information and identify implications. • Ability to assess the feasibility and relevance of a solution.

Core Function: Problem Solving/Troubleshooting

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
4. Develop resolution plan	• Resolution plan is developed, documented and accepted by all impacted parties. • Resolution plan is designed for minimal impact of process flow and productivity. • Resolution plan includes appropriate input from customer, key individuals, departments, and outside providers. • Contingency plans are developed and made available in a timely manner. • Internal and external obstacles are identified and potential resolutions are identified and documented.	• Ability to facilitate solution selection. • Ability to organize and manage complex processes. • Knowledge of the impact of solutions on whole system. • Knowledge of appropriate involvement levels and interfaces.	• Ability to gather data, analyze, and reach decisions and agreements. • Ability to resolve technical issues. • Ability to propose options/solutions based on research. • Ability to generate unique solutions.
5. Implement solution	• Resolution plan is implemented in an efficient and timely manner. • Any changes to the plan are communicated promptly to key individuals. • Appropriate change requests are completed according to company requirements. • Solution to the problem including operational adjustments is documented and communicated to appropriate individuals and groups. • Problem solution is written into knowledge base and/or communicated appropriately.	• Ability to assess resolution plan on a continuous basis. • Knowledge of company change management procedures. • Ability to deal with implementation obstacles.	• Ability to organize new processes/procedures. • Ability to predict outcome/result based on experience/prior knowledge. • Ability to implement plan of action. • Ability to write and edit technical documents. • Ability to communicate with a variety of audiences.
6. Evaluate problem solving processes and outcomes	• Evaluation determines whether the outcomes solved the problem in accord with what was intended (and did not cause any unintended or unexpected results). • Evaluation determines whether the process was used efficiently and responsibly. • The validity and usefulness of the outcomes is assessed by appropriate individuals and groups. Appropriate follow-up action is determined.	• Ability to evaluate technical solutions. • Knowledge of company procedures for follow-up actions. • Knowledge of appropriate continuous improvement strategies.	• Ability to summarize/generalize information. • Ability to compare multiple viewpoints. • Ability to analyze group/individual response. • Ability to pose critical questions. • Ability to evaluate problem solving processes and suggest continuous improvement.

Information developed by the NorthWest Center for Emerging Technologies.
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Guidebook Volume I

SKILL STANDARDS

Section III

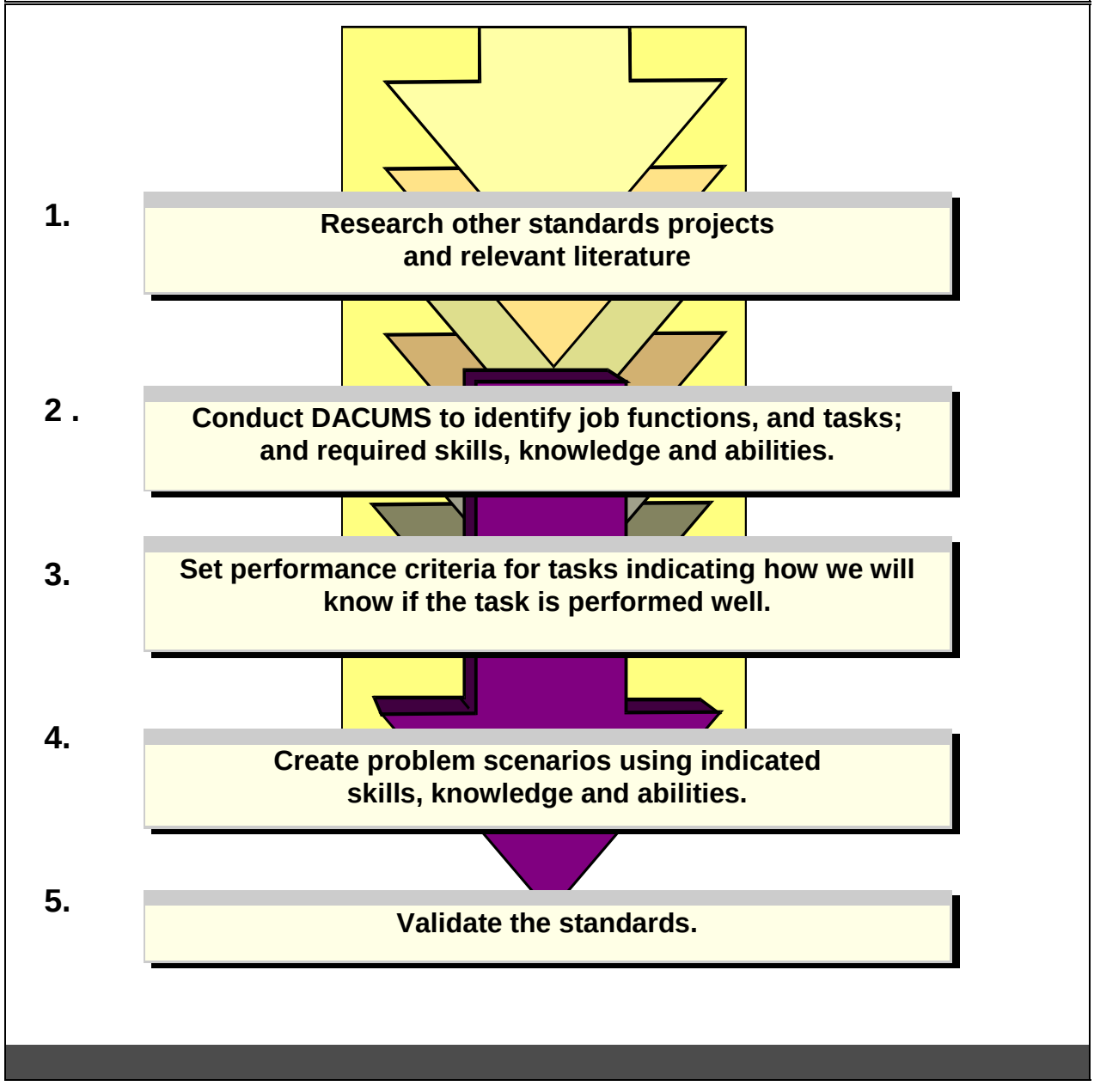
How Are Skill Standards Developed?

How Are Skill Standards Developed?

—Developing Skill Standards: A Recommended Process

Flow Chart

Process for Building Skill Standards



—Skill Standards Framework

Each of the skill standards in Washington State consist of a generalized job cluster identifying major job functions, tasks, and relevant performance criteria, the technical and foundational knowledge skills, and abilities needed to perform the task well and contextual scenarios which demonstrate use of the functions and tasks.

After identifying 5-8 major job functions or duties (key parts of a job) clearn, specific, high level, tasks are identified. One test of a good **task statement** is Can you video-tape the person performing the task, can you see what the person is actually doing when you read the statement? **Task statements** take the following form:

1. Implied subject *(a person in this job)*.
2. Singular verb *(For example action verbs might include: construct, initiate, coordinate, test, check, develop, evaluate, conduct, respond, document).*
3. Any modifiers needed for clarity, such as:
    - Gather information to identify customer's requirements.
    - Define scope of work to meet customer's requirements.
    - Approach customer to get money on past due account.
    - Check for bubbles in paint under microscope.
    - Perform analysis to identify problem cause.
    - Maintain financial records, such as daily cash reports, weekly sales, monthly statements.
    - Instruct others on product usage, procedures and/or standard operating practices.
    - Prepare site for installation and testing of switching and transmission equipment.

Performance criteria identifies how we know that the task is performed well. it is the standard of performance indicating the necessary outcomes of workplace tasks. Each criterion should begin with the outcome and be followed by the qualifiers of that outcome. The following questions are helpful when defining performance criteria:

1. What are the key desired outcomes of this task?
2. What are the key qualifiers or qualities of those outcomes?
3. What aspects of work organization, safety, procedures, etc. are critical to competent performance?

Typical qualifiers include:

accurately, concisely, clearly, correctly, timely, completely, appropriately, effectively, reliably, safely, promptly, confidentially, politely, patiently, ethically, respectfully, in accordance with company procedures, within required tolerances.

Examples of performance criteria include:

- The constraints are accurately and completely identified.
- User accounts are set up following standard operating procedures.
- Criteria for satisfying customers' needs are clearly and concisely identified.
- The problem identified clearly defines a gap in expectations.
- Solutions reflect concern for cost, schedule, and long-term implications.
- Documentation is completed accurately, at the specified time and forwarded in an approved manner.
- Tools and work aids are positioned, used and repositioned to achieve maximum efficiency.
- Monthly statements are accurately prepared within one month of closing.

Knowledge, Skills and Abilities are defined as follows:

1. **Knowledge** is a specific set of information that may be gained from particular academic disciplines, from organizational procedure manuals, or from experience. (Examples: Knowledge of principles of programming, knowledge of company operating procedure, knowledge of computer terminology, knowledge of child development stages.)

2. **Skills** suggest proficiency in an applied activity, often in a physical activity, but possibly in a mental or interpersonal sense. (For example, time management skills, skill in the use of word processing, speaking, giving presentations.)

3. **Abilities** are broad human characteristics that result either from native talent or from a variety of experiences over time. An ability underlies the successful performance of a large number of tasks. (Examples: analytical ability, ability to persuade, mechanical aptitude, writing ability.)

The task of scheduling airline reservations and hotel accommodations would suggest perhaps, a knowledge of travel agency, airline, and hotel references and procedures; a skill in probing for information; and abilities in the areas of communications, analysis, and planning.

Knowledge, Skills and Abilities together are called **competencies** in our framework.

—Definitions

***Academic Content Standards*:** Benchmarks for expected student outcomes pegged high enough to ensure the ultimate goal of a well-prepared and highly-skilled workforce.

Academic Skills: The underlying knowledge and skills represented in the core subjects of the educational curriculum. Examples include language, mathematics, and science.

Assessment: A process for measuring performance against a set of standards through examinations, practical tests, observed performances or projects.

Certification: The awarding of a certificate or recognition to an individual, indicating the successful performance of a set of critical work functions and an underlying set of academic, employability, and occupational knowledge and skills for an industry/occupational area or a specific occupational or industry-related specialization.

***Competencies*:** Competencies are descriptions of specific abilities required in the workplace to ensure workers' success. These abilities may take the form of knowledge, skill, attitude, judgment, or task.

Competency-based Instruction: A method of instruction whereby—

- Skill and knowledge standards essential for employment and further education are determined by task analysis and validated by business, labor and other technical experts.
- Learning objectives, derived from validated performance tasks, are criteria-based and measurable.
- Teachers facilitate learning using flexible methods and times which entitle each student to master specific skills and knowledge.
- Student success is based on the ability to demonstrate specific skills and knowledge.

***Critical Work Functions*:** Distinct economically meaningful sets of work activities which are: (1) critical to a work process or business unit; (2) are performed to achieve given work objectives; and (3) have definable performance criteria.

DACUM Charts: A DACUM chart is used in curriculum development, worker training programs, and needs assessment for identifying job task processes; usually involves 8-15 workers and supervisors generating the information with a trained facilitator.

Duty: A duty consists of the major sub-divisions of a job which are similar in nature and are composed of two or more related tasks in each area. Two or more duties make up a job.

Employability Skills: Generic skills that are related to the performance of critical work functions across a wide variety of industries and occupations. Examples include problem-solving, teamwork, and leadership.

Industry/Occupational Clusters: For any economic sector, a group of industries and/or occupations that reflect the way work is organized now and in the future.

Job: A job is a grouping of related parts of work into broad function areas or general areas of responsibilities. There may be one person or many people at the employment site doing the same job. A single duty/task analysis usually covers a complete job.

Job Analysis: The job analysis is the process of using job descriptions, Dictionary of Occupational Titles, or subject-matter experts to develop a list of job tasks to be validated by industry experts.

Performance Criteria: Specific behavioral evidence of workers' job achievements, knowledge and tasks. Answers the question "How do we know this task or work function is performed well?" The criteria are public and explicit.

Performance Objective: A statement in measurable terms of what the learner must do to master a task or outcome. It consists of three parts: (1) the conditions under which the task or outcome will be performed for evaluation; (2) a description of the task or outcome; and (3) the standard or criterion which states how well the task or outcome must be performed to meet job expectations.

SCANS Skills: Basic academic and behavioral skills identified by the Secretary of Labor's Commission on Achieving Necessary Skills that are needed to build more advanced competencies.

Foundation skills fall into three domains—

- Basic skills - reading, writing, speaking, listening, knowing arithmetic and mathematical concepts.
- Thinking skills - reasoning, making decisions, thinking creatively, solving problems, seeing things in the mind's eye, and knowing how to learn.
- Personal qualities - responsibility, self-esteem, sociability, self-management, integrity, and honesty.

Competencies—

- Resources - management of time, budget, materials and human resources.
- Information - acquiring, organizing, interpreting and distributing information; and the use of information technology.
- Interpersonal skills - participation, helping others learn, serving customers, exhibiting leadership, negotiating, and valuing diversity.
- Systems - understanding the organizational system, monitoring and correcting system performance, and improving system performance.
- Technology - selecting appropriate technology, applying technology and maintaining technology.

Skill Standards: Employer-defined knowledge and skills that are needed by employees to ensure success on the job. Standards are defined by occupational areas and validated by representatives from the occupation. Standards include the functions, tasks, and performance criteria for a job area; and identify the knowledge, skills and abilities needed to meet performance expectations.

Task: A task is made up of measurable and observable work activities which end in a product, service, or decision. It has a definite beginning and end. Each task is composed of a series of logically arranged and necessary work activities. Two or more like tasks make up a duty area.

***Task Analysis*:** The task analysis is the process of identifying measurable and observable work activities which end in a product, service, or decision and utilizing an advisory committee or panel of subject-matter experts to validate the tasks.

Technical or Occupational Knowledge and Skills: The underlying knowledge and skills required to perform the work functions within an occupation.

Voluntary Partnerships: Collaborative efforts among business, labor, education, training, and community-based organizations to establish and maintain skill standards and certification systems for an economic sector. These voluntary partnerships may seek and receive recognition from the National Skill Standards Board for their qualifications and endorsement systems.

—Acronyms

ABE	Adult Basic Education
AEA	American Electronics Association
CBE	Competency Based Education
CIM	Certificate of Mastery
CQI	Continuous Quality Improvement
DACUM	Developing a Curriculum
DOE	Department of Education
DOL	Department of Labor
ESL	English as a Second Language
ETAG	Electronic Technology Advisory Group
ETTF	Employment & Training Trust Fund
FJA	Functional Job Analysis
JSP	Job Skills Program
JTPA	Job Training Partnership Act
MTAG	Manufacturing Technology Advisory Group
NSSB	National Skill Standards Board
NWCET	NorthWest Center for Emerging Technologies
OAL	Office of Adult Literacy
PIC	Private Industry Council
PMCI	Performance Management for Continuous Improvement
RATEC	Regional Advance Technology Education Consortium
SBCTC	(Washington) State Board for Community and Technical Colleges
SME	Subject Matter Expert
WTECB	Workforce Training and Education Coordinating Board

—Templates

The following templates are useful when recording and presenting skill standard information. There are three templates:

- **Template A** can be used to record the results of the DACUM process. It displays, in a matrix form, the functions and tasks for a specific job;
- **Template B** can be used as a worksheet to develop "Performance Criteria", "Technical Knowledge, Skills, Abilities, Tools" and "SCANS Skills and Personal Qualities (foundational abilities)" for each task;
- **Template C** is a tool to summarize the complete skill standards for each job function.

All three templates are available on a diskette (included with this book).

Occupation Cluster: *Job description* *Date of the DACUM*

JOB FUNCTIONS	***Tasks***									
Function A	*Definition of task A1 - Function A*	*Definition of task A2 - Function A*	*Definition of task A3 - Function A*	*Definition of task A4 - Function A*	*Definition of task A5 - Function A*	*Definition of task A6 - Function A*	*Definition of task A7 - Function A*	*Definition of task A8 - Function A*	*Definition of task A9 - Function A*	*Definition of task A10 - Function A*
Function B	*Definition of task B1 - Function B*	*Definition of task B2 - Function B*	*Definition of task B3 - Function B*	*Definition of task B4 - Function B*	*Definition of task B5 - Function B*	*Definition of task B6 - Function B*	*Definition of task B7 - Function B*	*Definition of task B8 - Function B*	*Definition of task B9 - Function B*	*Definition of task B10 - Function B*
Function C	*Definition of task C1 - Function C*	*Definition of task C2 - Function C*	*Definition of task C3 - Function C*	*Definition of task C4 - Function C*	*Definition of task C5 - Function C*	*Definition of task C6 - Function C*	*Definition of task C7 - Function C*	*Definition of task C8 - Function C*	*Definition of task C9 - Function C*	*Definition of task C10 - Function C*
Function D	*Definition of task D1 - Function D*	*Definition of task D2 - Function D*	*Definition of task D3 - Function D*	*Definition of task D4 - Function D*	*Definition of task D5 - Function D*	*Definition of task D6 - Function D*	*Definition of task D7 - Function D*	*Definition of task D8 - Function D*	*Definition of task D9 - Function D*	*Definition of task D10 - Function D*
Function E	*Definition of task E1 - Function E*	*Definition of task E2 - Function E*	*Definition of task E3 - Function E*	*Definition of task E4 - Function E*	*Definition of task E5 - Function E*	*Definition of task E6 - Function E*	*Definition of task E7 - Function E*	*Definition of task E8 - Function E*	*Definition of task E9 - Function E*	*Definition of task E10 - Function E*
Function F	*Definition of task F1 - Function F*	*Definition of task F2 - Function F*	*Definition of task F3 - Function F*	*Definition of task F4 - Function F*	*Definition of task F5 - Function F*	*Definition of task F6 - Function F*	*Definition of task F7 - Function F*	*Definition of task F8 - Function F*	*Definition of task F9 - Function F*	*Definition of task F10 - Function F*

Occupation Cluster:
Function or Job Duty: Function A

TASK	***Performance Criteria*** How do we know when the task is performed well?	***Technical Knowledge*** Skills, Abilities, Tools	***SCANS Skills and Personal Qualities*** Foundational Abilities
Task A1	• • • • •	• • • • •	• • • • •
Task A2	• • • • •	• • • • •	• • • • •
Task A3	• • • • •	• • • • •	• • • • •
Task A4	• • • • •	• • • • •	• • • • •
Task A5	• • • • •	• • • • •	• • • • •

Developing Skill Standards

Occupation Cluster:
Function or Job Duty:

Task: 1.

Performance Criteria: (How do we know when the task is performed well?)

-
-
-
-
-
-

Technical Knowledge, Skills, Abilities, Tools:

-
-
-
-
-
-
-

SCANS Skills and Personal Qualities (Foundational Abilities):

-
-
-
-
-

Guidebook Volume I

SKILL STANDARDS

Section IV

How Do We Gather Data through DACUM Analysis?

How Do We Gather Data through DACUM Analysis?

The DACUM (Developing a Curriculum) process was refined at the Ohio State University Center on Education and training for Employment under the direction of Dr. Robert Norton. DACUM charts are used in curriculum development, worker training programs, test development, and needs assessment. The DACUM process involves role incumbents and supervisors in small group interview sessions where they work together to identify job tasks processes and order those tasks and processes temporally.

DACUM sessions usually involve 8-15 workers and supervisors who work for half a day to several days with a trained facilitator to generate the information. First, broad duties or functions are identified, then listed on sheets of paper or cards on a board. The facilitator asks the group first to arrange the duties according to process sequence or importance level and then identify the tasks performed by the job occupant for each broad functional category. These tasks are in turn analyzed for requisite knowledge and skills and then collapsed into main tasks and rated on a scale for frequency and for importance.

The result is a listing of tasks and activities for any particular job, as developed by job incumbents and supervisors that can be used for developing training materials that are highly task specific.

DACUM functions somewhat like an abbreviated version of a functional job analysis (FJA). The process requires a facilitator and 8-15 job incumbents who are willing to contribute a day or two of their time. Further, the facilitator must be familiar with the technique and trained in group process management.

According to Dr. Norton, DACUM operates on three basic assumptions:

1. **Expert workers can describe and define their job more accurately than anyone else.**

2. **An effective way to describe a job is to define the tasks expert workers perform.**

3. **All tasks demand certain knowledge, skills, tools, and attitudes in order to be performed correctly.**

—DACUM Process Steps

Procedurally, DACUM follows a sequential order as follows:

1. Orient the panel members

2. Review the occupation
- a. Conduct brainstorming
- b. Review the organization chart
- c. Compose one-sentence job descriptions

3. Identify general areas of responsibility (duties or functions)

4. Identify specific tasks performed

5. Refine/review functions and task statements

6. Arrange the functions and task statements according to process sequence or importance level

7. Identify performance criteria—(How do we know when each task is performed well?**)**

8. List requirements—
- a. General knowledge and skills and abilities required to successfully complete the tasks
- b. Desirable worker behavior attitudes and traits
- c. Tools, equipment, supplies, and materials

—Operational Guidelines for DACUM Process

1. Everyone participates equally
2. Share ideas freely
3. Hitch-hike on each other's ideas
4. Avoid judgment and criticism
5. All task statements are carefully considered
6. All task statements must begin with an action verb and reflect an observable performance

—Sample Action Verbs

- **Knowledge—**define, describe, identify, label, list, match, name, outline, recognize, reproduce, select, state

- **Comprehension—**convert, defend, distinguish, estimate, explain, extend, generalize, give example, infer, interpret, paraphrase, predict, rewrite, summarize

- **Application—**adapt, apply, change, compute, demonstrate, discover, implement, manipulate, modify, operate, plan, predict

- **Analysis—**break down, diagram, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, point out, relate, select, separate, subdivide, troubleshoot

- **Synthesis—**categorize, combine, compile, compose, create, devise, design, explain, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize, tell, write

- **Evaluation—**appraise, compare, conclude, contrast, critique, describe, discriminate, explain, justify, interpret, relate, summarize, support, validate

—Skills and Abilities of An Effective DACUM Facilitator

- Ability to display warmth and establish rapport quickly with participants.
- Ability to establish and maintain enthusiasm.
- Ability to be sensitive to others.
- Ability to relate to different occupational groups.
- Ability to mediate and gain compromises from the participants when necessary.
- Skill in clarifying participants' contributions to ensure that they are fully articulated and understood.
- Ability to synthesize and organize information and ideas.
- Ability to communicate with individuals and groups.
- Ability to manage group process.
- Ability to employ listening and memory skills to store and reintroduce various panel members' contributions.
- Ability to retain the role of the process expert while according the role of content experts to the participants.
- A professional image and style as well as the ability to utilize humor may also prove helpful.

—DACUM Research Chart Banks

A large collection of DACUM research charts covering a wide range of occupations has been collected and catalogued. These charts represent applied curriculum research of the highest quality.

This service is offered to assist curriculum developers and others who wish to develop either a competency-based education or performance-based training program, but for whatever reason, cannot immediately conduct a local DACUM workshop on their own. High-quality DACUM charts imported from elsewhere can provide valuable start-up information and/or serve as a basis for conducting a modified DACUM workshop. However, it is highly recommended that any chart purchased from CETE or elsewhere be locally verified (validated) via a mailed task verification process or appropriate advisory committee review.

A listing of the over 300 available DACUM charts is available from CETE. Individual charts can be ordered at $10 per copy (U.S. funds). For 13 or more charts, the price is $8 per copy. In addition, a 10% handling charge (minimum of $3.50) will be applied. Upon special request, we will also fax charts at $5.00 per chart additional charge.

For information about DACUM occupational analysis workshops, DACUM Facilitator Training Institutes, and/or Systematic Curriculum and Instructional Development (SCID) Workshops, write, call, or fax Bob Norton at 800-848-4815, Ext. 4-7667 or Debbie Weaver, Ext. 4-7682.

DACUM Research Chart Bank
ATTN: Robert E. Norton
Center on Education and Training for Employment
The Ohio State University
1900 Kenny Road, Columbus, OH 43210-1090
FAX: 614-292-1260
Phone: 800-848-4815 or 614-292-4353, Ext. 4-7667

A databank of nearly 1100 charts has been collected and catalogued during the past 15 years. They cover a wide range of occupational and skill related areas from Avionics Technician to Youth Worker.

Institutions and Agencies involved in producing DACUM Charts were invited, over the years, to contribute charts to the bank and in turn have been able to draw from it for their own purposes.

All interested individuals and organizations are herewith invited to draw from the current paper-based bank for a nominal fee. This is a non-profit, voluntary service offered on a professional, exchange, and resource basis by Humber College of Applied Arts and Technology.

List of Available Charts: **Can be ordered at $8.00 (CAN) per copy**
Individual Charts: **Can be ordered at $5.00 (CAN) per copy**

From: T**he DACUM Chart Exchange**
Humber College
Research and Development Department
205 Humber College Boulevard
Toronto, Ontario CANADA
M9W 5L7 Phone: (416) 675-5061 — Fax: (416) 675-6681

Institutions, Ministries, Agencies, and Private Sector Organizations are encouraged to add to the Database of "The Exchange" by sending a single copy of any DACUM Chart or Similar Curriculum Format to the above address.

Guidebook Volume I

SKILL STANDARDS

Section V

What Are SCANS Skills and How Do They Integrate Into Skill Standards?

What Are SCANS Skills and How Do They Integrate into Skill Standards?

—SCANS Skills

THE FOUNDATION — Competence requires:	
Basic skills	reading and writing, arithmetic and mathematics, listening and speaking
Thinking Skills	critical thinking, decision making, problem solving, visualization, ability to learn, and reasoning
Personal Qualities	responsibility, self-esteem, sociability, self-management, integrity and honesty, and flexibility

COMPETENCIES — Effective workers can productively use:	
Resources	management of time management of budget, management of materials, and management of human resources
Information	acquiring information, organizing information, interpreting information, distributing information, and the use of information technology
Interpersonal Skills	participation, helping others learn, serving customers, exhibiting leadership, negotiating, and valuing diversity
Systems	understanding the organizational system, monitoring and correcting system performance, and improving system performance
Technology	selecting appropriate technology, applying technology, and maintaining technology

Source: Secretary's Commission on Achieving Necessary Skills, 1991.

—Integrating SCANS Skills

The SCANS Skills include the academic and foundational skills necessary to perform a wide range of occupations. For each skill, five levels of complexity or proficiency were identified. Each job or position can be profiled by selecting the appropriate level of proficiency needed for successful performance. Additionally, the required proficiency level can be identified for each function or task using the scale.

The following charts contain text from the ADVANCE SCANSkill™ Profiling instrument, used with permission from ADVANCE Educational Spectrums, Inc.

The Washington State Board for Community and Technical Colleges purchased a license to use the Advance Profiler instrument. This survey instrument is used to determine the level of SCANS skills necessary to perform a specific job. If you would like to use this instrument for developing skill standards, please contact RoseAnn Stevenson at 206-865-7155 for utilization requirements.

Workplace Competencies Scale

BASIC SKILLS

Reading

- Selects appropriate information
- Identifies basic concepts

- Identifies relevant details, facts, specifications
- Follows set of instructions

- Probes to gain knowledge/information
- Qualifies/analyzes information
- Interprets and summarizes information

- Researches to gain knowledge/ information
- Proposes options/solutions based on research
- Synthesizes information

- Critiques publications
- Evaluates documents/proposals
- Validates content

Writing

- Records information accurately
- Completes forms/surveys/etc.

- Prepares messages
- Writes simple documents

- Summarizes/paraphrases information
- Composes/edits correspondence
- Creates original documents

- Synthesizes information
- Creates detailed supporting documents

- Evaluates consistency of written material
- Justifies writing

Arithmetic

- Performs basic computations
- Records numerical data

- Obtains data
- Performs measurements
- Interprets numerical data

- Converts numerical data
- Predicts arithmetic results

- Organizes numerical data
- Sets numeric parameters

- Forecasts quantitative results
- Adjusts/modifies numeric parameters
- Analyzes/assesses/evaluates numerical data

Mathematics

- Utilizes mathematical techniques/formulas/processes
- Records results

- Summarizes mathematical data
- Translates mathematical data

- Manipulates techniques/formulas/processes
- Interprets mathematical data

- Organizes mathematical data
- Determines/variables/constants

- Creates new mathematical applications
- Forecasts mathematical outcomes/events
- Evaluates mathematical data/applications

Listening

- Listens attentively
- Aware of nonverbal communication

- Responds to verbal/nonverbal communication
- Confirms information

- Interprets communication
- Clarifies communication
- Influences communication

- Compares multiple viewpoints
- Relates intent to desired results
- Analyzes communication

- Qualifies information
- Values differences of opinion
- Validates freedom of speech

Speaking

- Communicates appropriate verbal/nonverbal messages
- Addresses audience/purpose

- Presents basic ideas/information
- Explains concepts
- Actively participates in discussion

- Presents complex ideas/information
- Analyzes group/individual response
- Poses critical questions

- Composes/presents well organized speech
- Debates issues
- Speaks extemporaneously

- Critiques speeches/presentations
- Evaluates information accuracy

THINKING

Creative Thinking

- Makes connections between old and new
- Recognizes patterns/relationships

- Paraphrases/summarizes/generalizes existing ideas
- Demonstrates creative thinking process while problem solving
- Utilizes brainstorming techniques

- Develops creative solutions
- Applies creative solutions to new situations

- Generates unique solutions
- Formulates new ideas/plans/approaches
- Organizes new processes/procedures

- Judges/validates creativity
- Actively pursues creative expression

Decision Making

- Understands decision making process
- Recalls basic rules/principles
- Identifies goals and constraints

- Applies rules/principles to situation
- Gathers information

- Analyzes situation/information
- Considers risks/implications
- Compiles multiple viewpoints
-

- Generates alternative solutions
- Evaluates alternative solutions
- Formulates plan of action
- Predicts outcome/result based on experience/prior knowledge

- Judges consistency/precedence
- Justifies purpose/result
- Sets decision making parameters
-

Problem Solving

- Identifies the problem

- Understands the complaint/ discrepancy
- Appropriately refers complaint/ discrepancy

- Examines information/data
- Analyzes possible causes/reasons
- Recommends action plan

- Generates/evaluates solutions
- Devises/implements plan of action

- Evaluates/adjusts plan of action
- Judges effectiveness/efficiency of solution

Visualization

- Recognizes patterns/relationships
- Translates blueprints/drawings/diagrams

- Applies appropriate principles/laws/theories to situations
- Utilizes previous training/experience to predict outcomes
- Uses imagination to visualize events/activities

- Visually analyzes relationship between parts/whole, process/procedure
- Interprets charts/graphs/symbols pictures

- Generates operation plan/building plan
- Creates comprehensive model/situation
- Mentally pictures familiar activities/outcomes

- Visualizes new concept/design/ project/activity
- Evaluates concept/design/ project/activity

Knows / Learns

- Understands learning process
- Recalls basic rules/principles
- Draws upon experiences and prior knowledge
- Identifies own learning style

- Selects/applies learning tools
- Interprets and applies new knowledge and experience
- Interprets symbols, diagrams and schematics

- Analyzes application of learning tools
- Investigates new learning techniques
- Manipulates learning tools

- Formulates/adapts learning strategy
- Synthesizes multiple learning techniques

- Develops/evaluates new learning tools/techniques
- Validates learning process

Reasoning

- Identifies facts and principles
- Identifies the problem

- Applies rules/principles to process/ procedure
- Extracts information/data
- Uses logic to draw conclusions

- Analyzes logic/rule/principle
- Examine information/data for relevance and accuracy

- Creates/develops new rules/ principles
- Adapts rules/principles to new applications

- Validates rules/principle
- Judges logical consistency

PERSONAL QUALITIES

Responsibility

- Attends regularly
- Demonstrates punctuality
- Performs assigned tasks
-

- Follows rules/policies/procedures
- Employs level of concentration
- Volunteers for special assignments

- Works with minimal supervision
- Pays attention to details
- Demonstrates enthusiasm/ optimism/initiative

- Monitors performance standards
- Follows up on assigned tasks

- Exhibits commitment to organization
- Exerts effort and perseverance
- Ensures work quality

Self-Worth

- Maintains positive self-image
- Identifies own skills/abilities
- Recognizes own emotional capacity

- Responds assertively
- Defends own beliefs/viewpoints

- Values own individuality
- Accepts constructive criticism

- Accepts responsibility for own behavior
- Understands own impact on others

- Demonstrates self confidence, self reliance, and self discipline
- Actively seeks self improvement opportunities

Sociability

- Responds appropriately to others

- Willingly helps others
- Takes active interest in others
- Establishes rapport with co-workers and customers

- Modifies behavior to environment
- Shows understanding/empathy for others
- Demonstrates commitment to social improvement

- Works to identify/remove social barriers
- Encourages cooperation/negotiation

- Demonstrates social awareness/ responsibility
- Values differences of opinion/freedom of speech

Self-Management

- Identifies own strengths/limitations
- Identifies need for self improvement

- Maintains self-control
- Accepts responsibility for own behavior
- Accepts constructive criticism

- Sets well defined/realistic goals
- Demonstrates commitment to self improvement
- Applies self management skills
- Analyzes and adjusts goals

- Appropriately modifies goals
- Aggressively pursues goal attainment

- Evaluates self continuously
- Actively seeks self improvement opportunities

Integrity / Honesty

- Recognizes ethical issues
- Identifies personal societal values

- Demonstrates honesty
- Demonstrates trustworthiness
- Accepts responsibility for own behavior

- Demonstrates commitment to personal/social improvement
- Analyzes personal/societal implications of decisions
- Recommends ethical course of action

- Responsibly challenges unethical practices/decisions
- Formulates ethical course of action

- Justifies ethical decision/course of action
- Demonstrates social awareness/ responsibility

RESOURCES

Management of Time

- Starts on time
- Follows schedule

- Performs given set of tasks
- Efficiently manages time
- Adjusts schedule as required by supervisor

- Prioritizes daily tasks
- Prepares schedule
- Monitors/adjusts task sequence

- Prepares and organizes multiple schedules
- Manages timelines
- Recommends timeline adjustments

- Evaluates project timeframes
- Modifies project timeframes

Management of Money

- Accurately disburses and receives money

- Reconciles daily receipts and payments
- Performs routine recordkeeping

- Maintains balanced accounts
- Reconciles accounts

- Develops budget proposals
- Monitors multiple accounts
- Recommends budget adjustments
- Forecasts department or project costs

- Evaluates/revises organizational budgets
- Forecasts financial resources and expenditures
- Audits accounts

Management of Materials

- Uses materials in a safe and efficient manner
- Maintains job specific supplies and equipment

- Acquires supplies and equipment
- Distributes supplies and equipment

- Orders and maintains inventory
- Monitors safe and efficient utilization of materials

- Identifies future material needs
- Assesses need/quality/ efficiency/safety
- Coordinates acquisition, storage and distribution

- Estimates and projects facility/ material needs
- Prepares bid requests

Management of Human Resources

- Recognizes job tasks
- Distributes work assignments

- Matches talent to positions
- Analyzes work assignments
- Delegates responsibilities

- Assesses individual knowledge/skills
- Determines workload (quality/quantity)
- Monitors performance

- Proposes hiring/reassignment/staffing adjustments
- Plans expansions/reductions/ reassignments/retrenchments

- Forecasts future workloads
- Plans staff development
- Evaluates performance

INFORMATION

Acquiring Information

- Selects/obtains data/information relevant to the task
- Identifies need for data

- Identifies data/information
- Predicts outcomes

- Analyzes data
- Integrates multiple items of data
- Contrasts conflicting data

- Researches additional information sources
- Creates data gathering processes

- Validates appropriateness of data/information
- Justifies outcomes/results
- Evaluates data accuracy
- Evaluates relevance of data

Organizing Information

- Identifies process
- Selects appropriate categories

- Interprets information
- Applies processes to new information

- Analyzes organization of information
- Transfers information between formats

- Rearranges systems
- Proposes/formulates new processes
- Designs new organizational systems

- Evaluates effectiveness of process
- Appraises information system design
- Justifies distribution methods

Interpreting Information

- Understands information
- Recognizes accuracy of information
- Provides accurate communication

- Interprets information
- Prepares basic summaries
- Prepares basic reports
- Selects methods of communication

- Summarizes/integrates information
- Analyzes information
- Designs charts/graphs

- Organizes technical reports
- Incorporates multiple communication methods
- Formulates proposals
- Composes multimedia presentations

- Assesses needs analysis
- Assesses information accuracy
- Evaluates reports

Use of Information Technology

- Understands computer operation
- Performs basic data entry

- Utilizes integrated/multiple software
- Locates information
- Retrieves stored information/data

- Manipulates information
- Interprets data
- Integrates multiple platforms
- Utilizes networks
- Modifies/edits information

- Organizes information and reports
- Converts information formats
- Composes multimedia presentations
- Analyzes operational problems

- Verifies data accuracy
- Designs programs/networks/graphics
- Evaluates computer utilization
- Judges information accuracy

INTERPERSONAL

Participation

- Identifies with team
- Attends closely to team activities
- Completes tasks

- Obeys team rules
- Actively participates in team activities
- Volunteers for special tasks
- Assists team members

- Demonstrates commitment
- Works to improve team skills
- Encourages/supports team members

- Assumes responsibility for accomplishing team goals
- Understands strengths/limitations
- Resolves conflicts
- Responsibly challenges existing policies

- Motivates team members
- Evaluates team activities

Helping Others Learn

- Recognizes poor performance/attitudes
- Models proper performance/attitudes
- Understands material being taught

- Identifies training needs
- Conducts task specific training
- Coaches others to apply related concepts

- Provides constructive feedback/ reinforcement

- Develops appropriate training procedures
- Encourages learner independence

- Judges training alternatives
- Facilitates learning process
- Encourages development of whole person

Serving Customers

- Recognizes customer needs
- Identifies customer concerns/ complaints

- Responds to customer needs
- Demonstrates sensitivity to customer concerns/interests

- Analyzes customer needs
- Demonstrates commitment to customer
- Relates to customers fears/concerns

- Obtains additional resources to meet customer needs
- Makes exceptional effort on behalf of customer
- Resolves conflict to customer's satisfaction

- Develops extensive personalized customer care
- Evaluates effectiveness of solutions
- Forecasts future customer needs

Exhibiting Leadership

- Understands standards
- Adheres to standards

- Encourages others to adopt new concepts
- Demonstrates commitment to excellence
- Leads by example
- Interprets positions on issues

- Motivates others to extend their capabilities
- Displays enthusiasm/positive attitudes
- Develops minority/majority views

- Persuades others to reverse negative attitudes/behaviors
- Maximizes strengths/minimizes limitations
- Consolidates varied viewpoints/positions

- Empowers individuals/teams to achieve excellence
- Judges leadership styles
- Justifies positions/policies

Negotiating

- Understands negotiations process
- Recalls basic rules/principles
- Identifies conflicts

- Moderates discussion
- Demonstrates composure
- Interprets complaints/concerns

- Analyzes group dynamics
- Distinguishes between facts and inferences
- Detects underlying issues

- Summarizes/paraphrases both sides of issues
- Analyzes underlying issues
- Resolves technical issues

- Appraises negotiated outcomes
- Resolves critical and emotionally charged issues

Working with Diversity

- Recognizes differences/biases
- Understands legal aspects of discrimination

- Demonstrates sensitivity to fears/concerns of diversity
- Respects rights of others
- Demonstrates awareness of diversity

- Recognizes the value of diversity
- Encourages/supports individuality
- Encourages/supports a correct course of action

- Responsibly challenges discriminatory practices/procedures

- Proactively works to identify/remove barriers
- Assesses/modifies policies/procedures
- Judges discriminatory actions

SYSTEMS

Understanding the Organizational System

- Recognizes organizational, social and technological systems
- Understands system principles/ terminology

- Understands system organization/ hierarchy
- Follows processes/procedures
- Responds to system demand

- Analyzes system configuration/stability
- Recognizes system strengths/ limitations

- Evaluates system configuration/stability
- Evaluates process/procedure

- Judges system effectiveness/ efficiency
- Justifies system structure/ organization

Monitoring and Correcting System Performance

- Collects data
- Identifies system discrepancies

- Adjusts system operation
- Monitors system performance
- Troubleshoots system malfunction/ failure

- Analyzes system operation
- Distinguishes trends in performance
- Diagnoses performance deviations

- Evaluates system performance
- Devises plan to monitor/correct system
- Modifies process/procedure

- Verifies system operation
- Judges product/service quality

Improving System Performance

- Understands continuous improvement process
- Identifies needed systemic improvements

- Suggests system modifications/ improvements
- Determines system components to be modified or improved

- Analyzes goals/constraints
- Examines proposed modifications/ improvements

- Develops new/alternative system designs
- Challenges the status quo

- Justifies system modification
- Ensures quality control

TECHNOLOGY

Selecting Appropriate Technology

- Knows available technology
- Identifies appropriate technology

- Understands requirements of the task
- Understands technological results

- Analyzes task/technology relationship
- Proposes simple technological solutions

- Proposes new technology applications
- Integrates systems technology
- Predicts technological results

- Adapts technology for complex alternative uses
- Designs new technology
- Evaluates application of technology

Applying Technology

- Understands technology applications
- Follows proper procedures

- Understands operation/interaction
- Manipulates technology for desired results

- Analyzes technology output
- Examine task/technology relationship

- Integrates systems technology
- Interprets/evaluates data received

- Implements technological improvements/changes
- Generates technological solutions

Maintaining Technology

- Outlines maintenance procedures
- Follows specified maintenance
- Identifies symptoms

- Identifies and corrects malfunctions/ failures
- Troubleshoots failures

- Evaluates performance of technology
- Analyzes failures

- Implements technological improvements/changes
- Generates technological solutions

- Ensures quality control
- Judges technology applications

—Ideas for Integrating SCANS Skills into the Curriculum

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COMPETENCIES

Resources

1. Have students help determine how class time can be used to best advantage.
2. Ask students to estimate the length of time a project or assignment will take, and see how close they come. Ask them how they might estimate differently next time. Why?
3. Have students make schedules/pie charts of how they spend their time. Is the ratio consistent with what they value? Are they using their time to best advantage? Discuss. Can we learn to allocate time differently? Can we work smarter to "make more time?" Discuss why the ability to allocate time is an important work skill.
4. Give students a monthly income figure and ask them to prepare a budget. Ask them what they expect to earn when they begin working. Why did they pick that figure? Why would anyone be willing to pay them that much?
5. Have them see that any budget they make in the future will be a result (function) of their skill level. Show students how to make a function machine. Drop a low skill level in the function machine and see what happens.
6. Have students help allocate materials, space, etc. Is current classroom space being used most efficiently? Has anyone ever questioned this? Are seats arranged to optimize learning?
7. Do a skills/learning styles analysis of class members. Determine how each could make the most effective contribution to the class. Take turns utilizing the skills of different class members. Evaluate each others' performance in non-threatening ways, including the instructor's. Provide feedback to each other and ask questions about the feedback.

Interpersonal

1. Organize class into teams. Assign tasks/assignments requiring team members to depend on each other. Assign specific roles in teams. Identify components of effective teams and attributes of effective team members.
2. Make up a problem. Ask each class member to solve it working alone. Then ask them to work in groups, telling each other how they solved the problem. Discuss the difference between working alone and working as part of a group.

3. Have each student teach others a concept/process. Ask them to describe what is going on "in their heads" as they teach, and have others respond to that.

4. Talk about customers. What is meant by a customer driven economy? How can we learn to anticipate and satisfy someone else's expectations? Who are some of the students' customers? Are they fellow students, teachers, administrators, parents, community members? What new customers are they likely to encounter in the future? What skills will they need in order to meet the expectations of these new customers? Who are the instructor's customers? What are students' expectations? How can instructors better satisfy them?

5. Discuss leadership. Define a leader. Why are some people leaders? Are they born that way? Can anyone become a leader? Why do there appear to be so few leaders today? What would it take to change that? Is there a difference between being a leader in math, sports, music, or government? Are there similarities?

6. Ensure that every student has an opportunity to be a leader in class. This means stating a position and convincing/persuading others that the idea has merit. It also means being willing to have one's opinions challenged.

7. Expect every student to be able to challenge something responsibly. This means being able to question for information without ridiculing or putting someone else down. It means generating ideas to improve the common good.

8. Teach students how to negotiate; model these behaviors. Negotiate grades, assignments, contracts, uses of materials and equipment. Negotiate according to learning style. Negotiate for roles in groups.

9. Teach conflict resolution and see in how many ways it can be used. Teach people how to reframe issues and expand construct systems in order to increase the number of available options.

10. Ask students to discuss stereotypes. (Examples might include stereotypes about: people of color, people with disabilities, occupations, people representing different income or educational levels, courses, sexual orientation, gender, age, people who are in corrections institutions, etc.)

11. Discuss pecking orders, feeling left out, being different, etc. Discuss ethnocentricity, different customs, beliefs, etc. Make it clear that they will be required to work and function in a world of diversity upon leaving school. My way or our way may be important to us; but others have ways of being and viewing the world that are equally important to them. What can we do to ensure that everyone is able to contribute and maximize his/her potential? (Many of the concepts here relate to negotiation and conflict resolution.)

Information

1. Rather than giving students answers, teach them how to find their own answers. Use the networking principle. Have them view each other as information resources.

2. Teach students how to interview for information. Use the who, what, when, where, how and why questions. Teach them that there are many ways to frame a question in order to get information.

3. Teach them how to evaluate information. How current is it? How credible is the source? Is the information useful? (This is different from asking whether or not I agree with it.)
4. Discuss what is meant by the statement, "Information is power." Ask students what information they might need to increase their power base.
5. How can information be stored most efficiently? Ask students how they access information now. (Do they write things down in any kind of order, keep things in their heads, maintain journals, etc.?) As the instructor, share with students how you store and access information.
6. Can students use computer skills to access and maintain information? Show how local businesses and agencies (including your own) do this.
7. How is information classified? Why are classification systems important? How do students classify things? What happens when we change classification systems? What classification systems are used in different school subjects? What is the relationship between personal classification systems, construct systems, and learning styles?
8. Give students different types of information and ask them to interpret it orally, in writing, or both. (This could be a story, a project, a process, a math problem, a conflict.) The major question in interpretation is, "What does this mean?" Have students explain their interpretations until they are clearly understood by others. Determine the implications for members of the class. (What is the connection between interpretation of information and both the legal and criminal justice systems?)

Systems

1. Ask students to examine a variety of systems. (Examples might include a number system, the Solar System, the penal system, the education system, a system of government, a mechanical system, an accounting system, a computer system, systems of the body.) What do they have in common? Why is it important to understand systems? What kind of system will you be operating in? What will the rules be? What will be expected of you? What will you expect of others? What will be the pieces of the system? What will you need to know to operate in this system?
2. Ask students to examine their own personal systems. What are the components? (Mental, physical, emotional, spiritual, social, etc.) How do they fit together? How do they interact to help us reach a goal?
3. Ask students to predict/estimate results, and to determine their skill in doing so.
4. Ask students to identify deviations in their performance.
5. Ask students to look at trends and determine implications for themselves. (Examples might include employment trends, economic trends, demographic trends.) Help them understand that by understanding systems and recognizing trends, they can recognize potential trouble spots and head them off.
6. Ask students to improve a system. How would you improve the education system? The penal system? Our system of government? Why would these systems be better with your improvements in place? Be willing to have your improved system open to scrutiny.

7. Ask students to design their own individual systems for successful living. What are the major pieces? What behaviors are required to pull it off? What continuous improvement program would be helpful?

Technology

1. Give students tasks and have them determine the best technology to use. (This may require some research.) Ask them to set up and operate a variety of equipment. Ask them to describe intent and proper procedures for setting up and operating equipment.
2. Teach computer skills to students. Have them write letters on word processors; have them develop a resume—let them move data around. Have them write a variety of cover letters describing their skills. Help them become familiar with many programs.
3. Teach students about the kinds of technology that can help them reach their goals. This is especially important for individuals with learning difficulties.

FOUNDATION SKILLS

Basic Skills

1. Have students read and interpret a variety materials; charts, graphs, stories, manuals, schedules, timetables. Ask them to explain to others what they are reading.
2. Have students write a variety of documents; poems, essays, ideas, information, messages, letter, memos, flow charts. Have students exchange papers and edit each others' work. Discuss the importance of writing in a way that is appropriate for the occasion.
3. Ask students to interpret information from charts, graphs, and statistical tables. Help them see how arithmetical concepts are part of a larger system.
4. Give students statistical information and ask them to interpret this. Ask them to determine if certain things are possible. Show how a knowledge of mathematics is important for the quality movement.
5. Teach listening skills. (Examples include active listening, interpreting body language, paraphrasing to ensure understanding.) Model these skills as the instructor. Make sure students understand the importance of checking things out.
6. Ensure that students have many opportunities to speak in front of the class and in smaller groups. Make sure they can articulate a point of view so it is clear to listeners. Teach them to "read" their audience so they will know if their message is being received.

Thinking Skills

1. Ask students to think of all of the things that can be done with a _____.
2. Teach brainstorming, clustering and mindmapping.
3. Ask what would happen if . . .
4. Ask, "What could this become?"

5. Ask students to examine their construct systems, and the construct systems of others. Think of decision making as "the process of arranging and rearranging information into a choice of action." (This provides an opportunity to show why having access to good information is so important.) Ask students to describe their decision making processes in specific situations. Let them ask questions of each other. Ask them what would happen if they changed the ways in which they arranged or rearranged information.

Ask students to identify problems that need solving. Have them frame statements carefully so the "real" problems emerge.

6. Ask students to identify discrepancies between what is and what could/should be, then design strategies for reducing or eliminating the discrepancies. Keep the focus on what **they** can do. (Generating ideas about how **others** should behave is not necessarily problem solving.)
7. Have students evaluate and monitor progress of a problem solving activity they have undertaken.
8. Teach visualization to students. Ask them to visualize a finished product, a new process in operation, or their own success.
9. Make sure students know and understand their respective learning styles. Have them articulate both orally and in writing how they learn best.
10. Teach fallacies in reasoning that cause us to make erroneous assumptions about a variety of things.
11. Make sure students understand an array of generalizing principles that can be used in a variety of situations.
12. Teach students about simple syllogisms.

Personal Qualities

1. Discuss the total quality movement, and what it means. Include here the importance of continuous improvement and a value added philosophy. Show how these qualities are necessary for both individual and organizational success.
2. Ask students to maintain skills journals. Have them design resumes or qualifications briefs that include their skills. (Link learning style to self-esteem.)
3. Use listening and questioning skills indicated earlier to help students function successfully in social situations. Design classroom activities requiring a variety of social interaction. Demonstrate "procedures" such as shaking hands, etc.
4. Ask students to describe themselves. This could be both orally and in writing. Have them include strengths, weaknesses, values, interests, dreams, goals, etc. Ask them to share this information with and get feedback from at least one other person.
5. Discuss honesty/integrity. Is there a difference between personal and public integrity? What is it? What are some of the major ethical issues facing us today? What would it take to resolve them?

—WHAT MATHEMATICAL COMPETENCIES DO EMPLOYERS WANT AND HOW TO GET THEM

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*(from **BACKGROUND PAPERS**)*

Education, including math and science education, will have to become more customer driven. In this respect, education is not unlike every other part of the contemporary American economy. There is, however, one big difference. Unlike the rest of the economy, education's customer is elusive. It often appears as if higher education, and especially the engineering schools, represents the customer for much of today's math education. The most important mathematical functions seem to be the trigonometric ones, perhaps a vestige of a time when surveying was a likely outcome for the mathematically talented.

The overriding goal, for may secondary schools and community colleges seems to be producing students who understand the calculus of trigonometric functions. While some teachers may talk about calculus concepts for understanding ideas such as rates of change, these concepts are rarely "on the test." Good grades are more likely to depend on remembering some clever transformation that can be promptly forgotten after graduation. (See E.S. Ferguson's book "Engineering and the Mind's Eye" for a telling criticism of engineering education that emphasizes esoteric analysis at the expense of expertise in design and other practical problem solving.[1])

Some suggest that employers are the ultimate customer. Peter Drucker has a view that may be closer to the mark. Drucker says that *"The result of a school is a student who has learned something and put it to work ten years later."*[2] Higher education, with an eye on alumni contributions should feel very comfortable with this "virtual customer—not the youth sitting in the lecture hall but the imagined successful adult ten years or more later." What mathematics does that customer require?

THE JOB MARKET'S DEMAND FOR MATHEMATICAL COMPETENCY

What mathematics do employers want? The Secretary's Commission on Achieving Necessary Skills (SCANS) asked employees and supervisors to rank 17 foundation skills for 35 entry-level jobs. (See Table 1.) Mathematics came in dead last. Arithmetic came in 13th. Surely, the relative ranking would increase as the level, pay, and complexity of the jobs increased. If employers were asked about the mathematics needed by their chief engineer or senior scientist, they would give a different answer. The answer to how much math is needed depends on how the questions is asked.

The current methodologies for determining what math skills (or any other skill) are needed for any particular job usually includes an analysis of *frequency* and *criticality* (sometimes called importance). How often does the need for the skill arise and how much is at stake if it is missing? The SCANS researchers applied this methodology to the 35 jobs that led to math's last place finish mentioned above. How might this methodology be expressed mathematically? The importance of any skill in a particular job is some function of the probability of it being used, weighed by its criticality in performing the task. Taking this formulation across jobs for any particular student, the market demand (MD) for any skill is a function of the probability of having any job (P) multiplied by the frequency of it being used, weighed by its criticality (C) and the economic importance of the task (E). That is, (1) MD=f(P,F,C,E).

Although we do not have the supporting data to estimate this equation statistically, the mathematical reasoning alone should guide our thinking about the math competencies needed for the marketplace. We can then compare the demand to the math being taught in the current curriculum. The comparison will show which competencies are overemphasized and which ones need more work.

MATH COMPETENCIES IN OVERSUPPLY

Table 2 lists some jobs for which math is likely to be important and their proportion of the labor force as well as some jobs that are likely not to need much math. Jobs that require a lot of math represent a small fraction of the labor force. That is, P is relatively small for many higher order math skills.

Economists, mathematicians, physicists, and astronomers combined only account for 80,000 jobs. Add 1.5 million engineers, one million accountants and a half-dozen other high-math content jobs and the total is less than five million slots in a labor force of about 125 million. Indeed, the total of all 4.74 million high-math content jobs is slightly less than the 4.75 million employed as retail sales workers, only one of the selected low-math content jobs.

But what about the math for more common jobs? Newspaper stories about the increasing need for math in all jobs. The Business Section of the Sunday *NY Times* of April 21, 1996, had an interesting article on the resurgence of hiring in the automobile industry. The article emphasized the attractiveness of the jobs—paying over $30,000 annually and carrying full benefits. These incomes range up to $70,000 with overtime. It also emphasized the new requirements. *"This Hiring Spree is Rewarding Brains, Not Brawn"* was the sub-headline. *"At one point we were hiring hands and arms and legs, and now we are hiring total people—with minds more important than the other,"* said Robert Eaton, Chairman and Chief Executive of Chrysler. HR Strategies Inc. is screening candidates for reading, math, spatial relations, manual dexterity and spatial reasoning.

The auto industry is not looking for higher mathematics. The ability to reason mathematically, understand percentages, and read graphs will suffice. How representative is the auto worker of jobs in the U.S. economy? Is the auto story just anecdote or does it tell something about the nation's math requirements? American College Testing (ACT) is providing one good answer to the question. ACT's *National Job Task Analysis* project is determining Generalized Work Behaviors (GWBs) across the economy. Their initial sample of 3000 employees is intended to represent 80% of the nation's jobs. In ACT's preliminary list of the 25 most important GWBs, mathematics does not make the top 25. Even arithmetic is only in the #14 slot.

An earlier ACT analysis directly examined the need for *applied mathematics*. This ACT sample of 583 jobs included technical jobs (65% of the sample) and careers in science (7% of the sample of which 6% are engineers and related technologies.) ACT's researchers divided the math skills into seven levels. Over 90% of the jobs profiled would be satisfied with math level 6 or less. Level 6 requires" . . .using negative numbers, ratios, percentages, and mixed numbers . . . calculate multiple rates, find areas of rectangles and circles, volumes of rectangular solids, solve problems involving production rates and pricing schemes." Enough algebra would be required to look up formulas or even transpose a formula before calculating. Only 18% of the jobs profiled needed level 6.

About 8% of the jobs require level 7. Even this bar was not too high. Level 7 requires the ability to calculate the volumes of spheres, cylinders, and cones, solve nonlinear equations, apply basic statistical concepts and locate errors in multiple-step calculations. Calculus, vectors, and even serious trigonometry was not mentioned. These more advanced competencies are over represented in the math curriculum relative to the demands of today's market.

In addition to ACT, the American Institute for Research (AIR) is developing a data base on jobs in the U.S. economy. The AIR effort will support a job data bank entitled O*NET which will be pilot tested in 1997. During the development of this bank, AIR has examined a small number of jobs (40) by surveys of employees. These jobs represent about 35% of the U.S. jobs. AIR also had analysts examine a large number of jobs (1100). Both analyses asked about the math competencies required. One question asked how important mathematics was to job performance on a scale of one to five. The analysis were also asked to determine the level of mathematics required. Seven levels were defined with "anchor" points to separate them. Data from AIR is expected soon, but the researchers do not anticipate answers that differ dramatically with ACT on the question of math requirements.

The SCANS, ACT, and AIR analyses provide consistent answers to the question of what math is needed on the job. Insofar as their careers are concerned, over 90% of students would hardly ever notice it if they never went further than fairly simple geometry and a modest course in algebra. A small amount of solid geometry, somewhat more advanced algebra, and some statistics would suffice for most of the remaining 10%. Taking integrals or differentiating equations are primarily needed for teaching college math and for a smattering of advanced engineering or scientific jobs. Today's extraordinarily high unemployment rate for PhD mathematicians means that the supply exceeds demand. Compare these facts with the National

Council of Teachers of Mathematics proposed standards for grades 9 to 12 that include such "basics" as *trapezoidal estimates of the area under a curve*. (p. 148 in NCTM.)3

MATH COMPETENCIES THAT ARE UNDERSUPPLIED

Despite these findings that most jobs do not require higher (more than algebra 2) mathematics, many math skills are undersupplied relative to today's job market demands. Only 9% of ACT's sample of 125,000 examinees tested at level 6; yet, ACT's job profiles showed that 18% of jobs require a level 6. Only 2% of the examinees tested at level 7; yet, 8% of the job require a level 7.[4] That is, there is an undersupply of 9% and 6% at levels 6 and 7 respectively. According to ACT about half the jobs (47%) required level 5 or better, but only about a third (34%) of the examinees were that competent. What is level 5? The ability to look up and calculate within systems of measurements (e.g., converting from ounces to pounds) or between systems (from centimeters to inches) or calculate with mixed units (hours and minutes). The examinee must determine what information, calculations, and unit calculations are needed.

Some years ago, a similar analysis using U.S. Department of Labor (DOL) and Educational Testing Service (ETS) data produced comparable results.[5] The biggest gap between job requirements was at DOL level 4: "Perform arithmetic, algebraic, and geometric procedures in standard, practical applications, such as shop math and accounting." Jobs requiring more advanced mathematical and statistical techniques accounted for less than 10% of the total.

In addition to these broad industry-wide studies, the U.S. Departments of Labor and Education have been supporting 22 industries as they develop voluntary skill standards over the last three years. Recent legislation has established a National Skills Standards Board (NSSB) to bring these efforts together in a national system. In the meantime, however, we have preliminary results for a number of industries and jobs. High volume industries like retailing, hospitality and health care have modest requirements that primarily emphasize arithmetic. Some of the more technical jobs such as Electronic Technicians, Advanced Manufacturing, and CADD (Computer Aided Drafting and Design) require basic algebra, geometry and, in some cases, trigonometry. The demands are modest. The standards for trigonometry, for example, require the ability to identify and use a calculator to cosine, sine and tangent. None of the more esoteric trig functions (or any other functions for that matter) or calculus are mentioned.

These findings about what math competencies are undersupplied are consistent with data on wage rates. A recent study focused on the question of the growing importance of basic mathematics.[6] It asked: "Does mastery of basic math by individuals graduating from high school in 1980 play a larger role in determining their wages at age 24 than it did for individuals graduating in 1972?" It finds the skills needed are the "ability to follow directions, manipulate fractions and decimals, and interpret line graphs." The authors conclude that "a high school senior's mastery of the skills taught in American schools no later than the eighth grade is an increasingly important determinant of subsequent wages." Indeed, the premium placed on good basic math skills for high school graduates who did not go to college doubled over the eight years (from 22 cents to 53 cents per hour for males and from 39 cents to 74 cents for women).

In conclusion, the implicit mathematics goal in today's curriculum of trigonometry and calculus is unnecessary for the vast majority of American workers. At the same time, the mathematical achievement of most American graduates is inadequate. Math educators need to approach the question of what mathematics to teach in a different way.

AN ALTERNATIVE APPROACH

Clearly, the analysis up to this point is rather discouraging for those of us who believe in a rigorous mathematics education. What, however, if the criterion was not: What math is being used on the job? But, instead, What mathematics **should** be used and how? Henry Pollak's list of employer expectations is a good place to start.[7] High-performance employers want to hire men and women who:

- are able to set up *problems,*
- know a variety of techniques that apply to *problems,*
- understand the mathematical features of *problems*,
- work with others on *problems*,

- see how to apply mathematical ideas to *problems*,
- are prepared for open unstructured *problems*, and
- believe in the use and value of mathematics in *problem* solving.

Pollak's formulation leads to the conclusion that employers are less concerned with the "mathematics" their employees can do than with the problems they can solve. Employees prepared in this manner can help high-performance firms throughout the nation who are re-engineering or restructuring to become more competitive. Irrespective of the buzzwords used, this change process means more analytical work, decision-making, and problem-solving by so-called "front-line" workers. The relevant questions are what is being analyzed, what decisions are being made and what problems are being solved.

The SCANS commission concluded that graduates who can solve SCANS-type problems within the specific domains of their industry will be prepared for the 21st century. They identified five categories for such problems:

1. **Planning and resource allocation decisions**, such as scheduling, budgeting and allocating space and staff.
2. Analyzing, evaluating, organizing and communicating **information**, including using computers for these purposes.
3. **Working on teams**, negotiating, teaching and customer service.
4. Using and making decisions regarding **technology**.
5. Understanding, monitoring, and improving **systems**.

Consider math curricula that meet the following criteria:

1. **Courses meet the general goals established in the NCTM standards.** Students learn to value mathematics, become confident in their own ability and become mathematical problem solvers. They are able to communicate mathematically and reason mathematically.
2. **All students are required to take enough math** to qualify for a predetermined share of the jobs in the economy and given the choice of going further. For example, if every high school student must take two years of math—geometry and algebra II—they should be brought to a level sufficient to qualify for 75% of the jobs. If they choose to take three years of math, they should have the math needed for 90% of the jobs in the U.S. economy. (Obviously these are arbitrary cutoffs.)
3. **Mathematically-inclined individuals are able to go as far as they want** in these domains. Note that scheduling, systems, and information problems may appear as part of the math curriculum at levels as high as the PhD. In other words, there should be no tracking; students should be required to go along a single track until they meet the minimum qualifications (see para. 2) and permitted to continue if they elect to do so.
4. **Math courses are organized around problems in the five SCANS competency domains** instead of around techniques. That is, the algebra and geometry courses (if they must remain separate) should be organized around planning, information, and systems problems instead of around factoring polynomials or proving theorems.

A (SCANS) Problem-based Mathematics Competency

What would a problem-based curriculum look like? In a sense, all of today's mathematics courses teach their students to solve a set of problems: simple addition, long division, taking square roots, factoring a polynomial, proving triangles congruent and so on. Here are five randomly selected problems listed in the NCTM material[8]:

> *Find five examples of numbers that have exactly three factors (p. 93).*
>
> *Approximate the area of the region under the curve $Y=2^x$ above the x axis and between the lines x=1 and x=3 (p. 148).*
>
> *Find the roots of the equation $5x^3-16x + 8 = 0$ (p. 152).*
>
> *Suppose a Ferris wheel with a radius of 25 feet makes a complete revolution in 12 seconds. Develop a mathematical model relating the height of a rider to time (p. 184).*
>
> *Investigate limiting processes by examining infinite sequences (p. 180).*

None of these problems which, by the way, NCTM suggests are to be solved by **all** students including the non-college bound, seem to be related to the requirements described by SCANS, ACT, AIR, DOL, or the industry

standards. That is, the problems are not related to employer requirements. Consider the following alternative approach to math as practiced in a current NSF-funded project. The project involves five community colleges and the John Hopkins University. The goal is to introduce problem-solving into a math course that traditionally teaches linear algebra and provides an introduction to linear programming.

Manufacturing applications provide the impetus for the five CD-ROM modules that will be produced for the project. In the math module, students face the generic problem of allocating financial resources to maximize the profit for a new product. In this case, the new product is an electric car. The decision focus is on the advertising budget although the students—working in groups—have to budget for R&D, labor, materials, and new production equipment. Each of four groups has one version of the car to consider. The versions vary with the engine type (all electric or hybrid with a gasoline motor) and chassis (newly designed or retrofit). Students have to read charts, interpret marketing data, express relationships in linear equations and use them in a spreadsheet, and understand how to use inequalities and linear programming to maximize profit. At the end of the module they report back (communicate mathematically) and engage in a group decision-making process leading to the selection of one of the four designs.

The impetus for this module is a set of real world problems identified by industry. Representatives of Boeing, the Alliance (among AT&T and the unions that represent its workers), Ford, and the National Association of Manufacturers helped identify SCANS-type problems that they expect an Associate Degree holder to solve. The module is designed to be part of (about 20%), rather than displace, the traditional math course. In a sense, the CD-ROM provides the class with a case study, delivered electronically.

The electric car CD-ROM can be used in a number of math courses. For that matter, the module can be used in other classes, from a design perspective, where the focus might be on engine design to marketing. Students would then connect mathematics to other courses as called for by NCTM. A well-regarded mathematician, Dr. Ivar Stakgold, is part of the team. Dr. Stakgold's role is to insure that the math is rigorous enough to transfer to four-year colleges.[9]

This NSF project will produce four other CD-ROM-based modules. These other modules are designed for science and communication courses. Some modules will also be appropriate for use in math. One module for example, dealing with **systems**, will introduce the concepts of statistical process control and the statistics needed to use this technique. Another, also dealing with **systems**, requires that students examine the broader environmental and social system that constrains plant locations and design decisions. In this latter case, the physics course if home for the module. The math could get quite advanced as students are required to comprehend the physics of plumes emitting from smokestacks.

The point of all this is to follow Pollak's admonition to have students set up, solve, and present solutions to open-ended problems. It also meets the goals set out by NCTM. It reconciles the current practice of U.S. (but not European) math education to have courses with names that refer to broadly defined math techniques such as algebra, geometry, and trigonometry with employers' desire to talk about competencies in work-based terms. Curricula developers may ponder whether learning *perimeter = length x width* is an algebra or geometry problem. Employers would rather know whether their workers can allocate space in an effective manner. Of course, solving the allocation problem may very well require knowing the equation for the perimeter. By using employers' language, rather than that of academics, educators may change the current situation in which employers pay little attention to school transcripts.

A similar "start with the SCANS problem" strategy is being employed in a second Johns Hopkins University project. In this project, Hopkins was funded by the Department of Education to work with Baltimore City high schools rather than community colleges. In this instance, the occupational arena is not limited to manufacturing. Math, science, and English teachers will soon begin to choose the problems upon which the electronic case studies will be developed. Health, tourism, retailing, and the built-environment may be selected. Students, for example, may be asked to do a budget analysis for a new physical therapy service and develop a schedule for bringing it on line; thereby learning how to **plan and allocate resources**. Or they may be asked to design, budget and schedule the construction of a retail store,

combining the retail and built-environment fields. In the latter case, they may have to understand and design the **system** of traffic flow to yield a target rate of revenue. Students will have to communicate about their mathematical findings (in **information competency**) when presenting their results. Moreover, the students work in **teams** to solve the problems, obviously learning **teamwork** skills.

The strategy is based on the following criteria:

1. The mathematical techniques are found while searching for a solution to a work-related problem. This reverses the usual situation wherein "applications" are an after thought, designed to illustrate a mathematical technique, appearing at the end of the chapter and clearly artificially constructed.
2. The problems often take some time to solve, can be solved in groups and the results can be presented to the class. This, in contrast to the math problem that can be solved in ten to twenty minutes for a solo math test
3. The problem solution calls on math in an authentic way; yet, the math is rigorous enough to satisfy college entrance requirements.
4. The work-related problem meets a market demand. The problem is important to a wide variety of jobs. At a minimum, the student might expect to have a one-in-a-hundred chance of encountering a problem of this type.

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SKILL STANDARDS

Section VI

How Do Scenarios Contextualize and Integrate Skill Standards?

How Do Scenarios Contextualize and Integrate Skill Standards?

—Contextualizing the Skill Standard Profiles

To establish the link between the skill standards and the realities of the workplace, the Bellevue Community College Skill Standards Project developed several scenarios that represent typical, real-life work situations for Technical Writers (see *these and other scenario examples for bioscience and manufacturing skill standards in Section II).* These examples demonstrate how the skills standard information can be directly related to real workplace problems and typical projects. For each scenario, relevant functions and tasks involved in resolving the specific problem/situation were identified. Using the completed skill standards charts, it is easy to list the tasks, knowledge, skills and abilities necessary to approach and successfully resolve the specific work-related challenge.

The use of scenarios based on real work-life situations provides a powerful context to help students understand and master necessary work skills. Using a work-related project or situation as a context for learning helps students better understand both the process and content of learning. The scenarios also provide an effective link between learner and worker roles and environments.

—Scenario 1

You are a freelance technical writer with a strong background in the information technology industry. You recently submitted a bid for, and were awarded a contract for the development of a training manual for a new software program. From your original conversation with the company hiring your services, you formed the impression that the software package was not very different from another product for which you developed a manual only six months ago. You based your bid estimate on this assumption. After starting the project, you realize that this new product has very advanced features with which you are not familiar. You decide that you may need to hire some specialized expert help in order to meet the schedule and deliverables. You need to decide whether to re-negotiate the contract or absorb the additional cost.

Primary Functions and Tasks essential for this scenario:

Critical Function: A. ANALYSIS

A 5. Identify gaps in information.

Critical Function: E. PROJECT MANAGEMENT

E1b. Identify stakeholders, decision-makers and escalation procedures

E1c. Develop detailed task list (work breakdown structures)

E4. Identify required resources and budget

E6. Identify and evaluate risks

E7. Prepare contingency plan

E11. Secure needed resources

Critical Function: G. PROBLEM SOLVING/TROUBLESHOOTING

G1. Define the problem

G3. Identify/test possible solutions

G4. Develop resolution plan

G5 Implement solution

G6. Evaluate problem solving processes and outcomes

—Scenario 2

You have been asked to take charge of the user manual rollout for your company's new product. This project is receiving very high management visibility. The product is a monitoring system to be used by physicians in a hospital setting. Your company's image within that specific market has been marginal at best. In particular, physicians have complained about the poor level of usability of the product support manuals provided by your company in the past. This new product is viewed as a turning point for your company in playing a stronger and more effective role in this market segment. There is a lot of pressure on you and your team to turn-out a very effective manual.

Primary Functions and Tasks essential for this scenario:

Critical Function: A. ANALYSIS

A1. Gather data to identify customer requirements.

A2. Interpret, evaluate and confirm requirements.

A6. Clarify product, application or procedure.

Critical Function: B. RESEARCH

B2. Identify and evaluate sources of information.

B3. Gather background information.

B4. Interview subject matter experts and target audience.

Critical Function: C. DESIGN

C1. Define purpose, standards and use of documentation.

C5. Select style & tone.

C6. Determine level of detail.

C7. Identify appropriate visuals.

Critical Function: D. DEVELOPMENT AND WRITING

D1. Select, synthesize, organize and focus pertinent information to meet user needs.

D3. Obtain feedback on information and technical accuracy.

D4. Edit for readability, grammar, and usage.

D6. Test for usability.

—Scenario 3

You are working under a tight deadline to revise and finalize a training workbook for your company's state-wide user seminar. The product is a sophisticated accounting program that can handle a wide range of financial tracking and reporting applications. After reviewing the registered participants, the training manager realizes that a large part of the audience will be composed of legal professionals. This should not have been a surprise, as your company has been aggressively marketing its software line of products to that industry. Yet the current training package was developed to specifically address the needs of the retail industry, emphasizing inventory control, as opposed to the billing of services. You need to redesign the workbook to include problem samples that are relevant to the legal profession.

Primary Functions and Tasks essential for this scenario:

Critical Function: A. ANALYSIS

A1. Gather data to identify customer requirements.

A2. Interpret, evaluate and confirm requirements.

A3. Define scope of work to meet customer's requirements.

Critical Function: B. RESEARCH

B1. Frame research question

B2. Identify and evaluate sources of information.

B4. Interview subject matter experts and target audience.

Critical Function: D. DEVELOPMENT AND WRITING

D1. Select, synthesize, organize and focus pertinent information to meet user needs.

D2. Create content of document

D3. Obtain feedback on information and technical accuracy.

D4. Edit for readability, grammar, and usage.

D6. Test for usability.

Critical Function: F. TASK MANAGEMENT

F2. Develop time and activity plan to achieve objectives

F4. Identify and obtain tools and resources to do the job.

F5. Coordinate and implement work processes and procedures

F7. Generate and maintain task status report

—Scenario 4

Your company is developing Internet on-line help for its primary software products. You have been asked to adapt the current manual for one of the company key products to be posted on the Internet. You also need to set-up a feedback system that keeps track of the most frequently asked questions and encountered problems, so that the development group can use this information in the next version redesign. You have little experience writing for the Internet, but you see this assignment as an opportunity to broaden your skills and further your responsibilities within the company. This project will serve as a pilot for other areas of your company's technical support to its users.

Primary Functions and Tasks essential for this scenario:

Critical Function: A. ANALYSIS

A1. Gather data to identify customer requirements.

A2. Interpret, evaluate and confirm requirements.

A3. Define scope of work to meet customer's requirements.

A4. Identify time, technology and resource constraints.

A6. Clarify product, application or procedure.

Critical Function: B. RESEARCH

B4. Interview subject matter experts and target audience.

Critical Function: C. DESIGN

C1. Define purpose, standards and use of documentation.

C3. Select tools.

C4. Plan information flow.

C6. Determine level of detail.

C7. Identify appropriate visuals.

Critical Function: F. TASK MANAGEMENT

F2. Develop time and activity plan to achieve objectives

F3. Design and develop work processes and procedures

F4. Identify and obtain tools and resources to do the job.

F5. Coordinate and implement work processes and procedures

F7. Generate and maintain task status report

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SKILL STANDARDS

Section VII

Once Developed,
How Do We Validate Skill Standards?

Once Developed, How Do We Validate Skill Standards?

Why Validate?

The purpose of the validation process is to determine the reliability of the gathered data and assess its range of applicability. The validation process is especially critical when the original data was obtained using a small group of individuals not necessarily representing the target population at large. Let us take as an example a project developing a job profile for technical writers. If the gathered information comes primarily from technical writers in a specific industry, for instance environmental companies, it is difficult to justify generalizing the information to other industry segments. Similarly, the information may be obtained from a wide range of industry areas but represent only very small or very large companies. The larger and the more representative the original participant sample, the less the need for validation.

The other important factor to be considered in the validation process is the overall purpose of the study. If the application of the data is local, then there is no need for a national validation. If the purpose is to apply the information only to a segment of the working population, then a broad validation is not recommended.

In summary, two key questions must be answered before the validation process should be started: 1) what is the quality and range of the available data? and, 2) what is the intended purpose for the final information?

Validation Process

There are two types of validation: qualitative and quantitative. The main difference is in the number of persons surveyed and the amount of detail in the questioning sequence. Qualitative research is more opinion seeking. The qualitative process can be adjusted as needed. With a quantitative survey, on the other hand, the questions are set in advance.

Data collection for qualitative surveys can take one, or a combination, of several forms (for example, a series of one-on-one interviews lasting 30 minutes to an hour; half-day to day-long facilitated focus groups).

The quantitative process involves a set questionnaire and a much larger group of respondents. The questionnaire can be completed through phone interviews, in person, by e-mail, or through the mail. The general rule is that respondents will spend a maximum of about 20 minutes attending to and completing a questionnaire. As shown in the table below, the sample size for a quantitative survey depends on the confidence level one requires.

Confidence Level	*Required Number of Completed Surveys*	*Number of Mailed Surveys (assuming 60% response rate)*	*Number of Mailed Surveys (assuming 50% response rate)*	*Number of Mailed Surveys (assuming 40% response rate)*
2%	1800	3000	3600	4500
3%	1060	1767	2120	2650
4%	601	1002	1202	1503
5%	385	642	770	963

In the case of mail surveys, higher response rates are possible by using personalized correspondence, repeated mailings, and stamped return envelopes. One of the recommended survey procedures consists of four mailings and is outlined below *("How to conduct your own survey" Priscilla Salant, Don A. Dillman):*

- **First Mailing:** To all members of the sample— a personalized, advance-notice letter. Its purpose is to tell people they have been selected for the survey and will be receiving a questionnaire.
- **Second Mailing:** About one week later, again to all members of the sample— a personalized cover letter with slightly more detail on the survey, a questionnaire, and stamped return envelope.
- **Third Mailing:** Four to eight days after the questionnaire goes out, again to all members of the sample— a follow-up postcard thanking those who have responded and requesting a response from those who have not.
- **Fourth Mailing:** Three weeks after the first questionnaire goes out, to those who have not yet responded— a new personalized cover letter informing people, "We have not yet heard from you," with a replacement questionnaire and stamped return envelope.

According to the authors, return rates of 50 to 60% can be expected when using this procedure.

Factors Influencing Reliability of Results

- **Sampling Error:** The degree to which the sample chosen is a true representation of the overall population.
- **Non-Response Bias:** Bias created if the answers from non-respondents are likely to differ considerably from respondents, and the number of non-respondents is large enough to impact the findings.
- **Measurement Error:** The degree to which questions asked truly measure what the research intended.

A complete survey methodology with supporting documentation can be found at the Internet address: www.qrc.com/nsf/srs/rdexp/method94/start.htm

Technical Writer - Bellevue Community College Validation Survey

Occupation Cluster: TECHNICAL WRITER

How important are these Tasks in your Job?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function: A. ANALYSIS					
A1. Gather data to identify customer requirements.	0	1	2	3	4
A2. Interpret, evaluate and confirm requirements.	0	1	2	3	4
A3. Define scope of work to meet customer's requirements.	0	1	2	3	4
A4. Identify time, technology and resource constraints.	0	1	2	3	4
A5. Identify gaps in information.	0	1	2	3	4
A6. Clarify product, application or procedure.	0	1	2	3	4

Are there any important tasks missing from this function?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function: B. RESEARCH					
B1. Frame research question	0	1	2	3	4
B2. Identify and evaluate sources of information.	0	1	2	3	4
B3. Gather background information.	0	1	2	3	4
B4. Interview subject matter experts and target audience.	0	1	2	3	4

Are there any important tasks missing from this function?

How important are these Tasks in your Job?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function: C. DESIGN					
C1. Define purpose, standards and use of documentation.	0	1	2	3	4
C2. Identify delivery options.	0	1	2	3	4
C3. Select tools.	0	1	2	3	4
C4. Plan information flow.	0	1	2	3	4
C5. Select style & tone.	0	1	2	3	4
C6. Determine level of detail.	0	1	2	3	4
C7. Identify appropriate visuals.	0	1	2	3	4
C8. Provide feedback to development team/individual.	0	1	2	3	4

Are there any important tasks missing from this function?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function: D. DEVELOPMENT AND WRITING					
D1. Select, synthesize, organize and focus pertinent information to meet user needs.	0	1	2	3	4
D2. Create content of document	0	1	2	3	4
D3. Obtain feedback on information and technical accuracy.	0	1	2	3	4
D4. Edit for readability, grammar, and usage.	0	1	2	3	4
D5. Publish document.	0	1	2	3	4
D6. Test for usability.	0	1	2	3	4

Are there any important tasks missing from this function?

How important are these Tasks in your Job?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function:					

E. PROJECT MANAGEMENT

E1a. Define scope of project.	0	1	2	3	4
E1b. Identify stakeholders, decision-makers and escalation procedures	0	1	2	3	4
E1c. Develop detailed task list (work breakdown structures)	0	1	2	3	4
E2. Estimate time requirements	0	1	2	3	4
E3. Develop initial project Gantt/PERT chart	0	1	2	3	4
E4. Identify required resources and budget	0	1	2	3	4
E5. Evaluate project requirements	0	1	2	3	4
E6. Identify and evaluate risks	0	1	2	3	4
E7. Prepare contingency plan	0	1	2	3	4
E8. Identify interdependencies	0	1	2	3	4
E9. Identify and track critical milestones	0	1	2	3	4
E10. Participate in project phase review	0	1	2	3	4
E11. Secure needed resources	0	1	2	3	4
E12. Manage the change control process	0	1	2	3	4
E13. Report project status	0	1	2	3	4

Are there any important tasks missing from this function?

How important are these Tasks in your Job?

	Not Important	Somewhat Important	Important	Very Important	Critical
Critical Function: ***F. TASK MANAGEMENT***					
F1. Define scope of work to achieve	0	1	2	3	4

individual and group goals					
F2. Develop time and activity plan to achieve objectives	0	1	2	3	4
F3. Design and develop work processes and procedures	0	1	2	3	4
F4. Identify and obtain tools and resources to do the job.	0	1	2	3	4
F5. Coordinate and implement work processes and procedures	0	1	2	3	4
F6. Monitor, analyze, and evaluate work processes and procedures	0	1	2	3	4
F7. Generate and maintain task status report	0	1	2	3	4

Are there any important tasks missing from this function?

Critical Function: G. PROBLEM SOLVING/TROUBLESHOOTING	Not Important	Somewhat Important	Important	Very Important	Critical
G1. Define the problem	0	1	2	3	4
G2. Perform appropriate analysis to identify problem cause	0	1	2	3	4
G3. Identify/test possible solutions	0	1	2	3	4
G4. Develop resolution plan	0	1	2	3	4
G5. Implement solution	0	1	2	3	4
G6. Evaluate problem solving processes and outcomes	0	1	2	3	4

Are there any important tasks missing from this function?

How important are these Functions in your Job?

Critical Functions	Not Important	Somewhat Important	Important	Very Important	Critical
A. Analysis	0	1	2	3	4
B. Research	0	1	2	3	4
C. Design	0	1	2	3	4

D. Development and Writing	0	1	2	3	4
E. Project Management	0	1	2	3	4
F. Task Management	0	1	2	3	4
G. Problem Solving/Troubleshooting	0	1	2	3	4

Are there any important functions missing from this job description?

In order for us to better organize the survey data, we would appreciate if you could answer the following demographics questions.

How long have you worked as a technical writer for information technology applications?

___Less than 1 year

___1-5 years

___6-10 years

___11-15 years

___More than 15 years

What is the highest level of education you have completed?

___Did not complete high school

___High school graduate or equivalent

___Completed occupational, trade or apprenticeship program after high school

___Some college, no degree

___College degree (2 years)

___College degree (4 years)

___Advanced degree

What do you consider the level of education needed to do your job?

___High school graduation or equivalent

___Some occupational, trade or apprenticeship training after high school

___Some college, no degree

___College degree (2 years)

___College degree (4 years)

___Advanced degree

Guidebook Volume I

SKILL STANDARDS

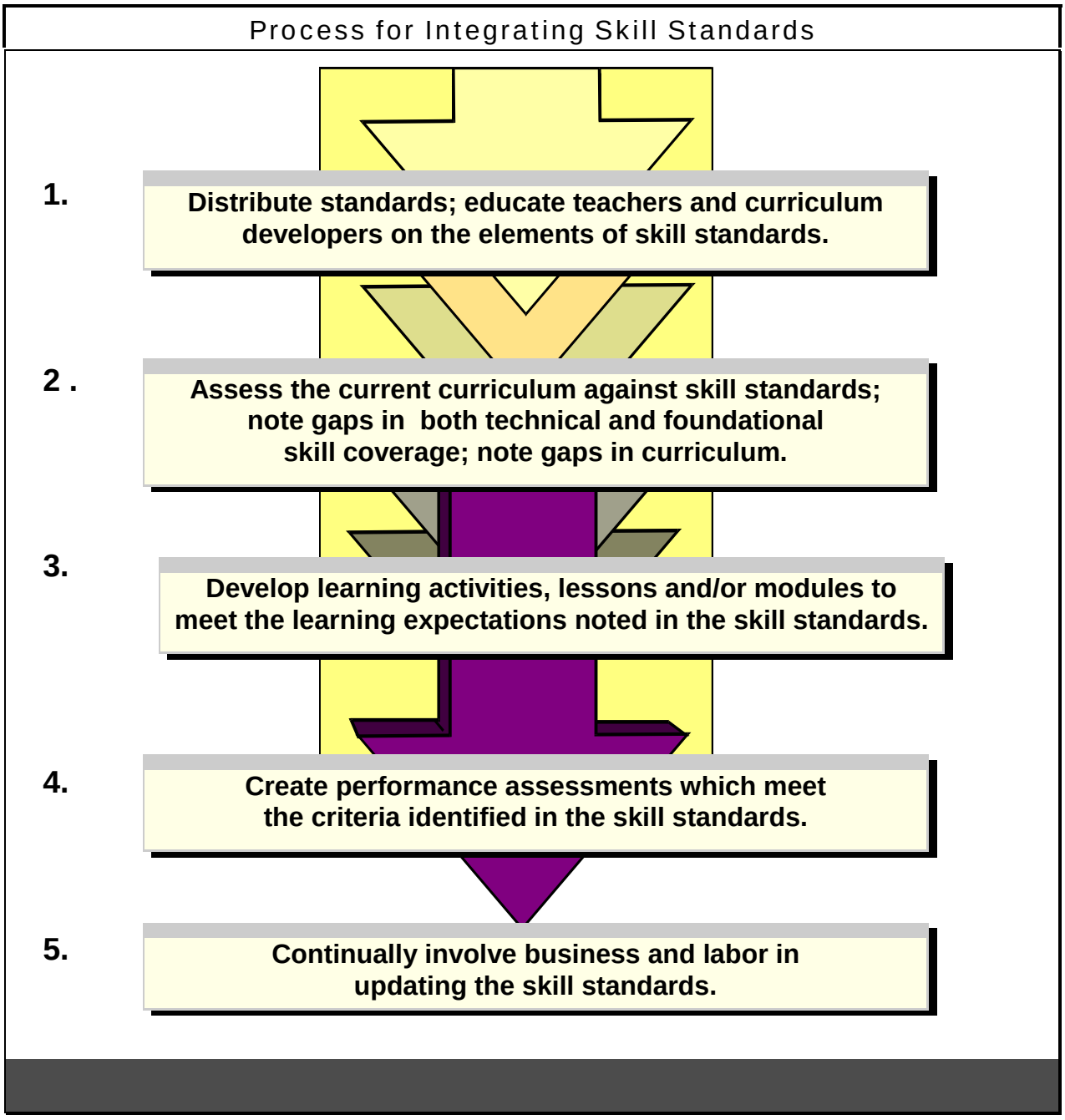
Section VIII

How Do We Integrate Skill Standards Into the Curriculum?

How Do We Integrate Skill Standards Into the Curriculum?

—Integrating Skill Standards with Curriculum: A Recommended Process

Flow Chart



—The Role of the Integrated Curriculum Standard

Modified from ***Education and Work: Designing Integrated Curricula: Strategies for Integrating Academic, Occupational and Employability Standards***.
—Center for Occupational Research and Development (CORD) Nov. 1996

The starting point for curriculum design is the identification of the knowledge, skills, and abilities in a particular area of study and the thinking processes needed to acquire an understanding of and meaningful application of the content. This collection of competencies, information, ideas, and capabilities is shaped by a business and industry perspective as well as the academic perspective. In the information age, reflective thinking must be given added focus. Knowing information is simply not enough; all students must be given the opportunity to apply and use knowledge through higher-order thinking skills and processes, such as analyzing details, synthesizing concepts, determining reliability of source, evaluating evidence, and validating a causal explanation.

Traditionally, content has been defined in several ways. In academic areas, the writing of textbooks has anchored the base of knowledge in the traditions of each subject as interpreted by expert authors, who are typically university professors, researchers, or experienced elementary and secondary teachers. In vocational programs, content has been defined both by textbook authors and by competency inventories developed with the assistance of occupationally-experienced practitioners and processes such as Developing a Curriculum (DACUM). Validation of both academic and vocational materials has relied on review processes involving other knowledgeable practitioners with similar expertise.

While these processes are successful from some perspectives, they lack a mechanism for integration or connection with other areas of the curriculum. Developing those connections is left to the teacher and to the students. Since teacher training typically does not provide the experience needed to integrate many areas of content, the student ultimately inherits the task of finding meaningful relationships among the many areas studied. Unfortunately, curricula often do not offer the student the frame of reference and thinking tools to apply and integrate material learned. This undesirable situation can be addressed only by providing a readily usable structure that assists both teacher and student in establishing interconnections among areas of learning. The concept of Integrated Curriculum Standards (ICSs) provides a structure that systematically connects to accepted standards in academic, employability, and occupational domains.

The advent of standards in areas of academic content, employability skills, and occupational capabilities provides a rich source of data to define curriculum content. Standards have not been perfected, and the quality and level of development vary considerably; nevertheless much progress has been made, and it is reasonable to expect standards will continue to expand and improve. If meaningful ways are found to use standards effectively, their further development will be encouraged.

Development of standards has opened the analysis of content to much wider view. Content experts have, in effect, shared their basic understandings of content, whether academically or occupationally oriented, through the publication of these standards. Curriculum development now can be based on the fundamental building blocks of content rather than on collected interpretations in the form of textbooks and course syllabi prepared in isolated areas of content. Curriculum developers have the opportunity to seek the deeper connections among the building blocks and present material to students in ways that expose the contexts and relationships among areas of knowledge and information. In addition, the interpersonal and intrapersonal

application of knowledge and skills fosters the development of students who are better prepared to meet the demands of a highly complex world of work.

At a more fundamental level, examination of standards opens the opportunity to rethink what is important within curricula and to add or remove elements based on a comparative critique recognizing that an overwhelming body of knowledge is available in modern society. Sequencing of content also can be reexamined to find efficiencies in learning by more closely connecting preparatory knowledge with applications. For example, not all trigonometry must be taught at one time in one course in which the future utility of some of the subject material may not be evident.

Related to employability, Daniel Goleman makes a connection to "emotional intelligence."[35] Goleman has the support of Howard Gardner whom he quotes as saying

> "...(I) appreciate how crucial these emotional and relationship abilities are in the rough-and tumble of life. Many people with IQs of 160 work for people with IQs of 100, if the former have poor intrapersonal intelligence and the latter have a high one. And in the day-to-day world no intelligence is more important than the interpersonal. If you don't have it, you'll make poor choices about who to marry, what job to take, and so on. We need to train (students) in the personal intelligences in school."

ISWEC (Integrated System for Workforce Education in Curricula Project) is designed to synthesize integrated standards from academic, business and industry, and employability arenas. This broad base for curriculum development maximizes the likelihood that content and process related to the development of all types of intelligences will be addressed. In such curricula, students can have continual experiences in seeking and applying connections and can form habits of mind based more firmly in analysis, synthesis, and reflective thinking, and do so within the context of authentic learning/working experiences.

The difficulty in using this rich source of information lies in the volume and complexity of the integration process. In raw form, the collection of standards that exists today fills several hundred pages of print material representing tens of thousand of distinguishable elements of information. Among these elements are many that overlap, duplicate, or restate others from various perspectives. It is unrealistic to expect teachers or even school systems to digest and translate this volume of information into workable instructional programs without assistance. Required are both a process and much preliminary work to assist educational practitioners in the development of integrated curricula based on a synthesis of standards within specific areas.

Small steps can be taken as a way of progressing toward these goals within the limitations of local capabilities. Incremental reform can use the Skill Standards to

- infuse standards into existing courses,
- augment contextual materials with use of standards,
- create linkages to worksite learning experiences based on standards,
- implement project-based and thematic-based curricula based on standards,
- use student portfolios as learning tools,
- incorporate learning technology with specific connections to standards,
- employ embedded and authentic assessment in the curriculum as a learning tool, and
- embed developmental career guidance in a curriculum through the standards.

The collective impact of these steps will lead to major curriculum reform in a manageable progression.

—Infusion of Standards Into Existing Courses

Infusion implies a pouring in or incorporation of something that gives new life or significance to a curriculum. Standards are a resource that can be infused into existing courses with little or no change in structure. Teachers in an existing class who are addressing a topic that relates to a particular standard can use the supporting database to identify examples of occupational contexts for the topic. Since teachers cannot be familiar with all occupational fields, the standards provide reference connections to applications of the topic that not only assist the teacher but also can be assigned for student research.

Used in this form, the concepts of standards become a teaching/learning resource that adds contextual motivation to students while providing the teacher assistance in lesson planning. Over time, the teacher can become familiar with a range of academic and occupational connections in a relatively efficient manner while providing an enriched program for the student. Workshops and other professional development activities can be used to accelerate the orientation process for teachers.

Another advantage of the infusion process is that it can be initiated at the local level immediately with no system or structural changes. In fact, infusion provides a mechanism for familiarizing teachers with these concepts in preparation for broader-scale implementation, and it provides an opportunity for teachers to critique the materials and offer suggestions for improvement. It is an opportunity to develop commitment to the concept at the grassroots level while providing support for the teacher in the form of ideas for lesson planning. Infusion of standards is the easiest step toward broader implementation of integrated curriculum concepts.

—System for Lifelong Learning

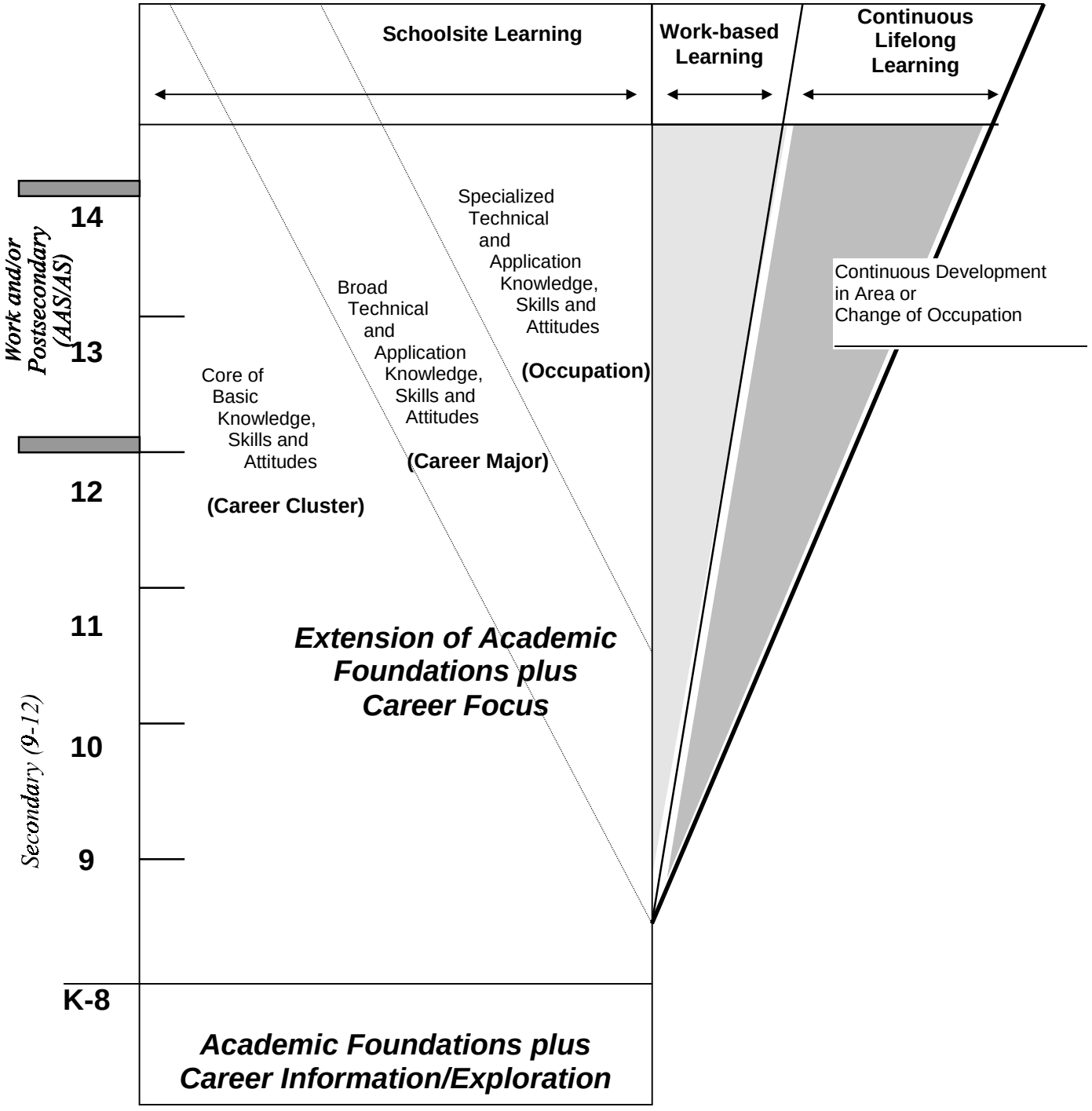


Figure 3

The areas of curriculum shown in Figure 3 correlate to the concept of clustering, since the third or specialized area corresponds to specific occupations and the middle area corresponds to career majors representing groups of occupation within a cluster. The core area has content common to all occupations and all career majors within a broad career cluster.

—Using Skill Standards to Assess Curriculum Coverage

One of the quickest and least expensive implementation strategies for Skill Standards is to use the standard to assess the current curriculum to see if the stated employer expectations and priorities are embedded in the lessons. An example of this implementation strategy, using the standard for Technical Support Representative provided by Suzanne Marks, Information Technology faculty member at Bellevue Community College, is on the following pages. Each task, drawn from select pages of the Skill Standard, is evaluated for the emphasis in the curriculum; where in the curriculum one might find the standard covered; a judgment on whether the lesson is competency-based; and an identification of the assessment methodology used to measure performance.

After the assessment charts are completed, the curriculum reviewers can identify what priorities have a low degree of emphasis in the curriculum and make suggestions for improvement. The changes may include changes in how the lesson is taught, how the lesson is assessed, or how much time is spent on the lesson. Rarely, if ever, does the Skill Standard call for a major re-design of the curriculum. Often more business related activities, more 'real world' projects, more team assignments, and more authentic performance-based student assessments improve the relevancy of the curriculum design.

—Curriculum Assessment For Skill Standards Integration

Occupational Cluster ______________________________________Function ____

Task #	Task Description	Degree of Emphasis in Curriculum 1 2 3 4 5 Low High	Where in Curriculum?	Competency Based Yes Somewhat No	Assessment Methodology
Task #	Task Description	Degree of Emphasis in Curriculum 1 2 3 4 5 Low High	Where in Curriculum?	Competency Based Yes Somewhat No	Assessment Methodology
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Task #	Task Description	Degree of Emphasis in Curriculum 1 2 3 4 5 Low High	Where in Curriculum?	Competency Based Yes Somewhat No	Assessment Methodology

—Curriculum Assessment For Skill Standards Integration

Occupational Cluster *Technical Support Rep* **Function** *Problem Solving/Troubleshooting*

Task #	Task Description	Degree of Emphasis in Curriculum	Where in Curriculum?	Competency Based	Assessment Methodology
I 1	*Define the problem*	1 2 3 4 5 Low High	*Throughout IT core curriculum, but primarily in Problem Solving, Hard-ware & Software Configuration, Networking & Help Desk.*	Yes Somewhat No	*Observation & review of documentation in Help Desk, written tests, team projects, hands on assessment of computer configuration and networking.*
Task #	**Task Description**	**Degree of Emphasis in Curriculum**	**Where in Curriculum?**	**Competency Based**	**Assessment Methodology**
I 2	*Perform appropriate analysis to identify problem cause*	1 2 3 4 5 Low High	*Throughout IT core curriculum, but primarily in Problem Solving, DOS, and Help Desk.*	Yes Somewhat No	*Written and verbal presentations in Problem Solving, written tests in DOS, hands on (practical) tests in DOS, review of Help Desk documentation and interviewing customers, etc.*
Task #	**Task Description**	**Degree of Emphasis in Curriculum**	**Where in Curriculum?**	**Competency Based**	**Assessment Methodology**
I 3	*Identify/test possible solutions*	1 2 3 4 5 Low High	*Throughout IT core curriculum, but primarily in Hardware & Software Configuration, Networking and Help Desk.*	Yes Somewhat No	*Individual and team assessments, practicum assessments, written assessments, review of Help Desk documentation and performance evaluation.*

Occupational Cluster *Technical Support Rep* **Function** *Project Management*

Task #	Task Description	Degree of Emphasis in Curriculum	Where in Curriculum?	Competency Based	Assessment Methodology
G 4	*Estimate time requirements*	1 2 3 4 5 Low High	*Throughout curriculum where team projects are emphasized: Customer/ Client Relations, Operating Systems, Hardware & Software configuration, Networking, Integrated Business Solutions.*	Yes Somewhat No	*Individual and team grading, oral and written project documentation, written tests, projected vs. Actual time estimate written document.*
Task #	**Task Description**	**Degree of Emphasis in Curriculum**	**Where in Curriculum?**	**Competency Based**	**Assessment Methodology**
G 5	*Develop initial project management flow chart*	1 2 3 4 5 Low High	*Because courses are only 3 months in duration, courses do not allow for long-term projects. The Visual Basic course requires a quarter-long project flow chart.*	Yes Somewhat No	*Written documentation of flow chart.*
Task #	**Task Description**	**Degree of Emphasis in Curriculum**	**Where in Curriculum?**	**Competency Based**	**Assessment Methodology**
G 6	*Identify required resources and budget*	1 2 3 4 5 Low High	*Not in curriculum very much. Some case studies in General Business require financial analysis.*	Yes Somewhat No	*Evaluation of oral and written presentation of case studies.*

Summary

Low Degree of Emphasis Included in Curriculum

Task #	Task Description	Comments

Suggestions for Curriculum Modifications (Add, Delete, Change)

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SKILL STANDARDS

Section IX

How Do We Use Skill Standards for Assessment?

HOW DO WE USE SKILL STANDARDS FOR ASSESSMENT?

—Assessment of Skill Standards

Within a skill standards or competency-based system, assessment is the generation and collection of evidence of performance which can be matched to specified explicit standards which reflect expectations of performance in the workplace. There are two main forms of evidence:

1) evidence of actual performance
2) evidence of underpinning knowledge, skills and abilities

The types of evidence may vary (see chart) and will include:

1) direct evidence (products and items produced by the performer)
2) indirect evidence (supporting evidence and information about the performer)

Evidence can be collected in a wide variety of educational or business settings. To a large extent, this will be determined by the range of opportunities for demonstration available. Often it is difficult to actually perform the task in the authentic work setting vs. in a classroom setting. In this case evidence generated during an educational course or an in-house training session can be collected by individuals and added to their overall portfolio.

By requesting that the student or trainee produce tangible results in the form of take-away products (videos, electronic products, tapes, paper products), the participant will have created real evidence which can be shown to human resource personnel, hiring managers, supervisors, or assessors. When assessing these products the trained assessor will seek:

- validity;
- currency;
- authenticity;
- sufficiency.

Therefore, when designing Skills Standards based assessment for your educational course or training session include consideration that the assessment process and results meets these four criteria:

validity—that is, it clearly relates to the relevant standards (examples of this would be a sample of a simple CD animation for a Digital Media Specialist, a video presentation of a mini-lecture for a teacher or trainer).

currency—that is, it calls for a demonstration of the current standards of the industry.

authenticity—that is, produced by the individual being assessed; it is their own work. Team activities will be useful to demonstrate the skills and abilities to work effectively with others, not necessarily the total end results. The individual can if possible, identify their part of the team project to demonstrate evidence of their own results.

sufficiency—that is, enough evidence is collected to match the key task and the performance criteria included in the Skill Standards.

When designing your educational or training course keep in mind that you can assist participants in generating high-quality evidence of performance or of underpinning skills, knowledge and abilities which will help them to be successfully assessed as fully competent. Seek the input of the participants and their "customers" to identify the kinds of evidence that will meet the criteria for successful demonstration of performance.

(Adapted from designing Competency-Based Training, Shirely Fletcher, 1991, Pfiffer & Company, p. 86-88.)

—Assessment Design

Type of Authentic Assessment	Description of Authentic Assessment Strategies
Project	• hands-on demonstration of knowledge, skills and attitudes that reveals a student's ability to plan, organize, and create a product or an event
	• documentation of process of development from initial steps to final presentation
Portfolio	• collection of pieces of evidence of a student's knowledge, skills, and attitudes
	• showcase of best work, work in progress
	• record of student's progress over time
	• content selection by student in collaboration with the teacher
	• centerpiece for parent conferences
On-demand Demonstrations	• hands-on performance of student, which illustrates levels of knowledge, skills, and attitudes
	• typically involve a "real life" problem or situation to solve
	• focus on the application of knowledge and skills learned in one situation as it connects to a new and different one
Case Studies	• analysis of events and individuals in light of established criteria
	• synthesis of evidence to support generalizations based on individual cases
Paper/Pencil Tests	• multiple-choice, essay, true-false questions that rely on extended responses to further clarify a student's understanding of the knowledge being assessed
	• graphic representations that reveal a student's understanding of connections among ideas
Structured Observation	• observation of events, groups, and individuals that focuses on the salient traits of the skill or attitude being observed

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SKILL STANDARDS

Section X

How Might
Industry Use Skill Standards?

HOW MIGHT INDUSTRY USE SKILL STANDARDS?

—Business Applications for Skill Standards

Skill Standards are not only useful for educators and students, many businesses are finding the Standards helpful in employee hiring, evaluation and development processes. Listed below are applications provided by businesses of possible uses of Skill Standards.

- Review the Functional Job Analysis, specifically assess the functions and tasks for relevancy, frequency and importance for a particular job at your worksite. Develop hiring criteria, identifying which ones are most critical for a new job opening in your company or department.

- Use the scenarios to trigger relevant in-house situations in which an employee may be required to solve typically occurring problems or critical incidents. Customize the scenarios for the particular job; include scenarios during an interview or an in-house problem solving training session.

- Communicate performance expectations for specific tasks by adapting the performance criteria for the particular job in your firm. Define specifically what the employee is expected to know and do, define what success looks like using the Standards.

- Use the performance criteria for evaluating job and task performance.

- Create individual criteria for evaluating job and task performance.

- Create individual development plans based on the identified gaps in performance and skill level; chart an employee's progress toward achieving the skill standard.

- Ask for evidence of achievement for a particular function or task. This could be a demonstration, a portfolio, or a description of accomplishments with appropriate documentation.

- Update job descriptions based on the information in the Skill Standards.

- Update compensation based upon the level of complexity required to perform successfully in a given occupational cluster.

- Use the Skill Standards as a benchmark for expected performance; a means for measuring progress.

- Use the Skill Standards as the basis for a certificate or credential to assure employers of the level of proficiency of a new hire or transferred employee.

- Use the Skill Standards to describe what it takes to develop a new occupation—as a career counseling devise.

- Articulate goals based on the Skill Standards for future work performance as roles and responsibilities expand.

- Stimulate strategic thinking about workforce reorganization—evaluate how work gets done using the major functions identified in the Skill Standard.

—Using Skill Standards to Formulate Interview Questions

Here is an example of how skill standards might be used for formulating interview questions for a Technical Support Representative. The questions were derived from key functions, tasks, and relevant knowledge and skills needed as noted in the Informational Technology Skill Standards developed by Bellevue Community College. Additional interview questions can be formulated around the expected performance criteria.

- Tell me about a time in a work-based experience when you needed to identify customer requirements and define the scope of work required to meet the customers expectations?

- During your time as a student or in a work situation, tell me how you managed multiple tasks, that is, when you had too much to do and not enough time.

- Tell me about a time when you did not have the technical background to meet the customer's needs. How did you handle the situation?

- Tell me about a time where you found yourself educating or training others on a particular software application.

- Describe the toughest problem you have solved on a Help Desk or in another customer-driven situation.

- Tell me about a time when you needed to develop and implement a installation plan. What difficulties did you face and how did you handle those situations?

- Describe a situation where the customer was "difficult" that is, you could not satisfy their requirements and they became frustrated and angry.

- Describe your knowledge, abilities and skills on office application software tools.

- Describe your knowledge, abilities and skills using and installing multiple operating systems, applications and hardware.

—What Experience Has Labor Had with Skill Standards?

*(Adapted from **Skill Standards and Labor Perspectives**, Ellen Scully, Work and Technology Institute, May, 1996.)*

Unions have an enormous amount of experience in establishing skill standards that are used in hiring, promotion, and training. "When you talk to workers about skill standards you have to talk about the differences between union and non-union work environments," comments John T. Smith, NSSB member and retired official of the United Steel Workers of America. "There is a distinct difference in how work is organized and how people are dealt with. Union environments are organized to recognize your ability and your tenure. Standards move non-union workplaces closer to some of the things we already have." Although there are some distinct similarities and differences between the experiences of labor and the new skill standard initiative, both systems can learn from the other.

Craft unions in the building and construction trades, for example, have long used the apprenticeship model of worker preparation and training as a road to higher pay and broader skills. "There is a relationship between skill standards and apprenticeship programs, a meaningful relationship. Apprenticeship programs must be involved in the process, they must become a key partner in the process," says Terrance Craney, NSSB member and president of the Wisconsin Education Association Council. Indeed, apprenticeship contains many of the features of the proposed system of voluntary industry skill standards. For example:

- Apprenticeships operate from skill standards that are jointly set at the national level by industry and labor representatives.

- Apprenticeships standards are linked to a comprehensive education and training strategy that ensures workers are supported in the development of needed skills.

- Apprenticeships provide a system of instruction that combines academic and vocational training with paid structured on-the-job learning experiences.

- Registered apprenticeship programs move workers from novice to mastery and journeyman upgrading programs offer ongoing training to ensure that masters continuously improve their skills and update their knowledge of new technologies.

- Graduates of apprenticeship programs receive portable credentials that are recognized by all employers throughout an entire industry. These credentials have meaning to the employer for they ensure that the worker has had a variety of experience in the tasks and problems associated with the occupation (Bailey and Merritt 1995).

In the public sector the issue of merit has always prevailed in hiring and promotion decisions. The civil service testing system, and the ability to challenge the tests has forced public employers to keep focused on the knowledge, skills and experience required for jobs. Public sector employers and unions have developed a variety of strategies that provide union members with equal access to jobs based on qualifications. For example, unions and employers regularly negotiate over the tasks, duties and qualifications associated with the work of bargaining unit members. Also, there is a long tradition of joint training to support workers in gaining skills for advancement in the civil service system.

Models of jointly negotiated skill standards are also in place in the health care, auto, steel and the telecommunication industries through use of internal classification systems that serve to standardize the requirements for jobs across large firms, and in some cases, across nationwide organizations and industries. The practice of jointly setting clear standards that are linked to a job classification system and promotional policies has resulted in career ladders that provide all workers with equal access to advancement opportunity (e.g., Cape Cod Hospital and Hospital Workers Union Local 767 SEIU 1994). Women and minorities have advanced to higher levels and in greater numbers in the public sector and in health care organizations than in other industries. These industries also have a long tradition of joint union-management collaboration on worker education through a variety of negotiated learning benefits and joint training programs that assist workers to upgrade their skills and qualify for advancement opportunities.

Yet these existing systems could be enhanced by Skill Standards work. The new heightened interest in skill standards could help existing joint systems further improve their standards. The standards associated with many of these systems are based on the requirements of work in traditional organizations, and lack the focus required to support the long-term goal of moving the American workplace to high performance. Skill standards partnerships could help these existing systems by shifting to a *performance-based* assessment system, rather than a *time-based* system. In many existing systems individuals demonstrate that they meet standards through satisfactory completion of a required program or through the right mix of work experience. Standards in high performance systems are competency based which means workers are required to demonstrate that they can meet the standard through a variety of assessment methods.

The bottom line is that labor and management in the unionized sectors of this country have had a long tradition in establishing and using skill standards to guide hiring and promotional decisions, helping workers and employers to determine and meet skill needs and provide workers with advancement opportunity.

—Labor Perspectives

The design and implementation of a national, voluntary system of skill standards represents both dangers and opportunities for labor unions and their members in all industries and walks of life. It's that classic paradox, explains Katherine Schrier, NSSB member and administrator of the AFSCME District Council 37 Education Fund: "Is the glass half empty or is the glass half full? Employers could use skill standards to shut the door on people and shut people out of jobs. On the other hand, if we use skill standards to set clear criteria around what people need in order to get ahead and support worker mobility and advancement in the workplace, then this would be a great improvement."

The Human Resources Development Institute, the employment and training arm of the AFL-CIO, conducted interviews with the labor members of the Board in order to gain insight into labor's perspective on the proposed development of a national system of voluntary skill standards. Six important themes emerged from these interviews. These themes may provide the foundation for labor's vision on skill standards and their role in the American labor market.

1. Skill standards must be accompanied by a broader strategy to transform the traditional form of work organization found in most workplaces today.
2. Skill standards must focus on helping workers develop the broad, competitive and portable skills associated with high performance workplaces.
3. Workers must feel ownership towards the process they use to guide their career development.
4. Unions must play an institutional role in national and industrial skill standards systems, regardless of the level of unionization within specific industries.
5. National voluntary skill standards, developed by joint labor-management committees, currently exist in industries such as construction. A new skill standards system must avoid undermining or diluting these standards in any way.
6. The system of assessment and certification that accompanies skill standards must ensure portability of skills for new entrants and incumbent workers alike.

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SKILL STANDARDS

Section XI

How Do We Access Funding to Develop Skill Standards?

How Do We Access Funding to Develop Skill Standards?

—Funding for Skill Standards Development

The State Board for Community and Technical Colleges has received School-to-Work funds to support the development and implementation of industry-based skill standards. Skill Standards identify what people need to know and be able to do to be successful on the job. Colleges, in partnership with business and industry, may apply for funding to aid in their efforts. Funding can be used for personnel, industry meetings, printing, and validation.

The criteria for grant approval include the following:

- The job area selected for developing skill standards must be of high demand in the local area.
- Partnerships with business and industry must be clearly established. Strong involvement of industry associations is highly recommended.
- Committed college leadership must be present (visible).
- Demonstrated evidence of previous work completed on skill standards or competencies in the intended job area (both state and national projects).
- Proposal needs to include project goals, scope of work, work plan, budget, evidence of business and industry involvement, project justification, and project evaluation.

Feedback on the proposal prior to submitting it can be obtained from RoseAnn Stevenson at 206-865-7155 or FAX 206-865-1984.

Final approval will be granted by the Workforce Division of the State Board (Dan McConnon 360-753-0878). Proposals should be sent to the State Board for Community and Technical Colleges, 319 East Seventh Avenue; P.O. Box 42495, Olympia, WA 98504-2495.

Instructions for Proposals
Skill Standards Development

To obtain funding, interested organizations must submit a proposal no more than five pages in length, including the project summary and budget including:

—Project Summary

1. Institution name and address
   Contact person, address, and phone number

—Business and industry partners

- Organization
- Contact person, address and phone number

2. Project description - Brief summary of the proposed project

3. Project period - Time period needed for project funding

4. Signature - The lead institution Chief Executive Officer must sign the proposal

—Project Justification

1. Describe the commitment and involvement of local business and community leaders to the project and its success.

2. Describe how the college will utilize the skill standards once they are developed.

3. Describe the specific problem or opportunity the proposed skill standards will address and how they will interface with other parts of your institutional curriculum development work.

4. Explain why this project is a priority for the college and business community - identify benefits to college, students, business and labor.

—Project Work Plan

1. Describe the proposed skill standards purpose.

2. Describe all major project activities - identify the anticipated starting and ending dates for each and the person responsible for each major activity.

3. Describe your partnering process - i.e., how the partnering agencies will work together, and the process through which roles and responsibilities will be identified.

—Project Budget

1. Summarize the costs of the proposed skill standards project. Include personnel, personal services contracts, printing and photocopying costs, mailings, rental and leases, goods and services, and travel.

2. If other resources will be committed to the project, please include these contributions and estimate their financial value.

Guidebook Volume I

SKILL STANDARDS

Section XII

What Literature Supports this Work and What Internet Resources are Available?

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BIBLIOGRAPHICAL REVIEW OF ASSESSMENT ISSUES RELATED TO THE SKILL STANDARDS EFFORT

This annotated bibliography modified from an American Electronics Association document reflects a sample of the current literature (primarily since 1990) on industry practices in assessment procedures, competency-based practices, and skill standards projects. The bibliography is designed to offer the user the opportunity to draw on information from wide-ranging sources to inform number of assessment-related issues.

These issues include the new and dynamic concept of work and how this new concept has affected U.S. legislation and the current drive toward skill standards. The focus on a successful School-to-Work transition has developed alongside this focus on how work is changing, and many business-education projects have been instituted that are aimed at improving this transition. Articles related to these efforts may provide readers with models for their own business-education partnerships.

Also included is an overview of some of the classic viewpoints on assessment from the industrial-organizational psychology and human resource management literatures. These pieces are designed to offer the reader an overview of the wide number of arenas in which assessment has traditionally been used and the important measurement issues that should be considered as well.

A particular focus has been placed on information about companies that are currently using performance-based assessment or competency-based assessment procedures in their human resource practices, particularly companies in the high-technology industries. Very little information is available about skill standards projects that are underway in the assessment phase. Also, very little information exists about competency-based assessment models and practices that have been evaluated and demonstrated to be successful in industry as a whole or in the electronics industry in particular.

Where examples and models do exist, they are included here in the section that addresses each practice individually, e.g., selection practices, training practices, etc. Additionally, a small sampling of information has been included on technology currently used in training. Finally, references are provided for similar efforts that have been undertaken to develop skill standards in other countries. Only a sampling of these articles has been included from the vast number that is available.

The references are grouped under the following headings: the changing nature of work, overview of assessment practices and techniques, government legislation and skill standards establishment, School-to-Work transition efforts (business-education partnerships), competency-based assessment efforts and models, self-assessment, applications to specific human resource practices (i.e., selection, pay/compensation, career succession, training, and orientation), trends in industries other than high-technology, and international efforts.

Cross-referencing is designated by "cf." where an item applies to more than one category.
~ indicates that the complete text was not available and information was drawn from an abstract.

—The Changing Nature of Work

Bridges, W. (1993). Job Shift. William Bridges and Associates. Reading, Mass: Addison-Wesley.

Discusses jobs as "social artifacts" and outlines the next evolutionary stage of jobless organizations. Describes ten rules for living in an age with no jobs, including seeing the organization as a "market," looking for customer's unmet needs, and learning to manage change-created transitions. Stimulating piece about the changing nature of the workplace and the individual's role in that dynamic environment.

DeFillippi, R.J., & Arthur, M.B. (1994). The boundaryless career: A competency-based perspective. Journal of Organizational Behavior, 15, 307-324.

Helpful piece that directly addresses the need for knowledge-based core competencies in dynamic contexts, such as starburst firms like Cypress Semiconductor and ThermoElectron. These new firms leverage key people as knowledge resources. Discusses the potential for boundaryless careers in the context of the changing organizational, occupational, and industry community contexts. An individual's worth is determined by "competency accumulation" for which the individual is responsible. Describes this in terms of know-why, know-how (includes reference to portfolio development), and know-whom. Notes that modern-day firms encourage more broad-based entrepreneurial competencies and a portability of knowledge and skills. Uses the Silicon Valley as an example of one place where individuals gain more industry-specific than employer-specific skills and notes the successes for organizations that result from this. Notes that emphasis is changing in the industry from a career-bounded approach of "I am an IBM engineer" to a boundaryless career approach of "I am a software engineer." Excellent article for outline dynamic nature of industry and explaining the need for occupational skills standards.

Downs, A. (1995). Planned people obsolescence. Training, 2, 54-58.

Discusses the need to hire workers with broad, flexible skills in light of the changing nature of jobs. Cites "learning skills" as one of the most important hiring criterion for management positions. Suggests a number of specialized training options including mentoring, internal and external courses, self-study courses, community college, and satellite courses.

cf. Selection; Training

Lawler, E.E., III (1994a). From job-based to competency-based organizations. Journal of Organizational Behavior, 15, 3-15.

Article argues convincingly for a new way of thinking about jobs. The changing environment of global competition and dynamic company needs and roles require a focus on the core competencies of organizations and the skills and knowledge of employees rather than upon "jobs." Outlines implications for many human-resource practices in high performing organizations.

Lawler, E.E., III (1994b). Ten new realities. Executive Excellence, 11(3), 18-19.

Suggests ten realities companies should be aligned with in order to restructure successfully. Among the ten are a new business environment, information technology, new work forces, competency-based organizing, and dynamic learning organizations.

—Overview of Assessment Practices and Techniques

Cascio, W.F. (1991). Applied psychology in personnel management (4th ed.). Englewood Cliffs, NJ: Prentice-Hall.

Exhaustive text on industrial/organizational psychology, discussing research on a number of assessment efforts. Outlines in depth technical expertise, measurement issues such as validity and reliability, and methods necessary in job analysis, performance appraisal, testing, human resource planning, recruitment, selection, job classification and placement, training and development, compensation and reward systems, ethical issues, and legal guidelines. Excellent text for complete understanding of technical issues. Focus on assessment centers provides a model for understanding potential internal and external certification centers.

Imel, S. (1990). Adult literacy learner assessment. ERIC digest, No. 103. Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education.

~Describes four approaches to adult literacy learning assessment: standardized tests, materials-based, competency-based, and participatory assessments. Competency-based assessment is useful for rewarding adults for prior learning but is still given under written test conditions.

Jenkins, D. (Jan., 1994). The role of standards, assessment, and credentialing in educating the high performance worker: Lessons from Denmark and Great Britain. Report of the New Standards Project Comparative Learning Team to the Center for Learning and Competitiveness.

Very helpful piece for contrasting various international assessment efforts and for outlining practical lessons that the U.S. can draw on for its own standards development. Describes efforts to develop an effective model for School-to-Work. At the time of the report, the U.K. was creating a standards system and Denmark was revamping its vocational education program. Particular challenges in the U.K. included the proliferation of specialized assessment programs and the overlapping efforts of different lead bodies. A broader overriding vision was needed at the outset. Pointers for conducting assessment efforts include: resist over-reliance on "end of course" and other on-demand testing; advocate assessment that is embedded in the teaching and learning process; encourage schools to involve members of the community in assessing students; provide training and support to help teachers learn new methods of assessment, but do not expect quick results; and give teachers opportunities for professional development to understand better what students need to know to succeed. Quotes Danish electronics student who argues for the learner having responsibility for his own learning because of the demands of electronics jobs.

cf. International efforts: Denmark; U.K.

Knapp, J. (June, 1992). Technical and Operational Standards for Credentialing Examinations: A Summary. Princeton, NJ: Knapp and Associates.

Useful technical guide for measurement issues in the development of a credentialing agency. Includes a discussion of validity issues, test development, and test performance.

Knapp, J. (March 3, 1995). Presentation at assessment forum describing procedures for establishing a credentialing system. Washington, DC: Department of Labor.

Very useful presentation materials contrasting established credentialing systems with the skill standards efforts. Addresses essential implementation, methodological, and legal issues. Describes two successfully established certification program

Simosko, S. (1993). Accreditation of prior learning: A practical guide for professionals. London: Kogan Page.

Excellent book outlining techniques to set up an accreditation of prior learning (APL) assessment center. Book draws on accreditation experiences from the U.S., U.K., and Australia. Outlines role of APL as portfolio of abilities and accomplishments—a recognition of individual's existing competencies. Notes that in the U.S., practices in competency-based assessment are primarily in the educational setting rather than in business settings. In the U.K., such assessment is largely used for employee career development.

cf. International efforts

Simosko, S. (Jan., 1995). Some initial thoughts on assessment. Unpublished paper.

Paper describes types of evidence that can be gathered in assessment efforts and outlines a number of issues that must be addressed when conducting an assessment effort.

Wigdor, A.K., & Green, B.F., Jr. (Eds.) (1991). Performance assessment in the workplace. Vols. 1 and 2. Prepared by Committee on the Performance of Military Personnel, Commission on Behavioral and Social Sciences and Education, and National Research Council. Washington, DC: National Academy Press.

Useful introduction to broad range of assessment issues, based on military research and practice.

Willis, J. (October 19, 1994). Building assessment services: The foundation. Draft manuscript prepared by the Institute for Educational Leadership and Meridian Corp.

Document outlining approach to developing and implementing job analytic techniques for a variety of purposes, including industry-wide skill standards. Suggests a moderate-specificity job analysis technique for efforts such as the skill standards project and low-specificity job analyses for developing and assessing basic and cross-functional skills. Useful technical manual for individuals not training in job analytic techniques or measurement issues, particularly validity. Also discusses a number of legal implications that should be considered.

Worthen, B.R. (Feb., 1993). Critical issues that will determine the future of alternative assessment. Phi Delta Kappan, pp. 444-454.

Provides perspective on performance-based assessment from an educational viewpoint. This field of assessment is not new to educators and there are striking similarities with industry's concerns, including accountability, uses of assessment, and clarity of terminology.

cf. School-to-Work

—Government Legislation and Skill Standards Establishment

Alexander, L. (August, 1991). America 2000. Department of Education publication.

Booklet outlining the education strategy and challenges under the Bush administration.

Alexander, L. (March 30, 1992). America 2000: One year later. Department of Education publication.

Outlines goals, progress, and challenges in implementation of America 2000 strategies.

Dole, E. (1990). Ready, Set, Work. Training and Development Journal, 44(5), 17-22.

Outlines four critical areas for improvement in U.S. labor market: skills gap, lack of structured School-to-Work transition, need to improve quality of training, and the shrinking labor pool. The Secretary of Labor discusses each of these difficulties and possible remedies, including the establishment of the National Skill Standards Board. Business-education partnerships are also suggested for the development of portable credentials, with the Department of Labor as a credentialing agency. Dole notes that only 1.4% of industry payroll is spent on formal training.

From the trenches: What vocational educators say about skill standards. (1994). Vocational Education Journal, January, 28-29.

Anecdotal support from vocational educators and trainers for the national skill standards project and the "certificate of mastery."

Geber, B. (1995). The plan to certify America. Training, 2, 39-44.

Critically examines skill standards effort, including in the electronics and retail industries. Includes samples of AEA's skill standards booklet. Notes that assessment will be very difficult and might include third-party verification for smaller companies, as well as increased use of computerized simulations where possible. Discusses the need for a taxonomy of occupational titles to integrate the effort. Much more positive review than provided by Lee (1995) in same issue.

Government and Public Affairs Dept. of Society of Human Resource Management/HR News staff. (1994). Executive Briefing: GOALS 2000: Education America Act Final. HR Magazine, May, 11-12.

Summary outlines the proposed membership of the National Skill Standards Board: two neutral human resource professionals; eight business representatives from small and large companies; six at-large members representing educational institutions, community-based organizations, state and local governments; chairperson of the National Educational Standards and Improvement Council; and three Cabinet members—Secretaries of Labor, Education, and Commerce.

Hodges, L. (April 1, 1994). Times Educational Supplement, Issue 4057, p. 11.

Introduces President Clinton's educational reforms and the program for national occupational skill standards certification.

Hudson, J.L. (1994). Skill standards will come with a price tag. Vocational Education Journal, 6.

Offers a generally positive overview of the skill standards development and portable credentials or skills certificates. The author, however, raises concerns about the definition of "broad occupational clusters" and industry sectors." He also questions the balance between training and certification of broad skills versus specific skills. Notes that disadvantages of the new skills system include additional cost, reorganization of programs, and increased teacher in-services.

Kaplan, L., & Seymour, W. (1994). Building consensus: How the electronics industry is developing skill standards. Vocational Education Journal, January, 23-25.

Introduces the efforts of the Electronics Industries Foundation (EIF), Electronic Industries Association, and the Department of Education in the development of national skill standards in concert with vocational education instructors (distinct from AEA efforts). The U.S. electronics industry will constitute $300 billion of the economy and will require approximately 2.5 million trained workers by the year 2005. The EIF goal is to develop entry-level requirements and a certification process for electronics technicians by September 1995. Presents several successful state models in education. Also discusses the difficulties of business-education partnerships, for example, the focus in education on specific skills and the contrasting desire of business for broad, general skills.

cf. School-to-Work

Lee, C. (1995). Out of the maze: Can the federal job-training mess be fixed? Training, 2, 29-37.

Very critical review of Clinton's progress in recreating a world class workforce. Provides details on the skill standards effort, one-stop career centers, and the School-to-Work Opportunities Act. Negatively reviews skill standards projects including AEA efforts. Describes basic flaws and practical problems inherent in standardizing quickly changing technical skills, the applicability of generic standards, and the usefulness of certification. Positively reviews Siemens' apprenticeship efforts.

Owen, J. & Sprow, E. (1994). Shop floor '94: The new world of work. Manufacturing Engineering, 112(5), 37-44.

~Introduces the standards set by Goals 2000 and outlines the establishment of the National Educational Standards and Improvement Council and the National Skill Standards Board. Also introduces the AEA project and three other industry-wide efforts.

Plan pushes certificates for every worker. (1994). Manufacturing Systems, 12(6), 10.

Announces establishment of National Skill Standards Board under the Goals 2000: Educate America Act.

Seligman, D. (June 14, 1993). The returning of norming. Fortune, 127(12), 139.

Criticizes legislative language on the development of the National Skill Standards Board and industry standards. Notes that warning to avoid disparate impact may lead to a return of race norming.

—School-to-Work Transition Efforts

[Note: The terms apprenticeship, business-education partnership, and School-to-Work transition efforts, while not synonymous, connote very similar ideas, and therefore, the term partnership will be used inclusively to refer to them.]

Applebome, P. (February 22, 1995). Employers wary of school system. New York Times, p. A1, A13.

Introduces research demonstrating lack of employer trust for entry-level worker proficiency. At a time when national education and labor policy is promoting cooperation between schools and businesses and when increasing skills are required in the workplace, employers making hiring decisions are most interested in applicant attitudes, communication skills, and work experience. The business and educational settings are operating on different tracks, in contrast to the integrated approaches in other countries, such as Japan.

Cunningham, A.M. (1992). Workplace SATs. Technology Review, 95, 20-21.

Notes efforts toward development of workplace SATs, criterion-based, work-related achievement tests, such as "Work Keys." Discusses the use of traditional General Aptitude Test Battery and Armed Services Vocational Aptitude Battery tests and notes problematic discrimination issues associated with these tests.

Dollar, E.R. (1988). In search of competent vo-tech grads. Training, April, 64-70.

Introduces competency-based vocational education (CBVE) approach from educator's perspective. CBVE is results-oriented vocational education that requires students to meet business standards. Performance objectives are based on three criteria: what the learner must do, under what conditions, and with what degree of skill. Proposes three methods of assessment: time-free curriculum (self-paced learning), competency profiles, and time-quality standards. Offers example of training auto mechanics by using industry-side, flat-rate manuals for assessing and timing students on task completion. Argues that office occupation training has traditionally been tested based on accuracy and speed and that the industrial trades should use the same model. Requests business experts to become involved in setting standards. Out lines vocational education effort to draw on the industry-wide skill standards even before they were officially developed. Good argument that standards are beneficial for instructors and students.

Filipczak, P. (1993). Bridging the gap between school and work. Training, Dec., 44-47.

Describes city-wide apprenticeship effort in Boston, established under the Job Training Partnership Act. Relates similarities of the German model with a 2 + 2 approach to certification. Excellent case study of the political and logistical difficulties of business-education partnerships as well as possible successes.

Frazier, F. (1992). Transition from school to work: Linking education and worksite training. Economic Development Review, 10(1), 78-79.

Outlines features of high-quality, cooperative education programs to facilitate School-to-Work transition. Features include agreement on training plans detailing general employability and specific occupational skills by employers, students, and schools; screening applicants to meet employer demands; and selecting employers who provide training in occupations with career paths.

Is your school ready for alternative assessment? (Feb., 1993). Phi Delta Kappan, pp. 455-456.

Outlines ten conditions that a school should meet before embarking on a new assessment approach. These conditions closely parallel those necessary in industry for creating a culture to support innovative assessment approaches.

Lynch, L.M. (1993a). Entry-level jobs: First rung on the employment ladder or economic dead end? Journal of Labor Research, 3, 249-263.

Comprehensive, longitudinal study examining education and training's effects on job tenure and mobility. Offers evidence of the positive effect of training for both the employer and the employee. Points out that when compared to Europe, one of the major differences in the U.S. is the lack of certification of qualifications (with the exception of apprenticeships). This prevents U.S. employers from being able to identify qualified workers and limits job mobility for young workers. Additional training or vocational education increases the likelihood that workers will advance in a company. Good argument for the development of skill standards.

Normann, R. (1994). Insurers, eyeing labor shortage, recruit students. National Underwriter, 98(39), pp. 16,37.

Outlines successful partnership between Allstate Insurance Cos., Zurich-American, and the Signature Group with local high schools, a community college, and a career cooperative. The School-to-Work Opportunities Act provides states with funding for job skills training for high school graduates..

Nothdurft, W.E. (1990). How to produce work-ready workers. Across the Board, 27(9), 47-52.

~Argues that U.S. new entrant work-readiness is low compared to overseas competitors and that an excellent public education system with work-relevant curricula is essential for workforce competence..

Office of Technology Assessment (1994). Testing and assessment in vocational education: Background paper. Publication of U.S. Congress.

Very useful document examining assessment techniques in education for workplace performance. Defines a number of current competency-based assessment approaches, including competency testing (written—multiple choice or matching), competency assessment (observed), academic testing, standardized testing, performance assessment, criterion-referenced testing and assessment, and norm-referenced testing. Report outlines various approaches to assessing broad technical skills and discusses the AEA project as establishing "occupational maps." Also discusses models being implemented in various states by different agencies and the challenges and successes of such efforts. Very informative for better understanding the levels of skills that can be trained and the implementation efforts being made across the nation on a number of different fronts.

Overman, S. (1990). Apprenticeships smooth school to work transitions. HRMagazine, 35(12), 40-43.

~Provides overview of Department of Labor efforts to expand School-to-Work programs. Outlines recommendations from the National Center on Education and the Economy's Commission on the Skills of the American Workforce for a uniform education performance standard and a comprehensive system of technical training and certification for noncollege professions. Discusses the German apprenticeship program as a model.

Overman, S. (1993). Business gives students a hand. HRMagazine, April, 46-50.

Outlines successful business-education partnerships in Texas, Nebraska, Tennessee, and Georgia. Although these are good case studies for local areas, they do not represent nationwide skill standards implementation. Such efforts may represent a first-step in that direction and also indicate the need for standards across companies as well as an integration with vocational school systems.

Packer, A. (Winter 1992/1993). The SCANS Challenge: Preparing your work force for high performance. Employment Relations Today, 19(4), 367-377.

Discusses Secretary's Commission on Achieving Necessary Skills (SCANS) competencies and argues that to integrate school and work successfully, human resource professionals will have to help workers in their own firms continuously improve SCANS competencies, agree on standards and approaches in the industry, and create working partnerships with local schools.

Packer, A. (1993a). Earning and learning major links to better living. HRMagazine, April, 51-54.

Realistic and helpful overview of the need for business-educational partnerships and shared values. The AEA integration of the skill standards and SCANS will assist in the development of successful education-business partnerships. States that a successful youth program has four necessary components: skill standards, option-rich schooling, learning-rich jobs, and development pilot programs.

Packer, A. (1993b). Skill deficiencies: Problems, policies, and prospects. Journal of Labor Research, 14(3), 227-247.

Suggests SCANS will help U.S. education systems and businesses respond to a number of labor problems. Recommends comparing graphs of skills profiles for the average occupational cluster against specific job profiles. Also explores some of the complexities of instituting standards and makes suggestions for addressing these complexities.

Secretary's Commission on Achieving Necessary Skills (April 7, 1992). Learning a living: A blueprint for high performance. Executive summary, U.S. Department of Labor publication.

Summary from SCANS provides an overview and approach to necessary changes in education and the workplace. Recommends changing programs in all schools to include the SCANS competencies (resources, interpersonal skills, information, systems, and technologies) as well as the foundation skills (basic skills, thinking skills, and personal qualities).

—Self-Assessment

Arnold, J. & Davey, K.M. (1992). Self-ratings and supervisor ratings of graduate employees' competences during early years. Journal of Occupational and Organizational Psychology, 65(3), 235-250.

Perceptions of employee work competencies were examined. Mean ratings of worker competencies differed across different organizations and self-ratings were higher than manager ratings. Self-ratings did not increase with tenure.

Guthrie, J.P., & Schwoerer, C.E. (1994). Individual and contextual influences on self-assessed training needs. Journal of Organizational behavior, 15, 405-422.

Study found that training self-efficacy and managerial support positively influenced perceptions of training utility. Educational level was negatively associated with perceptions of training utility. Could create problems in a dynamic workplace where continual training is necessary. Has implications for the increasing reliance on managers' self-assessed training needs and their accuracy.

Mitchell, L., & Sturton, J. (Eds.). (April, 1993). The candidate's role project: Final report. (Technical Report No. 12). Prime Research and Development Ltd., for the Employment Department's Methods Strategy Unit. Crown Copyright.

Helpful monograph for providing an overview of the variety of assessment techniques currently in use in the U.K. Exploring the desirability and feasibility of giving candidates an enhanced role in the assessment process. Concludes that candidate involvement enables the system to become fair, transparent, and enabling. The monograph, while recognizing limitations of candidate involvement, strongly supports their inclusion in assessment and outline steps for achieving involvement. Also offers definitions and models for assessment of competencies.

—Human Resource Practices: Selection Efforts

Dubnicki, C. & Williams, J.B. (1990). Selecting and developing outstanding performance. Healthcare Forum, 33(6), 28-34.

~Discusses use of competency-based techniques for selection and other personnel efforts, such as succession, training-development, and performance planning and appraisal. Argues that identifying the most critical criteria and assessing based on these criteria allows the company to reduce costs when making personnel decisions about key positions.

Myszkowski, G.J. & Sloan, S. (1991). Hiring by blueprint. HRMagazine, May, 55-58.

Outlines selection of salespeople through uncovering competencies. The salespeople work in a communication and telemarketing firm. Competencies are defined as being both personality and behavioral. Company's competency-based selection effort, white firm-specific, has significantly improved selection and return on investment through the identification of necessary competencies. Distinguished between excellent and average performers. This offers a good case study and model for the development of a selection system based on skill standards.

Nemerov, D.S. (1992). Finding successful telesales representatives. Telemarketing Magazine, 11(3), 19-22.

Argues that competency-based selection is the most appropriate for selecting telesales candidates. Job competencies are classified as conceptual, interactive, and trait. Selection is based on a behavioral interview and on job analysis information.

Rollins, T. (1990). How to tell competent salespeople from the other kind. Sales and Marketing Management, 142(11), 116-118.

Details a large computer company's efforts to launch a competency-based selection and training effort for sales positions. System was established through interviewing outstanding and average salespeople and determining "differentiation competencies." Competencies for average, excellent, and detrimental performance were uncovered. For average success, salespeople have to be competent in information collection, communication, personal sensitivity, relationship building, and technical knowledge. For excellent performance, three competencies were necessary: achievement, influence, and thinking. Characteristics detrimental to success were lack of self-confidence and high affiliation needs.

—Human Resource Practices: Job Orientation Efforts

Budreau, G.K. (1990). CBO: How well is it working for us? Nursing Management, 21(9), 50-51.

Discusses a competency-based orientation program. Reports improved incumbent perceptions and increased learner self-motivation.

—Human Resource Practices: Career Planning Development and Management Succession

Catalysts for career development: Four case studies. (1993). Training and Development, 47(11), 26-27.

Outlines case studies of innovative career development efforts in several companies, including 3M, AT&T, Corning, Ford Motor Co., and Westpac. Only the latter describes a competency-based effort and is focused on managerial competencies.

—Human Resource Practices: Performance Appraisal

Nowack, K.M. (1993). 360-Degree feedback: The whole story. Training and Development, 47(1), 69-72.

Describes the use of assessment information from around an employee, including supervisors, subordinates, peers, and customers. Offers an alternative to assessment centers, can be used for a variety of human resource purposes, and includes software used to score the information and to give personalized feedback. Suggests skill competencies as one source of examination in the assessment. Discusses the psychometric considerations and possible challenges.

cf. General assessment practices; Self-assessment; Technology in training

—Human Resource Practices: Compensation and Skill-Based Pay

Crowe, D. (1993). Managing Change—The compensation issues. Benefits and Compensation International, 23(9), 18-22.

Describes risks involved in change efforts to competency-based pay and incentive arrangements. Risk areas include commitment of sponsors, skills of the change agents, overcoming resistance to change, and cultural alignment.

cf. International efforts: U.K.

MacLean, B.P. (1990). Value-added pay beats traditional merit programs. Personnel Journal, 69(9), 46-52.

Outlines how to add competency-based compensation programs to existing traditional merit pay systems and how this reduces organizational costs. Effort requires a redefinition of performance and competencies. Superimposes salary curve with levels of competency ranging from familiarity to proficiency to mastery.

Nemerov, D.S. (1994). How to design a competency-based pay program. Journal of Compensation and Benefits, 9(5), 46-53.

Very helpful piece for describing implications that well-developed skill standards can have on effective compensation efforts and the need to move away from traditional pay systems. Suggests employees be rewarded for skills, not job descriptions. Defines competencies as existing at a higher level than knowledge, skills, and abilities and uses conceptual model very similar to that of the electronics industry's skill standards project. Describes how a Bell operating company developed training competencies based on the strategic plan. Outlines development of an in-house competency model and then how a pay system (and conceivably any human resource effort) can be developed from this model. Describes how a computer service sales organization related particular competencies to specific outcomes desired and outlines an information technology firm's use of the competencies for managerial placement recommendations. Also discusses measurement difficulties involved in conducting individual employee assessments. Notes that a telecommunications company has used the competency-based approach to reward, using outcome-based "results achieved" rather than performance appraisals.

—Human Resource Practices: Training Efforts and Certification

Bottoms, D.T. (1993). Value-added employees. Training Week, 242(3) 58.

Presents continuous work-based learning as the key to productivity as outlined by the National Advisory Commission on Work-Based Learning. Commission will promote workplace changes to incorporate the use of SCANS to development of industry-specific skill standards.

Cavanaugh, H.A. (1991). Learning to work the lines at Tampa Electric. Electrical World, 205(9), 93-34.

Case study of competency-based training program for a power company line worker. Each skills module includes four parts: the employee studies written materials and watches accompanying instructional videos; second, employee passes a written test; next, employee practices skill as much as needed; and, finally, employee demonstrates skill performance to an instructor. Program is computer-based and can be customized for local needs. Participants are pre-screened on baseline competencies in order to be eligible for training. Program appears unwieldy in its inclusion of 249 skills modules for workers to move from entry-level to full journeyman positions.

cf. Technology in training

Cobb, J., & Gibbs, J. (1990). A new, competency-based, on-the-job programme for developing professional excellence in engineering. Journal of Management Development, 9(3), 60-72.

~Discusses Mobil Oil Corp.'s use of competency-based training for workers at foreign locations.

Hamm, M.S., & Early, L.A. (Dec., 1994). Certification: Yes or no? Association Management, 89-94.

Very good practical guide for developing certification programs. Introduces the skill standards effort in light of existing certification programs in trade associations and professional societies. Outlines caveats that must be considered and avoided; competing certification programs, over-estimating the financial benefits, neglecting evaluation and risk analysis, and narrow support for program. Necessary components of the effort should include objectivity, consensus, budget, time, demand, revocation provisions, recordkeeping, consultation, and attention to liability, membership, and perceived threats.

Krebs, R.E. (1992). A curriculum for professional research administrators? SRA Journal, 24(1), 25-30.

~Outlines a competency-based, self-instructional curriculum training program for the research administration profession. Two types of curricula exist: (1) an individualized program requiring independent effort and (2) a systematic approach using clearly defined competencies to be achieved.

cf. Self-assessment

Mirabile, R., Caldwell, D., & O'Reilly, C. (1987). Soft skills, hard numbers. Training, 24(8), 53-56.

Focuses on management training but covers many of the competencies in the skill standards including analytical thinking, forecasting, and organizational knowledge. Outlines steps for development of content-valid, competency-based program, including individual skills profiles and evaluation of proficiency on various knowledge and skills. Discusses usefulness for career development.

Moskal, B.S. (1989). Hybrid incubator hatches workers. Industry Week, 238(15), pp. 27, 30.

~Discusses Saturn Corp.'s use of individualized, needs-driven, competency-based training that includes team concepts and leadership skills. Team members learn at their own pace and advance after having mastered a task.

Smith, J.E., & Merchant, S. (1990). Using competency exams for evaluating training. Training and Development Journal, 44(8), 65-71.

Discusses competency-based training and evaluation based on a content analysis model. Offers guidelines for "hands on" or work sample testing and distinguishes training approaches for new and more senior employees. Presents case study of General Dynamics' use of content-valid training for training computer use in manufacturing. Training exams and retesting offer opportunities for feedback and development and are not used to screen out employees.

cf. Technology in training

Tompkins, J.A., & Daley, F.E. (1992). Relying on competency-based training for computer-based systems. Industrial Engineering, 24(5), 46-51.

Strong piece regarding the development of a competency-based training model for training computer use. Notes that to motivate individuals in the training process, a pay-for-skill program should be instituted. Argues that the most significant benefit to result from competency-based training and pay-for-skill is the correct use of the company's computer-based system. Benefits also include increased workforce flexibility, increased productivity, improved customer service, increased organizational commitment, and reduced turnover and absenteeism.

cf. Compensation; Training; Technology in training

—Human Resource Practices: Technology Used in Training and Training Efforts in High-Technology Firms

*A large number of books are available using technology in training efforts. A sampling is included here.

Bentley, T. (1992). Training to meet the technology challenge. London: McGraw-Hill.

Relatively current book covering a spectrum of training-related issues in light of the increasing use of technology.

Carnevale, A.P., Gainer, L.J., & Schulz, E.R. (1990). Training the technical work force. San Francisco: Jossey-Bass.

Book discusses special training need of technical workers and describes the best practices for training them using a number of systems. Presentation is pertinent to the electronics industry.

Denning, J.D., & Verschelden, C. (1993). Using the focus group in assessing training needs: Empowering child welfare workers. Child Welfare, 72(6), 569-579.

~While concerning a different industry, this article may be helpful for outlining how groups of employees can assess specific training needs of individuals. Also includes the presentation of multimedia, interactive, computer-based training technology for meeting training needs.

cf. Examples in other industries

McDade, C.E., & Goggans, L.A. (1993). Computer-based precision learning: Achieving fluency with college students. Education and Treatment of Children, 16(3), 290-305.

~Discusses a university academic support center's use of computers with competency-based courses. Students do not attend traditional lectures, work at their own pace, use course materials, tutors, and computers.

cf. Self-assessment

Office of the American Workplace (1994). Integrating technology with workers in the new American workplace. Publication of U.S. Department of Labor.

Discusses manner in which new technology has changed the American workplace, the need for training in the move to high performance companies, and offers case studies of several organizations (e.g., NUMMI, NYNEX) undergoing such changes. Describes technological training techniques such as simulation software programs, satellites, videos, and computer networks. Mentions Motorola's use of CD-ROM training technology, Holiday Inn's use of multimedia training, and Fannie Mae's training program based on expectation for future technological needs.

Thomson, S. (1992). Using videotape as a supplement to traditional student-teacher supervision.

~Discusses use of videotaping to improve competency of student teachers. Feedback with supervisors created optimal learning.

—Trends in Industries Other than High-Technology

Hainsworth, B.E. (1993). Commentary: Professionalism in public relations. Public Relations Review, 19(4), 311-313.

~Article argues for importance of accreditation, ongoing professional education, and competency-based examinations for public relations practitioners. Author also favors a move toward certification programs that are similar to those used in the U.K.

Kinsella, B. (1993). A year of training accomplishments. Graphic Arts Monthly, 65(1), 80-81.

Discusses the establishment of the WorkPLACE basic skills assessment test that has been developed for graphics arts employees. Effort is part of the Department of Education grant to the printing consortium.

Sutphin, E. (1994). Following the ASE lead. Vocational Education Review, Jan., 26-27.

Useful piece to understand the current use of standards in the automotive industry. Argues that lack of ethics created the need for industry-wide mechanical skill standards and testing criteria. Automotive Service Excellence (ASE) is the only program for auto mechanics that outlines the standards for certification and recertification. Author sees certification as a means to prove his own mastery while noting that others have seen it as a waste of time. Notes that use of advisory committee from local business and trade to vocational education is important.

—International Efforts

AUSTRALIA:

Conway, R.N. (1992). Disability and legislation: The relationship between changing policy and changing practices. Australia and New Zealand Journal of Developmental Disabilities, 18(2), 65-73.

~Discusses impact of competency-based national skill standards on employment and legal issues for the intellectually disabled.

Horrocks, R. (1993). A case for developing generic management standards in Australia. Practising Manager, 14(1), 18-23.

~Describes case for establishment of nationally accepted, generic management standards as Australia moves toward a competency-based system.

cf. Assessment practices

Pinto, C.D.G., & Corbett, S. (1994). Top Australian business people—Geoff Morgan and Andrew Banks. Practising Manager, 14(2), 3-12.

~Discusses how individual responsibility for one's own career, divorced from any particular organization, has changed employment patterns. Also discusses use of psychological and competency-based tools for selection.

cf. Selection

Robinson, P. (1993). Teachers facing change. A small-scale study of teachers working with competency-based training. Leabrook, Australia: National Centre for Vocational Education Research.

~Interviews with vocational teachers regarding changes in their roles as a result of competency-based training

cf. School-to-Work

CANADA:

Field, L.M. (1993). How competent are your managers? A five-step training cycle can help develop key competencies. Canadian Manager, 18(3), 18-19.

~Offers cyclical competency-based training model for managers.

cf. Training

SINGAPORE:

Law, S.S. (1992). Overview of vocational training programmes: Singapore study. Singapore: Institute of Technical Education.

~Outlines history of vocational education in Singapore and discusses recent efforts to develop skill standards that meet industry needs.

cf. School-to-Work

UNITED KINGDOM:

Brown, S. (1980). What do they know? A review of criterion-referenced assessment. Edinburgh, Scotland: Her Majesty's Stationery Office.

Book partially funded by Scottish Education Department. While largely focused on education, also addresses validity issues that are pertinent to competency-based assessments in businesses. Particularly helpful for detailed understanding of benefits of criterion-based assessment compared to normative-based assessments.

Crabb, S. (1991). Certified competent. Personnel Management, 23(5), 57-58.

Describes an accreditation program for managers at Safeway, in the United Kingdom, using a number of different assessment procedures for both selection and training. Appears to be a well-developed program that has applicability across the grocery industry as well as within a local company context. As an example of their interpersonal training, author notes that conflict resolution is contained in six competencies: problem analysis, problem-solving, oral communications, human relations skills, leadership, and self-confidence. On-the-job training is used for eight of the fourteen competencies that are trained. Employees are required to have regular updated skills assessments and are held accountable for their performance results from the training program. Good model for examining a credentialing program for managers.

cf. Training

Education/Industry links: Compacts' job guarantee fails. (1992). Personnel Management, 24(3), 51-52.

Describes how recession prevents industry and education compacts from guaranteeing jobs upon completion of certification but notes that such coordinated efforts still spur many positive outcomes.

cf. School-to-Work

Fletcher, S. (1992). Competence-based assessment techniques. London: Kogan Page.

Book based on competency-based assessment efforts in the United Kingdom and comparing U.K. efforts to U.S. practices. Outlines difficulties encountered in the U.K. efforts. Written in simple language, offers a general overview to assessment, without emphasizing technical aspects, and includes several case studies.

Jessup, G. (1991). Outcomes: NVOs and the emerging model of education and training. London: Falmer Press.

Book outlines the approach to nationwide skill standards in the U.K. Discusses outcome-based efforts and practical implications. Notes that issues still need to be resolved, including the need for a common language of assessment and consensus on the role of knowledge that underlies performance competencies.

cf. Assessment practices

Madaus, G.F., & Kellaghan, T. (Feb., 1993). The British experience with 'authentic testing.' Phi Delta Kappan, pp. 458-469.

Reviews the successes and difficulties of the use of performance-based testing in the British K-12 educational system.

cf. Assessment practices; School-to-Work

Newton, W.M. (1993). Skill standards, British Style. Linking assessment and training in the United Kingdom. NOICC Occasional paper No. 6. Washington, DC: National Occupational Information Coordinating Committee (DOL/ETA).

~Comprehensive overview of U.K. skill standards development methodology and implementation guidelines.

Rylands, J. (1993a). Construction upgrade. A pack to improve communication, numerical and IT skills for NVO. London, England: Adult Literacy and Basic Skills Unit.

~Materials packet for assisting students to improve carpentry and joinery skills. Lists basic and core skill units. Includes self-assessment questionnaire and materials that can be used in a variety of settings.

cf. Self-assessment; Training

Rylands, J. (1993b). Caring upgrade. A pack to improve communication, numerical and IT skills for NVO. London, England: Adult Literacy and Basic Skills Unit.

~Materials packet for assisting students to improve caring skills (e.g., child and community care). Lists basic and core skill units. Includes self-assessment questionnaire and materials that can be used in a variety of settings.

cf. Self-assessment; Training

Standards Program Training Agency. (1990). Competence and Assessment: Compendium No. 1. Quarterly bulletin of the Employment Department, U.K. Winchester: Sarsen Press.

Excellent piece to read to understand complexities of instituting a national skills project. Includes selected articles from the first two years of publications regarding the U.K.'s national skill standards project. Includes many important pieces regarding the common use of language, case study successes, the challenges of implementing an assessment system, and measurement issues including validity, reliability, and accuracy. Reader should recognize that the systems and purposes in the U.K. are distinct from those in the U.S., however.

cf. General assessment practices

Standards Program Training Agency. (1993). Competence and Assessment: Compendium No. 3. Quarterly bulletin of the Employment Department, U.K. Winchester: Sarsen Press.

Helpful piece to understand the continuing challenges of instituting a national skills project. Includes selected articles from the latest thinking about the U.K.'s national skill standards project. Includes insightful pieces of outlining difficulties in a number of areas including assessing each performance criterion, training assessors, and distinguishing knowledge and performance. Also discusses the importance and effectiveness of including candidates in assessment development and in self-evaluation as well as how to devise an assessment plan. Reader should have some familiarity with the U.K. efforts.

cf. Assessment practices; Self-assessment

INTERNET RESOURCES

Note:
Internet sites are subject to change.

Advanced High Performance Manufacturing Skill Standards

National Skill Standards Project for Advanced Manufacturing. What manufacturing workers need to know and be able to do...Introduction.
http://www.bmpcoe.org/

Center for Learning Connections

Link to Washington State Skill Standards and Work-based Learning Resource Center
http://www.learningconnections.org/

Coop Ed Skill Standards

Cooperative Education Skill Standards…
http://www.dpi.state.wi.us/dpi/dlsis/stw/cestand.htm

Council on Hotel, Restaurant, and Institutional Education

Student Connection. Current Update. Benefits of Skill Standards.
Skill Standards Project info…
http://www.chrie.org/skillinfo_new.html/

Dictionary of Occupational Titles (DOT) Index

Dictionary of Occupational Titles (DOT) Index.
http://www.wave.net/upg/immigration/dot_index.html

Documents About Standards

Documents About Standards. Here are abstracts of projects to develop state curriculum frameworks and content standards
http://inet.ed.gov/G2K/doc-stan.html

Gateway: Bioscience Industry Skill Standards

ABSTRACT OF "GATEWAY TO THE FUTURE" "Gateway to the Future:
Skill Standards for the Bioscience Industry"
http://www.edc.org/CEEC/home/bioscibk.html

GOALS 2000: A Progress Report -- Table of Contents

GOALS 2000 A Progress Report Spring 1995
http://inet.ed.gov/pubs/goals/progrpt/index.html

Industry Based Skill Standards

Standards developed by the U.S. Department of Education and Labor.
Twenty-two industries are profiled.
http://vocerve.berkely.edu/skillstand.htm

Making Sense of Industry-Based Skill Standards

Making Sense of Industry-Based Skill Standards (MDS-777) T. Bailey, D. Merritt.
The skill standards movement has emerged from a conviction that technology...
http://vocserve.berkeley.edu/Summaries/777sum.html

MDS-777: Industry-Based Skill Standards

NCRVE Home | Site Search | Product Search | Events Calendar | Rate This Website.
Making Sense of Industry-Based Skill Standards. MDS-777**.** Top of Document.
http://ncrve.berkeley.edu/MDS-777/contents.html

Michigan Center for Career and Technical Education

MCCTE. Home.
http://www.mccte.educ.msu.edu

National Center on Education and the Economy

Home. Programs. Products. Prof. Development. What's New. Map
http://www.ncee.org/

National Center for Research in Vocational Education [NCRVE]

National Center for Research in Vocational Education
http://ncrve.berkeley.edu.Default.html

National Health Care Skill Standards Project

Interesting Allied Health Links. Jump to: Skills-Related Documents and Internet Sites.
Internet Resources for the Allied Health Professions.
http://www.wested.org/nhcssp

National School-to-Work Learning and Information Center

National Skill Standards Board. Definition: Established under Title V of the Goals 2000: Educate America Act, the National Skill Standards Board
http://wwwstc.cahwnet.gov/stwgloss/def32.htm

National Skill Standards Board

National Skill Standards Board Home Page | Links.
http://www.nssb.gov/

National Tooling and Machining Association

National Skill Standards Board Home Page | Links.
http://www.nssb.gov/

Natperf.htm

Summary: National Performance or Skill Standards-are another occupational resource for our technical programs. Check out the skill standard projects to see if your occupational area is being…
http://www.waukesha.tec.wi.us/homepage/natperf.htm

NCRVE's Skill Standards Page

NCRVE's Skill Standards Page. NCRVE's links to information about the 22 skill standards projects sponsored by the US Departments of Education and Labor....
http://ncrve.berkeley.edu/SkillsPage.html

NCRVE MDS-777: Executive Summary

Summary: Bailey, D. The skill standards movement has emerged from a conviction that technology and market changes have caused significant modifications in the types of skills and behaviors needed by workers on-line job.
URL: *http://ncrve.berkeley.edu/MDS-777/ExecSum.html*

NCRVE MDS-777: References and Skill Standards Pilot Projects

NCRVE Home | Site Search | Product Search | Events Calendar | Rate This Website.
NCRVE Home | Full-Text Documents | Contents | Previous Section | Next...
http://ncrve.berkeley.edu/MDS-777/Refs.html
http://ncrve.berkeley.edu/MDS-777/Projects1.html
http://ncrve.berkeley.edu/MDS-777/Projects2.html

O*NET - The Occupational Information Network

O*NET - The Occupational Information Network. The Nation's Primary Source of Occupational Information
http://www.doleta.gov/programs/onet/

Outcome Based Learning - A Background

From the fall of 1991 until September, 1994, Curriculum and Instructional Services staff prepared for the implementation of Outcome-Based Learning
http://www.yrbe.edu.on.ca/obl/bkground.html - size 3K - 25 Apr 96

Outcome Based Learning - Action Plan Summary

September, 1994 - December, 1995. The tasks defined in the "Strategic Action Plan for the Implementation of Outcome Based Learning in October 1994...
http://www.yrbe.edu.on.ca/obl/action.html

Outcome-Based Learning

Background: The York Region Board of Education introduced an Outcome-Based Learning (OBL) approach to curriculum to schools in York Region
http://www.yrbe.edu.on.ca/obl/obl.html

OVAE Skill Standards

States and communities across America are focusing on improving schools and raising student achievement. One important effort, supported by the U.S.
http://www.ed.gov/offices/OVAE/SkillStan.html/

Resources

Extensive national and international literature review of the Skill Standards Research and Communications Project is stored in the Texas Skill Standards Repository.
http://www.coe.tamu.edu/~ehrd/skills/exsummry/rsrcs.htm

SCANSLINK

ScansLink. A product of the Texas Skills Standards and Certification Project.
"A professional development newsletter designed to instruct, inform, and provide feedback to educators."
http://www.dcccd.edu/nlc/misc/scans/slink.htm

Sites Offering Academic and Skill Standards

This is an annotated listing of sites emphasizing the development of state and national academic and skill standards as well as educational standards for the arts, civics, mathematics, and sciences. ...
http://www.ed.gov/G2K/standard.html

Skill Standards

NACFAM's skill standards work focused in three areas; The Research and development of skill standards for manufacturing funded by the U.S. Departments…
http://www.nafam.org/skill.htm

Skill Standards Links

| Home | Searches | Key Areas | Hot Spots | News Events | Links | Contacts | Tips | Skill Standards Links Skill Standards Making Sense of Industry-Based Skill Standards A Conceptual Framework for Industry-based Skill Standards Integrating.
http://connections.msu.edu/links/ss/index.html

Skill Standards Links

Skill Standards Links Washington State Skill Standards is not responsible or liable for any content on these links. Council on Hotel, Restaurant, and Institutional Education Human Services Research Institute Illinois Skill Standards
http://www.wa-skills.com/links.html

Skill Standards Projects

Skill Standards Projects: agriculture, early childhood education, chiropractic, cosmetology, chemical dependency counseling, allied dental health, natural resources and environment, food processing, information technology, manufacturing technology advisory, patrol officer, wood products manufacturing…
http://www.wa-skills.com/projects.html

Skill Standards: Related Web Sites

[ETA Directives | Directories | Legislation | Press Releases | External Links] Skill Standards-Related Web Sites National Skill Standards Board SkillsNET NCRVE Skill Standards Page CORD Skill Standards Page National Health Care Skill Standards…
http://www.ttrc.doleta.gov/WWWBETA/chris/skillstd/old/sites.html

SkillsNET Corporation

SkillsNET. A service dedicated to the development and advancement of Skills and Skill Standards
http://steps.atsi.edu/

Standards: Making Them Useful – Assessment

Standards: Making Them Useful and Workable for the Education Enterprise – 1997 Assessment**.** Assessment and Testing are fundamental to any conception of a national standards system…
http://www.ed.og/pubs/Standards/assess.htm

TTRC – Skill Standard Home Page (TEXT)

General Information includes a fact sheet on skill standards, a fact sheet and information on the National Skill Standards Board (NSSB), Guiding Principles,
and the NSSB legislative charter.
http://www.ttrc.doleta.gov/skillstd/skillstdtxt.htm

Texas Skill Standards Research and Communications Project

Welcome to the Texas Skill Standards Research and Communications Project. Project Information. Skill Standards Literature Review. National Skills...
http://www.coe.tamu.edu/~ehrd/skills/sshomepg2.htm

Washington State Skill Standards and Work-Based Learning Resource Center

Information on current and developing issues and projects.
http:www.wa-skills.com

What Are Industry Skill Standards?

What Are Industry Skill Standards? About NIMS. About Skill. Standards. What Are Industry. Skill Standards? Which. Metalworking. Industries Have Skill Standards.
http://www.nims-skills.org/pages/Indskil1.htm

What are Skill Standards?

As defined by the National Skill Standards Board, skill standards are "performance specifications that identify the knowledge,.
http://www.ocbbs.odessa.edu/public/oc/haz.mat/skillstandards.htm

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Guidebook Volume I

SKILL STANDARDS

Section XIII

Appendix

- Articles

—What Employers Want from College Grads
Occupational Outlook Quarterly/Summer 1994

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—R & D Survey Methodology, FY 1994

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Appendix 1 - Article

What Employers Want from College Grads

—Occupational Outlook Quarterly/Summer 1994

The ability to accept responsibility, honesty, and integrity are always important indicators of job performance, say employers who hire new college graduates. In a survey of more than 600 businesses, industries and governmental organizations, employers of new college graduates were asked to rate 65 factors by level of importance.

Among the factors rated "almost always important as a job performance indicator" were sincerity, eagerness, decision-making skills, critical thinking, initiative, professional attitude and oral communication and verbal skills.

"Sometimes important" factors included leadership in extracurricular activities, numerical and mathematical aptitudes, research and investigative skills, and quality of college or university attended.

Some "seldom important" indicators were athletic team achievements, laboratory experiment reports, intramural sports participation, and samples of long research papers.

(The surveys did not ask about the importance of one's major field of study; **"The Class of '90: One Year After Graduation,"** by Gary Steinberg, which appears elsewhere in this issue of the Quarterly, shows how important a major can be.)

The survey report, **"Recruiting Trends 1993-94,"** also has information on hiring intentions among employers of new college graduates, average starting salaries, interview "weeder" questions used by employers, new and emerging occupations, job opportunities by geographical regions, and more.

For a copy of the study, write to L. Patrick Sheetz, Director, Collegiate Employment Research Institute, Michigan State University, 113 Student Services Building, East Lansing, MI 48824-1113, (517) 355-9510, ext. 361. (Cost: $25.)