NSRP ASE Crosscut Initiatives Panel Project

Workforce Preparation Improvement

Final Report

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For the

NSRP Crosscut Initiatives Panel

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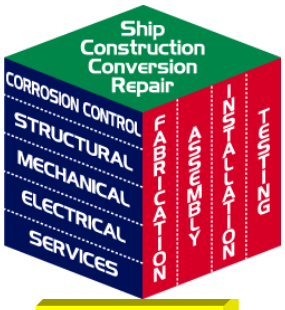
1. Project Summary

Project Goals: The Workforce Preparation Improvement (WPI) project was aimed at meeting needs identified in the Crosscut Initiatives Panel Strategic Initiatives Plan (SIP) topic for improved workforce development, education and training. These needs are:

- To have an easy way to manage and share skill standards;
- To get more support from community colleges for core academic components and basic knowledge; and,
- A strategy and compelling common rationale for shipyards to participate in skill standard implementation.

Skill Standards: The project continued Crosscut Panel emphasis that skill standards are a bridge between the world of learning/education and the world of employment/work proficiency. Prior to the panel project, no participating shipyard reported use of a skill system with broad database capability and strategic management features. National skill inventory and management systems were reviewed. Many shipyards do not use common skill standards produced by NSRP, US Department of Labor O*NET, or Manufacturing Skill Standards Council. Others have used entry level job profiling services of Work Keys® customized to their shipyard or in-house systems.



SkillsNET Corporation's approach to skill inventory and management was introduced to participating shipyards and colleges. SkillsNET supported the project with training, services, and web-enabled tools built around their SkillObject™ construct. Several shipyards and colleges are considering adopting/adapting skill inventory and management systems.

Community College-Shipyard Connections: Fourteen percent decline in shipbuilding and repair industry employment between 1983-2002 minimized significant need for new workforce preparation. Impact of current workforce aging and retirement along with increasing defense, homeland security, and commercial-offshore shipyard activity noted in 2006 has accelerated recruiting efforts. Many entry-level workers are not prepared resulting in additional cost and time for training borne solely by shipyards. Community colleges are an important source of work-based learning. The shipbuilding industry is more clearly stating its need for entry level knowledge and core skills or abilities as a result of skill standards analysis. Extensive dialog between educators and shipyard managers resulted in new programs and pilot projects. New curriculum specifically focused on shipbuilding and repair skills has been or is being developed. General academic and manufacturing-assembly curricula is customized to include shipbuilding and repair examples in courses. The Training Within Industry (TWI) program, used to

accelerate workforce preparation at the beginning of World War II, is being re-introduced to US manufacturers and supporting colleges.

Regional resource centers are improved or developing to provide improved visibility and services for community college and related job service centers that support shipyard workforce preparation. Methods of improving on-the-job instruction, a key overlap to college work, are introduced. A pilot project between one mid-tier expanding shipyard, Alaska Ship and Drydock, Inc., and its supporting college University of Alaska Southeast, Ketchikan Campus demonstrated a range of learning technology, modular curriculum design, and multiple-path learning delivery techniques that is already showing positive results.

Strategies for Industry Collaboration: Crosscut Panel activities have long sought collaboration around common organization, management, supervision, and manpower business elements. Multiple factors, including general decline in industry employment, failed to provide incentive for shared effort around workforce preparation improvement. Project activities to improve collaboration were undertaken. A web site to share panel project information and connecting links was established and used by participants. Open meetings were held in four different locations between May, 2006 and January, 2007. A draft generic career path representation for shipbuilding and repair was developed by Bender Shipbuilding and SENESCO Marine then simplified by the Northrop Grumman Newport News apprentice school. Specific regional initiatives begun in Hampton Roads in 2004 and as a result of hurricane Katrina on the Gulf Coast involving Alabama Technology Network of the Alabama College System, Northrop Grumman Ship Systems, Signal International LLC and others revealed emerging practices and methods to overcome roadblocks between labor-organized and independent shipyards, cross-state and other boundary issues that can lead to job portability to achieve "one yard – any yard" workforce flexibility. Curriculum is being shared between shipyards and community colleges, then cross-shared between colleges, in ways that do not reveal any proprietary information. The Crosscut Resources Center, dormant since 2004, is revitalized. The lack of good industry image representation and generic but realistic job descriptions (words and video) led to development of projects for 2007 in progress focused on industry image improvement and a career day for junior high/middle school youth.

Coordinating Activities: Fourteen shipyards, ten community colleges and six other organizations had some participation in the project. The four regional panel project meetings held in conjunction with Crosscut Panel meetings resulted in the highest ever attendance and participation in Crosscut events. Three regional resource centers in Hampton Roads, greater Seattle, and Gulf Coast along with their supporting web sites were showcased. The panel project web site www.crosscutprojects.com and revitalized Crosscut Resources Center hosted by www.nsrp.org provide extensive reference and best practice information. Project leadership team made presentations to Lean Forum IV in

Jacksonville, the Ship Production Symposium in Fort Lauderdale, and the Navy Ship Tech 2007 conference in Biloxi and briefed several other NSRP Ship Production Panels.

Budget, Cost Share, and Return on Investment: The project was completed under budget but required a two-month extension for some collaborative work completion. Documented cost share exceeded expectation by a factor of eight. In addition, other resources have been committed to related workforce preparation improvement in part levered by this panel project. The main pilot project in Ketchikan, Alaska, drew an additional $148,000 US Department of Labor-ETA grant, and a $126,000 Alaska Department of Labor and Workforce Development grant for building workforce preparation capacity led by the University of Alaska Southeast, Ketchikan Campus. The Alabama Technology Network, along with cooperating shipyards and colleges received additional Katrina-related funding. The Hampton Roads consortium of shipyards, colleges, and job service centers obtained a $1.8 million US-DOL ETA High Growth Initiative grant and is preparing additional grant funding request to the National Science Foundation for additional work centered at the Tidewater Community College. Impact of the workforce preparation improvement project on cost savings or avoidance in the US shipbuilding and repair industry cannot be computed at this time. The project investment is consistent with recommended improvements needed in manpower and organization of work that were identified as priority 13 of 48 for first-tier shipyards, and priority 4 of 50 for mid-tier shipyards in Global Shipbuilding Industrial Base Benchmark Studies reported in 2006 and 2007.

Recommendations for further research and development. The full benefit of a national shipbuilding and repair skill inventory and management system requires additional research. Other industries, such as health care, information technology, and aerospace, and construction use national skill standards and related databases effectively in *Recruiting & Selection, Capacity Planning, Training and Development, Personnel Alignment, Promotion, Retention, Staffing, and Career Structuring.* Demonstrated success of college-shipyard collaboration and networked learning between colleges point to the opportunity for additional steps in developing a nationally recognized curriculum for selected shipyard specific skills, and exploration of a nationally recognized curriculum for shipyard leadership and supervisory skill development.

2. Project Background and Rationale.

The National Shipbuilding Research Program publishes a Strategic Initiative Plan to guide research and development efforts. The 2005 SIP contains guidance on initiatives for education and training and for workforce development – two topics that overlap in the WPI Project. The following pertinent extract is from the Crosscut Initiatives section, of the NSRP SIP pages 119-124 of the SIP.

> A critical element in the transformation of the industry is the shipbuilding and ship repair workforce. The U. S. shipbuilding and ship repair industry shares much in common with other U.S. manufacturing and construction industries. The productivity of many U.S. manufacturing and construction industries is directly related to the level of skill of the workforce employed in that industry. More than 50% of U.S. employers say they cannot find the skilled workforce required. This is particularly true for entry-level positions. It is estimated that U.S. businesses, in general, spend up to $30 billion to train and retrain their workforce. The shipbuilding industry is no exception. In fact, the U.S. shipbuilding industry has lost approximately 150,000 skilled employees since the late 1980's mostly due to the stagnant market. This has caused the shipbuilding industry to experience a "generation gap" of skilled employees.
>
> A successful transformation of the industry must address the factors in existing shipyard cultures that negatively impact and influence the workforce. These factors limit the implementation of needed technology and process changes. They limit the industry's ability to compete for and retain skilled and quality workers.
>
> To address the industry's people and organization needs, this major initiative includes five sub-initiatives:

- **Education and Training –** the programs and technologies that enable existing and future shipbuilding and ship repair employees to acquire needed knowledge, skills and experience.
- **Technology Transfer** – the process of sharing and transferring technology and expertise gained from research program results and best practices within the shipbuilding and ship repair industry.
- **Workforce Development and Retention -** the programs and activities needed to attract, develop, and retain qualified personnel to support shipyard operations.
- **Organizational and Cultural Change** – the activities that support modifying/altering workplace values, behaviors, and organizations to enable changes in processes, tooling, and technology in the shipbuilding and ship repair industry.
- **Human Resources** - the programs and technologies that support the people services within the shipbuilding and ship repair industry.

Table 1: Difficult Challenges and Key Issues in Crosscut Initiatives

Difficult Challenges	Key Issues
Education and Training	The industry's workforce training is under-funded. The industry has limited school and industry partnerships. Workforce has weak process improvement, information technology, and basic soft skills. Industry lacks training technology implementations.
Technology Transfer	Key information supporting technology transfer not always available. Limited incentives, processes, and resources in shipyards to encourage adoption. Current business models and contracts not structured to reward technology adoption.
Workforce Development and Retention	The shortage of skilled shipyard employees, the aging of existing employees, and the ability to retain skilled shipyard personnel is essential to the health and success of the industry. Where will the workforce to build and repair ships come from in 2010?
Organizational and Cultural Change	The values, behaviors, and organizations required to accept and sustain change are not pervasive in shipyards. Leadership is not well prepared to

	lead change. Tools and metrics to support continuous improvement are not commonplace.
Human Resources	Industry needs competitive compensation/rewards, and methods for handling regulations and benefits costs. Industry is weak in handling diverse workforces, supporting employee quality of life, and building effective labor relationships. HR departments need updated approaches.

Education and Training

Schools, in general, are not providing adequate education for shipbuilding and manufacturing work environments. High school graduates frequently are not prepared to enter the work environment. Math skills, analytical and problem solving skills are severely lacking in current high school graduates. At the college level, the educational infrastructure for naval architects and marine engineers is eroding. The number of degree programs for these two careers is shrinking and those remaining often struggle to keep curriculum current with industry requirements. One of the most important challenges facing the shipbuilding industry today is the need to develop and support a growing capability to design commercially competitive ships. The loss of these degree programs intensifies this problem.

The shipbuilding industry has not historically been involved in building bridges or linking with high schools or community/technical colleges to prepare young people for careers in the shipbuilding and ship repair industry. A lack of programs and tools exists in the industry for school-to-work, youth apprenticeship, and job shadowing programs. Materials explaining the industry and desired curriculums for schools have not been readily available.

A majority of U.S. shipyard management and professionals have been promoted from the skilled trade workforce. Industry and academia offer few opportunities for supervisory personnel to learn or develop management skills that are critical to operating effective and efficient line-function organizations.

Technological and organizational changes are also impacting the industry's production workforce. Changes in processes, tooling, and work teams are being implemented. Often there is not a clear understanding of the competencies and skills associated with these changes nor the necessary training curriculum or programs in place to accommodate the changes.

Currently, most shipyards are equipped to provide conventional classroom or hands-on training for their employees via on-site training programs. Few shipyards allocate funds for off-site learning. Across the industry, however, these on-site training programs are often specifically tailored for the specific company conducting the training, and are not shared with the rest of the industry. Considering the overlap in training requirements and needs that must exist across shipyards performing similar work, these separate training endeavors may be draining individual shipyards, and the industry as a whole of much needed resources. Training technology options generally have not been widely adopted. Methods such as e-learning and virtual classes, which could ease training scheduling difficulties, have not been broadly prototyped or implemented.

The industry lacks implemented skills standards needed to support shipyard operations and the "One Shipyard" concept. Industry-specific skill standards can provide shipyard workers portability of their skills. This will allow the shipyard worker to remain industry focused while working at various yards, due to industry business cycles. Additionally, shipyards can be assured of the skill level that a certified shipyard worker will bring to a job.

Workforce Development and Retention

One issue common to most U.S. shipyards is the shortage of skilled employees and the aging of the existing craft production workforce. Shipyards are discovering that there is a critical shortage

of skilled employees in the current economic environment of the United States. The U.S Shipyards have a poor image with the general public, educators, parents and students. Additionally the ship building and repair business cycle compounds this poor image. Traditional methods of attracting, hiring, and maintaining a viable workforce are becoming less effective for the U.S. shipyards. The number of skilled individuals is decreasing and the pool of candidates willing to train is shrinking.

The retention of skilled, experienced shipyard personnel is essential to the health and success of the industry. Turnover of skilled, experienced employees at all levels continues to be a tremendous cost issue to the shipyards. Shipyard Human Resource professionals must also work closely with each area of the shipyard to identify new skills that are needed (international business, manufacturing technology, process engineering, competitive marketing and procurement, etc.) and develop plans to bridge the missing skill sets. U.S. shipyards lack career development process and systems. Few employers have identified career paths for engineers into production and vice versa. The U.S. shipyards are negatively impacted by poor working conditions, an aging workforce, and have great difficulty in retaining a skilled workforce. There is significant competition and loss of skilled employees. The shrinking U.S. Navy budget to build and repair the Navy fleet has caused severe reductions in the workforce of shipyards that have primarily served the Navy as their main customer, and many of these employees have moved to other industries. The U.S. shipyards must find a way to retain skilled workers.

It is shipyard management's responsibility to develop a competent workforce. The competent workforce builds and repairs ships. The competitiveness of the shipbuilding and repair industry is directly related to the knowledge, skills and abilities (KSA) of the workforce. The cyclic nature and complexity of modern shipbuilding and repair increasingly requires: a) multi-skilled and teachable employees within a shipyard; b) inter-shipyard alliances; c) unique subcontractor capabilities; and, d) mobile or temporary contract labor relationships. Historic submarine teaming between Northrup Grumman Newport News and Electric Boat Corporation, recent Naval Sea Systems Command calls for "one yard-any yard" flexibility for Navy vessel repair, and SENESCO MARINE's 150,000 bbl ATB new construction team and repair team are examples in the industry. A functional connection between shipbuilding and repair stakeholders is common, standard terminology and KSA descriptions. Despite these trends, the industry and its supporting post-secondary education lacks common skill standard implementation. Past work in this area is described below. As a result, individual shipyards and teaming arrangements are perceived to spend excess time, money and management attention on aligning workforces to take on complex defense or commercial work. A comprehensive survey of manufacturing worker skills prepared for the National Association of Manufacturers, including the shipbuilding and repair industry, is in Appendix C.

Three clear problems are: a) the NSRP skill standards are not in an web-compatible database that shipyards and community colleges can access, use and update; b) shipyards and community colleges lack common accepted curriculum and instructor skills for core knowledge requirements; and c) the shipbuilding industry has not implemented common entry-level skill standards as have other manufacturing, information, health care and other industries have done. Work by the Crosscut Panel in 2002-2005 identified practical solutions to these problems that need integration in a panel project to refine industry action and further R&D.

Project Goals and Objectives: The goals of this project are: a) adapt existing NSRP skill standards to web-based technology that other complex industries such as aerospace

use to manage their workforce skills; b) determine a representative core knowledge course catalog and trainer skill set that effectively connects shipyards and community colleges; c) develop a methodology to adapt existing Manufacturing Skill Standards Council (MSSC) entry-level skill standards ($10 million MSSC investment) to shipbuilding and repair in ways that promise ROI, and evaluate the system at one shipyard-college site. A proposed option to expand community college connection and evaluate at two shipyard-college sites was not funded yet substantial work was done at other sites.

Objectives include:

- Retain and enhance all valuable skill standards work performed with NSRP funding and cost-share.
- Further synthesize shipbuilding and repair skill standards with MSSC's general manufacturing industry standards rolled out in November 2005 while preserving those KSAs unique to shipbuilding and repair.
- Develop a topical matrix of shareable community college and shipyard learning objects and learning delivery approaches (classroom, computer-based self-study, practice laboratory, on-the-job training, etc.
- Demonstrate how web-enabled technologies and employee skill information display can connect learning delivery by community colleges and shipyard-based training programs
- Demonstrate how these technologies can assist shipyard production and HR/Training staffs to: assess skills of the current workforce and compare to business requirements; close skill gaps quickly through community college and company-based learning systems; gather workforce development and learning information for management ROI and decision-making in terms of cost savings or cost avoidance for both new and incumbent workers, subcontractors and teaming partners, and contract labor firms.
- Identify gaps in current and best practices of skill standards and identify additional research required for the industry, for educators and job service organizations to help attract and prepare new workers.

Previous and Current Related Work: In 1999 the Crosscut Initiatives Panel published a comprehensive report titled "Assist U.S. Shipyards to Develop and Maintain Skilled Trades Workers" (NSRP) Project 9-96-1 & 2. This effort included a comprehensive skill standard database that aimed at: common terminology and vocabulary; scenarios for major shipbuilding and repair functions; common industry tasks consistent with Manufacturing Skill Standards Council descriptors; unique ship-related tasks not found in general industry, and a detailed knowledge, skill and ability matrix to achieve tasks and the more complex scenarios. Subsequently, the skill standards have been expanded to include professional work such as planning and scheduling.

Although participating shipyards agreed on the skill standards and KSA descriptors, there has been limited implementation and collaboration and little return on investment from an industry perspective. Surveys, studies and conference activities conducted in 2003-5 under the Crosscut Initiatives projects titled "Emerging Workforce Development for

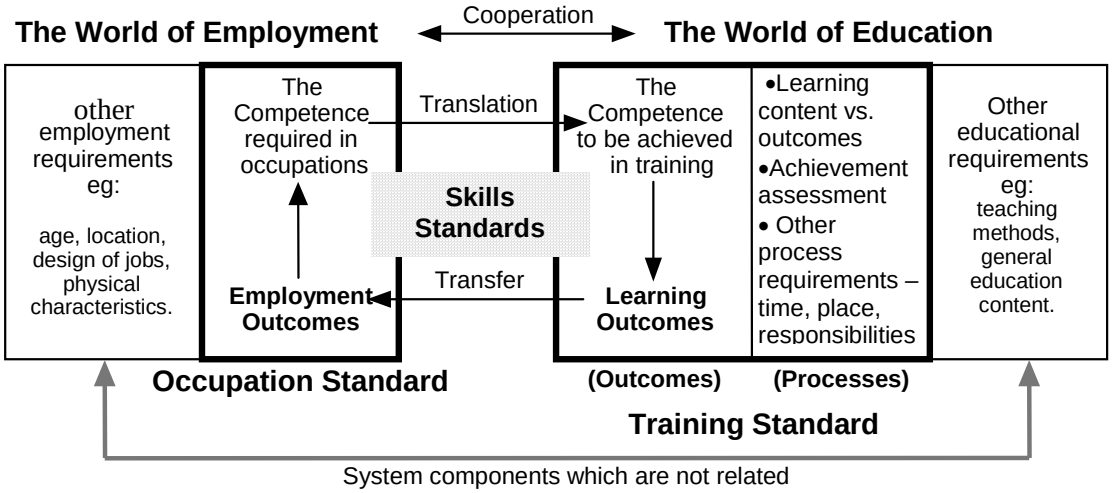
Shipbuilding" and "Employee Sources & Skills Summit" point to both the need to continue skill standards implementation for current and future industry competitiveness.

An independent review of college-shipyard collaborative work concentrated on the shipfitter skill area was conducted by long-time industry consultant Lee Walker as part of this project. His findings were shared at the November, 2006 project conference and are synthesized in this final report.

3. Skill Standards

3.1 Skill Standards Background

The figure illustrates how skills standards may be considered as a metaphorical bridge between the world of work and the world of learning.



Skill Standards System Elements

A skill standards system has three elements: the skill standards themselves that describe the knowledge and skills workers need to perform successfully on the job, an assessment instrument(s) to demonstrate mastery of the knowledge and skills, and a portable certification or credentialing process that assures possession of the knowledge and skills assessed. The elements, used both together and separately, are looked on to benefit employers and workers and to provide a link between the world of training and the world of work. The end product of the system is a "certified" worker who has a known quality for potential employers and who can sell him or herself to employers based on recognized ability. Trainers and educators enter into the system by using the standards as a basis for course content.

The Standard

The skill standard itself consists of two parts; (1) a statement of something that must be accomplished and (2) some description of the criteria for determining if the thing has been done properly. Analysis of the workstation (layout, equipment, tools), the work (process and procedure) and the worker (limitations and capabilities) helps define elements of skill standards. Design of the product structure and its testing points at how to measure proper work accomplishment. The format of the presentation varies but is normally organized in a hierarchy of job, duty, task, and knowledge, skills and abilities (KSA). The statement of what is to be done is the quintessential part of a skill standard system. The other parts, including the standard or criterion itself, are important, are demanded and supported by logic, but may be missing in practice. Common academic

knowledge such as literacy, employability knowledge such as communication and problem solving, and other core skills can be standardized.

Assessment
The assessment is a means of measuring whether a person is performing to the standard as described. In a complete system the assessment is formally described, passing criteria are established and success or failure is judged on the same basis for all candidates. Proponents argue that without assessment, standards are meaningless. Assessment may have elements of knowledge or understanding as well as performance ability achieved with motor skills.

Certification
Certification provides a formal record of a person's success in meeting the requirements of a skill standard set. For the employee or job seeker, it is a means of documenting previous accomplishment and may provide entré to jobs not otherwise available. To the employer, it provides an element of confidence that a prospective employee is capable of acceptable performance in a job. Proponents argue that certification is essential if the benefits of a skills standards system are to be fully realized by both worker and employee.

Skill Standards Development
Since 1995 the American National Standards Institute (ANSI) which coordinates US standard setting under the International Standards Organization (ISO) tent and the US National Skills Standards Board (NSSB) have teamed up to develop and implement a voluntary system of skill standards nationwide that will increase the productivity, economic growth and competitiveness of America and American business. Fifteen industry cluster groups participate. In 1998 the Manufacturing Skills Standards Council (MSSC) began implementation of a national strategic plan to address the demand for skilled workers growing in every industry sector. Fourteen manufacturing sectors are participating. Why? For example, the Big Three U.S. automakers needed some 250,000 mostly skilled new workers by the year 2005. In the same time frame, more than one million technicians are needed to meet the requirements of the information technology industry. The semiconductor industry conducted a national campaign to train and attract 40,000 manufacturing technicians over the between 2001 and 2006. The health care industry and the construction industry have developed similar national standards and campaigns for workers. Shipbuilding is in competition with other manufacturers for workers.

Industry-wide skill standards provide: 1) a basis for working with educational institutions in preparing supporting courses and curricula, 2) a means to gage the preparation of job applicants for entry into the industry, and 3) a means determining the skills status of the current work force. In addition skill standards can be used to improve the quality of the hiring pool from which an industry draws employees and, coupled with certifications, can improve the stability of the work force and, in consequence, provide measurable improvements in productivity.

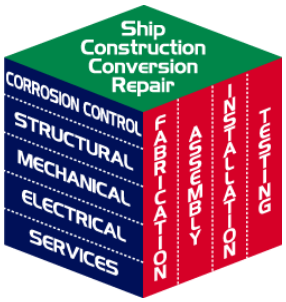
The development of skill standards for shipbuilding and the need for worker credentialing have been important issues to the National Shipbuilding Research Program, Crosscut Initiatives Panel (previously NSRP Panel SP-9) for many years. In 1997, a comprehensive multi-phase project (Project 9-96) developed a set of production work competencies for the shipbuilding industry. Follow-on projects were initiated in 1998 and 2000. Even with this continuing emphasis, the industry has not acted quickly to embrace skill standards. Current conditions in the shipbuilding/ship repair industry, namely consolidation of corporate ownership in both large and small yards, the cyclic nature of work in individual yards, the scarcity of qualified labor resulting from high national levels of employment, and the continuing pressure from foreign yards on traditional domestic markets all combine to make incorporation of skill standards important to building and sustaining a competitive industry.

A comprehensive review of skill standards concepts and their application for the shipbuilding and repair industry was prepared in an article Shipbuilding Skill Standards: Trying on the Shoe (Gebhardt, Hansen, Walker, 2002) that is available through the Crosscut Resources Center (www.nsrp.org).

3.2 Web-Based Skill Inventory and Management Systems

NSRP skill standards were produced and distributed in late 1990s using the software database application File Maker Pro. The relational database synthesized skill standards and their knowledge-skill-ability requirements illustrated in the cubic logo.

Note that the three major shipyard functions: construction, conversion, and repair top the database. Then four major processes are shown: fabrication, assembly, installation, and testing. Then five craft/trade areas, corrosion control, structural, mechanical, electrical, and services are added. Subsequently, additional scenarios of planning, project management, etc. were added. One can also imagine a set of core KSAs that serve all skill standards.



Most shipyards did not use File Maker Pro software. Some consideration was given to converting the database design to Microsoft Access perceived to be in broader use. The NSRP skill standards database was converted to a family of Microsoft Word and Excel spreadsheet documents to reveal the building blocks of the system; however, the utility of relational database design and adaptation to a specific shipyard remained extremely cumbersome. In early 2005, MIT Ocean Engineering professor Hank Marcus suggested that a web-based skill inventory and management system be considered as an alternative.

In June, 2005 SkillView, Inc., a New England based software development firm briefed Crosscut Initiatives Panel about their web-based skill inventory and management system. SkillView had developed a broad client base in health care and IT industries. As the panel project began in the Spring, 2006, SkillView, Inc. was purchased by SkillSoft, Inc., a larger national firm that subsequently advised of no interest in the shipbuilding and

repair industry because of the relatively small customer base possible. SkillsNET Corporation, a SkillSoft competitor already providing skill inventory and management services to the US Navy, agreed to be a project partner and provide cost share to the project. Descriptions of skill inventory and management systems use SkillsNET terminology and concepts are more fully described in Appendix C.

How Web-Based Skill Systems Work

A Skills Management program is comprised of:

An easy-to-use, powerful software platform

Site-tailored data (content), including...

- Skill Library (those skills germane to the organization.)
- Job Profiles (specific proficiency levels needed in skills germane to each job) SkillsNET names these "Skill Objects™)
- Employee Profiles (actual proficiency in germane skills possessed by each employee)
- Learning Events (to close "skill gaps")

The skill library is developed by analyzing and breaking down shipyard work. A start point is looking at the shipyard from a conceptual birds-eye view and describing in text and images the processes and important task sets needed to achieve contract work and operate the business. The skill library would also include for each task set standards such as tools, software, other resources, and performance standards to meet contract or company job quality requirements. Performance standards include technical items such as weld parameters, safety requirements, and also communications requirements such as reporting.

Job profiles are created by experienced workers using templates and a database. Using workers that perform the work is central to the SkillObjects™ process. It has been learned that if a worker is asked, "what do you do", the worker will often rely upon his or her memory of recent tasks and is unable to provide a comprehensive description of critical tasks and duties performed. To help the worker the SkillObjects™ process uses an intelligent queuing technique that challenges the worker to think critically about their work. This is accomplished by using a series of well-designed templates. The templates begin with broad descriptions of work and continue until the worker has developed a comprehensive list of tasks, tools, knowledges, skills, and abilities, all of which are evaluated and surveyed by other workers and placed in the SkillObjects™ database.

The queuing database for the panel project includes generic skill standards drawn from the US Department of Labor O*NET system drawn from categories listed in Table 1.

SkillsNET staff modified the database by adding Manufacturing Skill Standards Council standards, an extract of which is shown in Table 2. The panel project focused on the shipfitter skill area because it is quite complex. Many shipyards work with their one-stop or job serviced centers that have developed WorkKeys™ shipfitter standards. A WorkKeys skill library example is in Table 3. One NSRP skill standard example, location and orientation, is in Table 4.

When workers complete job profiling then supervisors and managers can review, facilitate corrections or changes, and finally end up with a legally defensible job profile connected to specific tasks in the shipyard.

Table 1: O*NET categories of enabling skills and abilities – generic work

Enabling Skill Categories	Enabling Ability Categories
Content Skills	Verbal Abilities
Process Skills	Idea Generation and Reasoning Abilities
Social Skills	Quantitative Abilities
Complex Problem Solving Skills	Memory Abilities
Technical Skills	Perceptual Abilities
Systems Skills	Spatial Abilities
Resource Management Skills	Attentiveness Abilities
	Fine Manipulative Abilities
	Control Movement Abilities
	Reaction Time Abilities
	Physical Strength Abilities
	Endurance Abilities
	Flexibility, Balance, and Coordination Abilities
	Visual Abilities
	Auditory and Speech Abilities

Table 2 is an extract of the MSSC Skill Standard element for material quality. The knowledge represented would be an entry-level or basic core knowledge requirement.

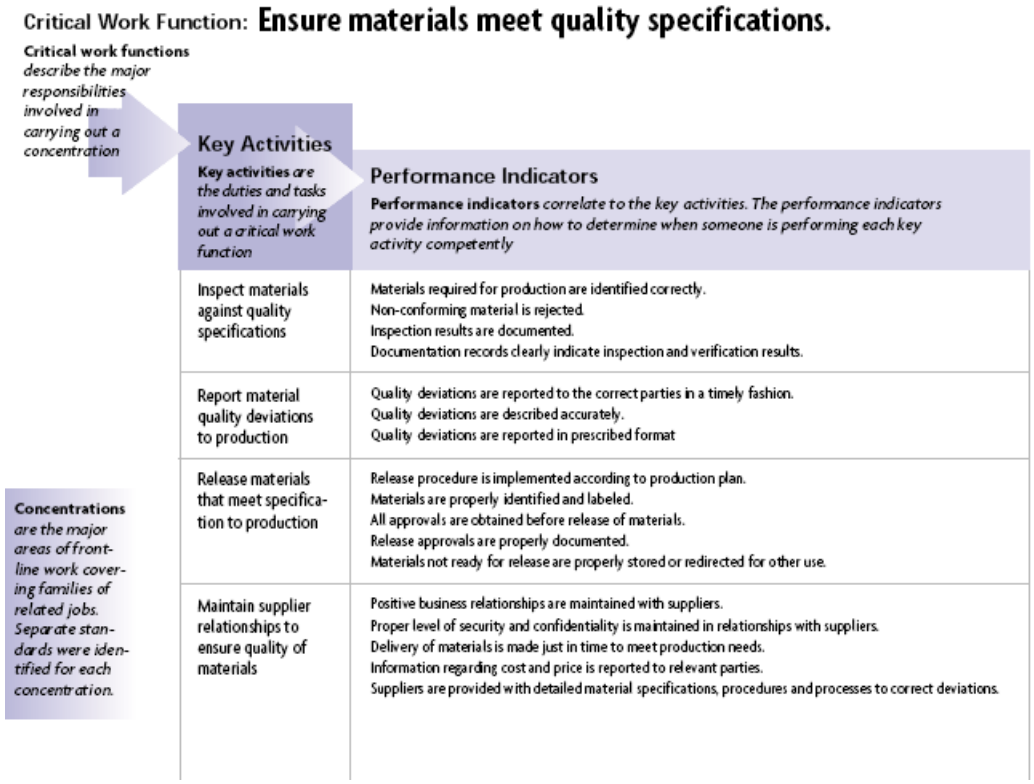


Table 3: Extract from one shipyard's Work Keys Technical-Trade skill library for the shipfitter
• Assembles and installs variety of structural pieces of ships, such as bulkheads, decks, machinery foundations, hatches, horizontals, longitudinals, etc. using a variety of materials, primarily steel. • Mounts and/or installs structural pieces, using various processes, such as welding and bolting, etc. • Reads and interprets weld symbols. • Reads and interprets work package in order to begin job. • Reads/interprets drawings and transforms the drawing to do the actual construction in an out-of-ship position. • When beginning a job, reads drawings and general notes, ensures correct revision/changes, and determines type and size of pieces, fittings, related materials and equipment, according to drawings and verifies correct materials prior to starting. • Lays-out, fabricates, assembles, installs, and maintains structural items. • Determines all reference lines (aboard ship, platens, shop, etc.) in order install foundations and other structures. • Secures structural pieces and foundations to other structural pieces or longitudinals/horizontals with various brackets and clamps using hand tools and power tools or by tack welding. • Cuts, bends, shapes, de-burs, and finishes steel components using saws, cutting torch, sanders, angle grinders, and other tools. • Works jobs in proper sequence to prevent creating situations that mandate rework.

Table 3: Extract from one shipyard's Work Keys Technical-Trade skill library for the shipfitter
• Measures distances/spacing between existing shipboard structures to determine the required dimensions of pieces to be cut. • Uses calipers, tapes/rulers (may be English/metric/tenths scales), scales, and micrometers to measure pieces for length, width, diameter, thickness, etc . . . • Builds jigs, patterns, and molds in order to support the completion of various aspects of the job. • Measures and determines the proper angle required to properly connect bulkheads, decks, etc. Uses a six-foot ruler, a bevel square, or framing square to verify angle. • Fabricates braces for installing material based on the knowledge of how the installation will occur. • Uses a variety of temporary attachments to hold ship pieces in place until welding is completed. • Uses knowledge of the characteristics of steel in order to correctly accomplish tasks in varying conditions/temperatures/etc . . . of jobs.

Table 4: NSRP Shipfitter-specific KSA example: Location and Orientation (Structural)
1 Knowledge of ship's framing *2 Ability to locate ship's reference lines and points* *3 Ability to uses sketches, blueprints and other technical information to determine the correct location for a structure* *4 Ability to accurately translate positions between the reference point and desired location* *5 Ability to achieve structure orientation relative to hull and deck contour, e.g., sheer, camber* *6 Ability to scribe structures for orientation of hull and deck contour camber* *7 Ability to compensate structure orientation for ship orientation, e.g., list, trim*

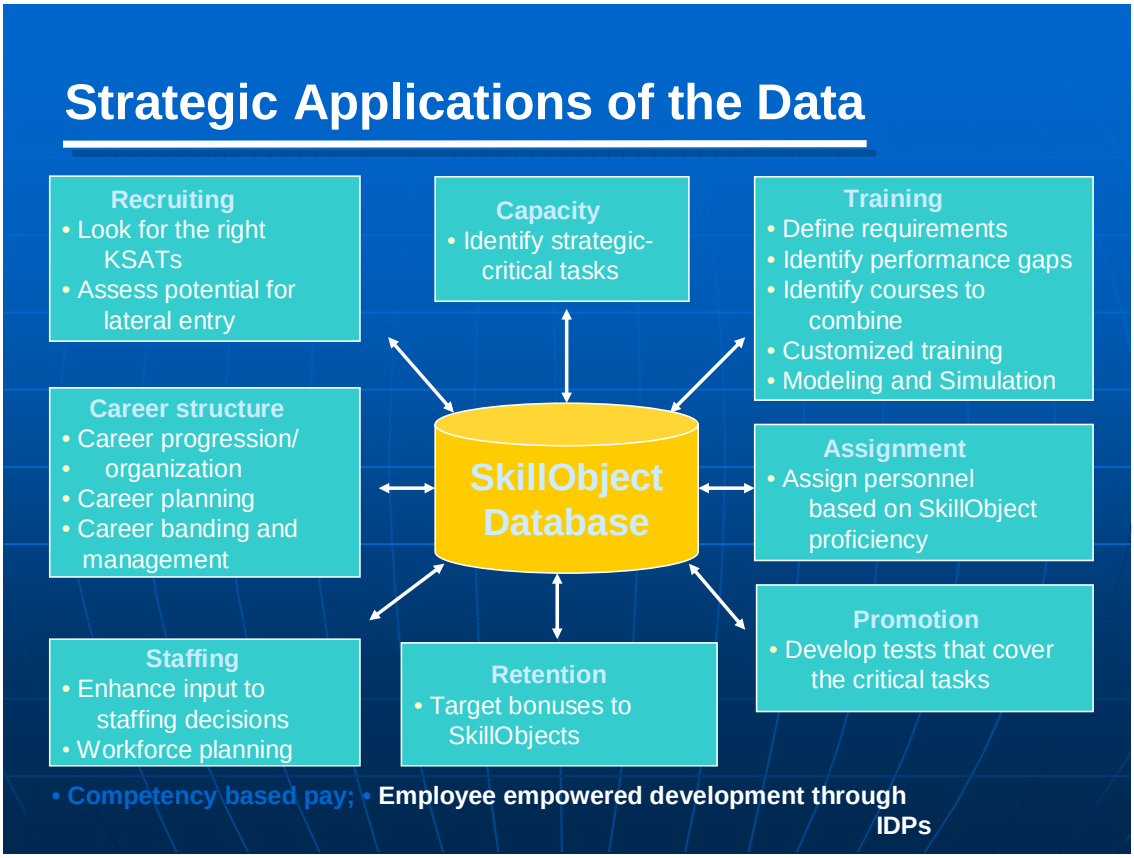
Employee profiles assess an individual's competency in terms of knowledge, skills, abilities, their certifications and other personal factors related to the SkillObject that describes the work the employee is expected to do. Employee profiles may begin with the employee himself or herself self-identifying profile data. The company may have a testing or assessment program beginning at entry and continuing through a career to update an individual's profile. Extracts from performance evaluations and other external assessments can further update the profile. Note that a robust skill inventory and management system allows the employee to enter data not only about the specific assigned jobs, but also other multi-skill information. Comparison of expectations or desires and the individual's actual status creates awareness of knowledge, skill or ability gaps.

Learning events can be assigned for an individual to close skill gaps. Learning events could be planned classroom-type courses, focused self-study, learning-lab practice to improve proficiency, structured on-the-job learning, coaching or other event. The process of developing the skill library, job profile, employee profile, and gap analysis may reveal

that current curriculum falls short in gap closure so must be changed. This leads to concepts of strategic management using the database system.

Integration of Expert Knowledge into the skill standards database has been proposed by Crosscut Initiatives Panel and partially implemented through Navy SBIR 05-061. Two technologies proceeded through Phase 1 work but have not been funded for Phase 2. As a result, there are no common and easy-to-use ways to capture expert knowledge from retiring workers, store, access, and share or re-use the knowledge.

Strategic Management. The power of the web-based skill inventory and management system is in its strategic applications of the gathered data. The figure illustrates some



examples of strategic applications such as recruiting, career structure, staffing, capacity, retention, training, assignment, promotion, and competency-based pay.

3.3 Panel Project Application

Training on the web-based skill inventory and management system was provided for all project participants at panel meetings, “web semiinars,” one-on-one sessions, and follow-ups for system use. SkillsNET provided PowerPoint summaries and PDF files describing their skill management methodology. Fourteen shipyards were exposed to this material.

SkillsNET Corporation provided usernames and passwords to all participants (shipyards or shipyard-college teams) to use their system and develop job profiles for shipfitters then report back their experience.

Progress checks with shipyards about six months into the project revealed that some shipyards chose to not fully use the SkillsNET system and others chose to not reveal their results in part because the work and results of job profiling is considered proprietary. As the SkillsNET profiling was used, some shipyards perceived it was not much different from the WorkKeys process that had generated task scenarios and entry level knowledge-skill-abilities requirements.

Another round of training and facilitation was provided in November, 2007, and the project was formally extended for two months to invite further participation.

The good results experienced by Alaska Ship and Drydock, Inc. and the University of Alaska, Ketchikan campus resulted in a recommendation that a coordinated statewide effort using SkillsNET technology be considered to:

- Identify common manufacturing-steel construction-shipbuilding industry skills that can lead to common curriculum elements.
- Help government agencies and the legislature understand skill numbers and KSA gap realities to help shape state investment strategy.
- Provide yet another web-based tool to give visibility to the types of work and skills in the shipbuilding and repair industry.

The good results experienced by the Hampton Roads coalition, described in Section 4.1 resulted in further contracting with SkillsNET to work on the workforce needs Survey for the planning of the Maritime and Transportation Center to be hosted at Tidewater Community College. Northrop Grumman Newport News provided their WorkKeys based job profiling information for inclusion in the expanding SkillsNET shipbuilding and repair database. BAE Norfolk Ship Repair is active in this work.

Project leaders were disappointed that no shipyards used the system enough so that strategic workforce management features could be demonstrated. Additional industry information and education will be developed by SkillsNET and Crosscut Initiatives Panel for inclusion on the revitalized Crosscut Resources Center web site, hosted at the www.nsrp.org portal.

An example of strategic use of skill data is summarized in the following Navy case study.

A Task-Centric Approach to Framing Navy Skills “Improving the Navy’s Workforce”

I. Modernizing Navy Practices

The Manpower, Personnel, and Training (MPT) Enterprise recruits and trains Sailors and, then, schedules to position them in the right jobs. However, technology has not always supported these efforts. Recent advancements in human performance management and technologies now give us the ability to transition the Navy from stove-piped MPT functions to a Human Resource (HR) management approach. The foundation of this approach is creating a linkage between the actual tasks Sailors perform and the Knowledge, Skills, Abilities and Tools (KSATs) they need to be successful in their work.

Under the sponsorship of CNO N12, the Navy Manpower Analysis Center (NAVMAC), the Center for Naval Analyses (CNA), and SkillsNET™ Corporation have launched a CNO sanctioned effort entitled "Improving the Navy's Workforce". This initiative will conduct a Navy-wide review of enlisted work and identify the jobs, associated tasks, and required Knowledge, Skills, Abilities, and Tools (KSATs) to perform the work.

II. Improving the Navy's Workforce Using a SkillObject® philosophy
The "Improving the Navy's Workforce" project is using industry best practices and tools contained within SkillsNET™ methodology to facilitate the collection, analysis, usage, and linkage to government standards of skill-based job data. SkillsNET™ methodology has a proven and documented record of accomplishment in supporting human resource management with the private sector and government. This concept uses a validation process and common-language framework to produce SkillObject® items.

SkillObject® are created using a clustering technique that helps workers and management to organize job tasks that are performed, learned, and evaluated in a similar way. As depicted, tasks are identified and unique knowledge, skills, abilities, and tools are then linked to them. A single job within the Navy will have several SkillObject®.

To facilitate Sailor certification, SkillObject® and Navy jobs can be linked to the Department of Labor's Occupational Information Network O*NET™. Developing Navy-wide SkillObject® is a complex process, but the mechanics of data collection are surprisingly simple. The data are collected using a completely web-enabled procedure.

III. Sailor Interaction. The web-enabled process begins with Legacy tasks that are reviewed on-line by Selected Subject Matter Experts (SMEs) from across the Navy. They will add pertinent tasks missing from the legacy list. Using the Internet reduces the impact on the Sailors and their organizations.

Acting as a second set of eyes, another set of SME's will then review the revised tasks to ensure total coverage and will delete non-pertinent tasks. This list will be consolidated and standardized generate a formal task list. A broad population of Sailors will then assess the tasks in terms of relevance and criticality to their current jobs. Fortunately, the project's ability to use the Internet will allow us to call upon the knowledge of our best Sailors without significantly impacting their current work assignment because this third review requires minimal time. This is an important fact.

Finally, project partners will cluster the comprehensive data into enlisted job clusters with associated SkillObject®. The creation of the Enlisted SkillObject® and jobs will serve as a launching pad for truly revolutionary changes across the HR Enterprise.

IV. Revolutionary Changes On the Horizon for the MPT Enterprise
In the future, work will be more sophisticated and performed by fewer Sailors. To provide the flexibility and responsiveness necessary to support the Navy's shift from old economy work and hiring/promotion/training practices to the 21st century environment of constant change, MPT must experience a revolution in the way we look at HR. A task-centric environment based on clear SkillObject® is the vehicle to facilitate these process revolutions.

Manpower management impacts will be in the areas of utilizing position management, deletion/reduction of Navy Enlisted Classification Codes (NECs), and in the realignment of the Navy's Enlisted and Officer occupational structure.
Recruiting will be able to develop and implement strategies directly related to the acquisition of specific KSAs – not just individuals. These strategies will allow recruiters to adopt selective recruiting practices that capitalize on academic aptitude and personal proclivity - targeted recruiting.

Training activities will be able to develop broad skills-based curricula and employ varied delivery methods (e.g., classroom, etraining, etc.) to optimize the distribution of training

across the fleet. Sailor-centric training will be able to focus on validated jobs within an occupation, as well as those jobs that span occupational groupings.

Distribution will truly be able to relate the skill needs of an activity (manpower requirements) with Sailor capabilities (skills) throughout the placement and assignment process. It will, also, reduce or potentially eliminate our dependence on NECs throughout the distribution process.

V. Conclusion

The "Improving the Navy's Workforce" project, using the SkillsObject™ methodology, is not just collection of data that will go into a report and sit on a shelf. This project is a concerted effort to pioneer real changes in how the Navy manages Human Resources. We are partnering with Task Force Excel, CNET, NETPDTC, and others to ensure that we only collect valid data once, and we will be able to use it effectively across the HR Enterprise.

4. Community College-Shipyard Connections

Crosscut Initiatives Panel studies in workforce development and education and training concluded that the nation's community colleges are the best work-based learning centers available. States that develop and improve community college systems recognize that over 60 percent of jobs for the 21st century require STEM learning (science, technology, engineering, math) that is beyond the K-12 learning system but not 4-year degree learning. Community colleges also know that only about 20 percent of jobs require college degrees, and the bottom 20 percent of jobs require only basic literacy. Therefore, community colleges have developed impressive work-based learning systems.

The Panel Project assumed that substantial win-win benefits could evolve if colleges and shipyards collaborated more closely collaborate. Invitations to participate were broadly circulated through e-mail, phone calls, meetings, and conferences. Fourteen shipyards, ten community colleges, and six other organizations had some learning, input, and/or active participation in the project summarized in Table 5.

Table 5 - Shipyard-College Teams that had some participation in the panel project

- Alaska: Alaska Ship & Drydock, Doug Ward; University of Alaska Southeast Ketchikan, Cathy LeCompte, Campus Director; University of Alaska Faibanks, Curt Madison – Director, Distance Education; Alaska Dept. of Labor and Workforce Development, Tara Jollie and AVTEC, Fred Esposito
- Seattle area: Todd Pacific Shipyard, Chris Marletti, John Nelson; Renton Technical College, Beth Arman; Skagit Valley College, Dolores Blueford; Olympic Community College
- San Diego area: BAE San Diego Ship Repair, Donn Yover; NASSCO, Valerie Houlihan; San Diego Community College
- Mississippi/Louisiana Northrop Grumman Ship Systems: Larry Crane, Mark Scott, Dave Cobb – Community College System
- Mobile area: Bender Shipbuilding: Dale Jermyn, Dawn Wilson; Alabama Technology Network – Alabama College System, Byron Dunn, Audrey Smallwood; Ozark Community College
- Jacksonville, FL Area: Atlantic Marine, Larry Hickey; Florida Community College
- Hampton Roads area: Northrop Grumman Newport News, Bob Leber and Dick Boutwell; Colonnas Shipyard; BAE Norfolk Ship Repair, Ron Rusnak; Earl Industries; Tidewater Community College, Barbara Murray and Thomas Nelson Community College
- Connecticut: Pat Bullard, Electric Boat Rhode Island: Electric Boat Quonset, Fred Pendlebury, SENESCO MARINE, Larry Gebhardt; Community College of Rhode Island
- Louisville, KY: Tradesmen International – a contract labor support company, Don Bewley, (Former Jeffboat and Crosscut Vice Chair)
- Public (Navy) yards were aware of the project but were unable to participate

Other organization participants

- US Maritime Administration – Regina Farr

Table 5 - Shipyard-College Teams that had some participation in the panel project
• Shipbuilders Council of America – Daniel Youhas • Central New York Technology Development Organization, Training Within Industry Program – Robert Wrona • Art Anderson & Associates, Naval Architects/Engineers – Doron Zilbershtein • Consultants Les Hansen and Lee Walker • L.M. Miller & Associates – organization design and culture change, Lawrence Miller

Ozark College – Mobile. A model of shipyard-college collaboration is Ozark Community College in Mobile. One of the college course sets prepares entry-level welders, pipefitters, and shipfitters. College policy, supported by the State of Alabama, assumes that economic development is driven by private business that needs basic infrastructure provided by the government. In return, the private industry provides good-paying jobs structured so that employees have a career path so they can own a house, car and boat. So in the Ozark model, learning to entry level is free of cost as part of industry-serving infrastructure. In the Ozark model, the learning is relevant and rigorous but graduation is not a diploma but rather going on the job. Workers are motivated to learn so they can earn. Careful documentation of course work and completion assessments enables a learner to re-engage later to continue on a path toward an associates degree.

Pictured is the panel project team learning about the hull simulator at Ozark Community College. Shipyard subject matter experts from Bender Shipbuilding, Atlantic Marine, Austal USA, and others provide materials and expertise for the course and learning labs. In this simulator, learners move beyond the sterility of a classroom welding booth or shipfitter workbench to a small hull section that requires coping with weather, confined spaces, adjacent workers and other distractions. Learners perceive that multi-skilled learning is essential – for example, simple rigging is required to position parts for welding.

Instructors at Ozark Community College are industry professionals. Recently retired persons with rich wisdom and experience along with younger instructors, some who suffered on-the-job injuries at a shipyard but want to teach are in the mix. The curricula used include a blend of commercial off-the-shelf materials, and course modules customized to specific shipyard requirements. Instructors who know life's realities work closely with learners who are recent graduates from the correction system, drug or alcohol abuse prevention, welfare-to-work and other sources that need a second or third chance to succeed. As a learner nears graduation, that is demonstrated skill levels for hiring, then the hiring shipyard can visit the school and prepare the learner further for the work environment, discuss realistic job scenarios, etc.

While shipyards help the community colleges to make their courses more relevant to the industry, the colleges also share best practices about learning to shipyard trainers. This collaborative work means that shipyard training can more intentionally include learning design and delivery that gets best results for the business and the learner.

Shipfitter Curriculum: A panel project goal was to focus on the shipfitter task and job family. The shipfitter is one of the most multi-skilled technicians who has responsibility for both new construction and repair work in fabrication, assembly, and outfitting processes. The shipfitter requires a high degree of academic literacy so these knowledge, skill, ability core areas can be addressed by the colleges. The shipfitter needs a wide range of machine and hand tool KSA that can be practiced in a learning-lab setting to hone proficiency before moving into structured on-the-job learning.

Northrop Grumman Newport News provided their shipfitter DACUM document. DACUM is an acronym DACUM stands for "**D**eveloping **A C**urricul**UM**." The DACUM process is a structured type of occupational or task analysis that is used by businesses, industry, and educational institutions to identify knowledge gaps. The basic characteristics of the DACUM philosophy are:

- Curriculum needs to include **real-world** preparation for an occupation.
- An occupation can most effectively be described in terms of successfully performed **job tasks** or competencies.
- The **expert worker** is the best source for recognizing and describing job tasks.

The DACUM process has three main elements: needs assessment, a data-gathering workshop, and curriculum development. A needs assessment is simply a focused effort to determine whether instruction is needed and, if so, in what area; this effort often begins with a curriculum review or labor market survey. A DACUM workshop is held to bring together a focus group of expert workers in a specific field or occupation for a brainstorming session. A trained DACUM facilitator guides the workshop participants to produce a chart that lists the tasks performed by an entry-level worker in the occupation. A curriculum designer can then use the DACUM chart to develop an industry-validated program of instruction for training an entry-level worker for the job.

NASSCO graciously provided a generic shipfitter curriculum for used by community colleges. This document, which could be used as a template, included an instructor guide and illustrated student guide. It, along with the DACUM was used to guide shipfitter curriculum development by the Tidewater Community College, University of Alaska Southeast Ketchikan Campus, and Florida Community College.

Training Within Industry Program (TWI). The Workforce Preparation Improvement project included a bridge into the workplace. While much theory and principle can be learned in a classroom, perhaps 90 percent of what a person really needs to learn comes through on-the-job (OJT) learning. Many shipyards and factories throw a new person into a work team and assume that he/she will pick up what is needed over time. This type of OJT is inefficient, usually incomplete, and can teach bad habits as well. TWI program

presumes the shipyard has training for supervisors on their technical work and their responsibilities. TWI then teaches three key skills: how to instruct on-the-job; how to improve job methods, the cornerstone of lean manufacturing; how to lead teams and improve job relations. TWI also helps teach shipyard production people how to develop learning and continuous improvement programs within the shipyard.

The key to good OJT is to add structure and to put the supervisor in charge of new learners. The TWI program is included in the project design because it is a benchmark for existing supervisory training programs. Shipyards can use this program as a new effort, or to improve existing programs. The Central New York Technology Development Office, a US Department of Commerce NIST Manufacturing Extension Program partner is taking a national lead to revitalize the TWI program for US manufacturing. Robert Wrona, author of The TWI Workbook was an active project participant.

TWI was developed by the U.S. government during WWII to bring an inexperienced workforce up to speed quickly to replace "the boys" being sent overseas to fight. After the war, TWI was largely forgotten in the U.S. Yet when it was introduced into Japan in the postwar reconstruction period, it took root, becoming one of the foundations Taiichi Ohno used to build the Toyota Production System.

The core of TWI's robust method of training was a precisely scripted training manual for each program, thoroughly tested in actual manufacturing plants. This meant each program could be delivered in standard and repeatable form, maintaining quality even when trainers had varying levels of experience.

The manuals still exist in almost original form. When trainers give the TWI courses in contemporary plants, they deliver the same instruction, using the same examples and nearly the same wording as trainers used in the 1940s. The programs emphasize a learn-by-doing approach. Like their WWII forebears, participants bring in actual jobs from their worksites to practice on. TWI is centered on its J-programs: Job Instruction (JI), Job Methods (JM), and Job Relations (JR). Additional TWI information is in Appendix C.

> **Job Instruction (JI)** The purpose of JI is to teach supervisors how to teach. The method emphasizes preparing the operator to learn -- giving a proper demonstration, breaking down the job into important steps and key points -- and observing the operator performing trial runs, tapering off coaching and continuing to follow-up.
>
> Today, JI training allows manufacturing firms to, as one plant executive put it, "turn top employees into even better employees, average employees into top employees, and poor performing employees into good employees."
>
> One company using JI was able to reduce training time from two months to two weeks. The training helped reduce rework by 96%, cycle time by 64% and inventory by 50%. JI achieved these numbers by "having all operators do jobs the same way."

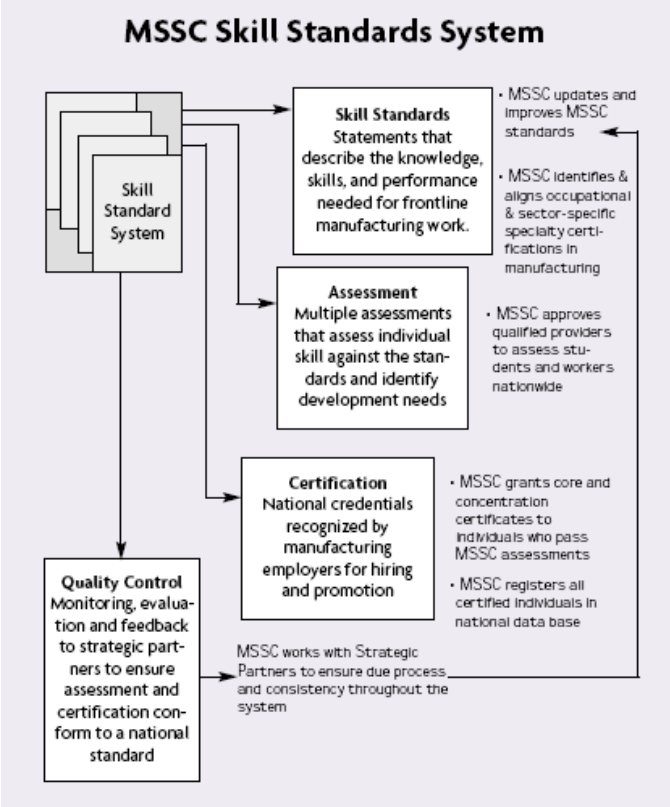
Job Methods (JM) JM helps supervisors make the best use of the manpower, machines, and material available. This allows the supervisor to amplify improvements without outside help from engineers or managers.

Job Methods teaches supervisors how to break down jobs into their constituent operations. Next it teaches them to question details to develop new methods by eliminating, combining, rearranging, and simplifying.

By using this method today, one company was able to save 800 man hours a year and reduce one department's cost by 32%.

Job Relations (JR) The objective of JR is to help supervisors improve their ability to work with people. For a supervisor, results are all about the output of other people. Without their cooperation, work will not be carried out effectively. When this skill is acquired, supervisors get the cooperation they need.

Developing and maintaining good relations helps supervisors and employees solve and prevent problems. The JR principles include providing constructive feedback, giving credit when due, telling people in advance about changes that will affect them, making the best use of each person's ability, and earning the employee's loyalty and cooperation. The JR method teaches supervisors how to get the facts, weigh them carefully, make the decision, take action, and check results.



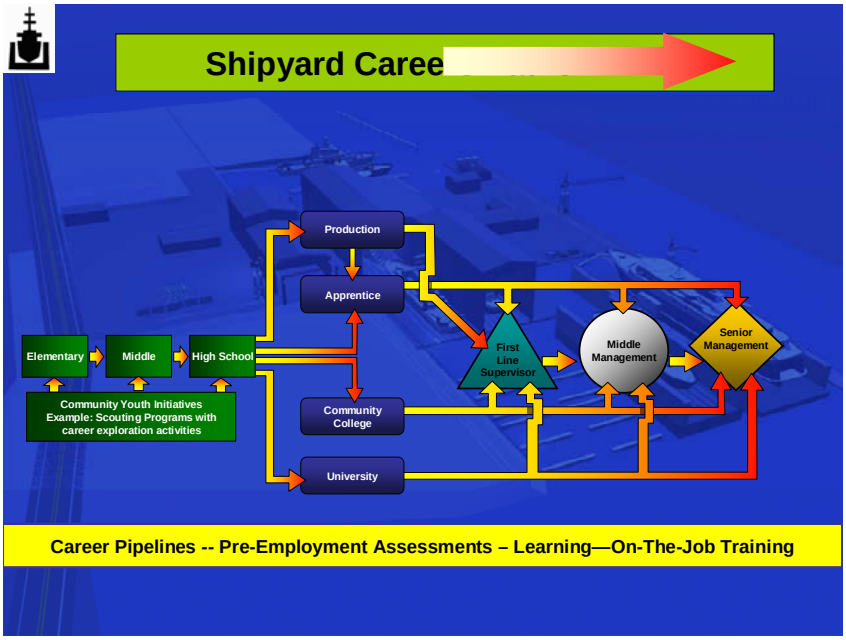
High Performance Manufacturing Curriculum. The Manufacturing Skill Standards Council (MSSC), a subset of the National Skill Standards Board, developed national core skill standards for entry-level manufacturing technicians. These standards were validated by 2001 and included: Core academic standards; and specific standards for Production; Manufacturing Production Process Development; Quality Assurance; Health, Safety, and Environmental Assurance; Maintenance, Installation, and Repair; Logistics and inventory control. Some shipyards participated in this process.

Then a comprehensive high-school

curriculum was developed by MSSC and McGraw-Hill/Glencoe named *High Performance Manufacturing – portable production skills.*

The MSSC standards and curriculum were shared with interested colleges for their own use and as a bridge to their feeding K-12 systems. Additional MSSC skills standard and curriculum information is in Appendix C.

Generic Industry Career Paths. A key tool for both shipyards and colleges to think about education for workforce preparation and advancement evolved as a career path representation. Work by Bender Shipbuilding and SENESO Marine developed a version that was conceptually reviewed and accepted by participating shipyards. Northrop Grumman Newport News required a more simplified version that spoke to persons visiting their serving job service center. Alaska Ship and Drydock teamed with a number of Community Youth Initiatives to increase the complexity but represent how one may find a pathway to understanding the industry.



Following in this section are summaries of the two most active college-shipyard teams. Related information is in Sections 5 and 6.

4.1 Hampton Roads Shipyard-College Collaboration

Beginning in 2004, shipyards in the greater Hampton Roads Virginia area began collaborative work between shipyards, recognizing that future workforce recruiting and training would be difficult and expensive if each shipyard worked solely by itself. More information on collaboration in this area is in section 5.

Following are key panel project outcomes from the Hampton Roads area as reported by Barbara Murray, Director, Maritime and Transportation Center and Apprenticeship Related Instruction Coordinator for Tidewater Community College (TCC). Ms. Murray also serves as Chairperson-Education and Training subcommittee for NSRP Crosscut Panel. This consortium won a high-growth initiative grant of $1.8 million to facilitate

workforce preparation improvement and is developing a National Science Foundation grant to enhance the academic components.

Tidewater Community College (TCC) integrates and uses various shipbuilding and repair skill standards such as NSRP, MSSC, US DOL O-Net, and job profiling systems of SkillsNET and/or Work Keys to better understand the academic needs (college courses) of new workers and the on-the-job/apprentice needs of new worker. Specifically,

- TCC works closely with area shipbuilding and repair companies in the integration of all of the above named skill standards.
- TCC has made large gains with shipbuilding and repair companies both regionally and nationally through the relationships borne and grown as a result of the NSRP meetings.
- TCC sees great worth in actively participating with NSRP crosscut projects and conferences. The November 2006 NSRP meeting held at TCC in Norfolk proved to be a great link with professionals in regards to both education, program development and human resource issues.
- TCC has Registered Apprenticeship Programs at three (3) local shipyards, offering all the Apprenticeship Related Instruction (ARI) by offering and creating courses through the College, and coordinating all coursework, hiring the appropriate instructors skilled in this industry.
- TCC works daily with the USDOL and DOLI in our partnering with registered apprenticeship programs with the ship repair sponsors—the largest registered apprenticeship program sponsors in Hampton Roads. O-NET is used in working with DOLII and the registered apprenticeship programs.
- TCC assists Sponsors with the selection process of new apprentices by coordinating, administering, and preparing summaries for all pretest screening tests to qualified apprenticeship program applicants.
- TCC has developed a professional relationship with SkillsNET as a result of NSRP meetings and collaborations. TCC has contracted SkillsNET to work on the workforce needs Survey for the planning of the Maritime and Transportation Center which will serve the companies nationally, being housed at TCC in Portsmouth, VA.
- TCC utilizes the job profiling and screening system of Work Keys in collaboration of apprenticeship sponsors by administering WorkKeys assessments and then interpreting results for said company/sponsor.
- TCC has begun to utilize KeyTrain, a Gap training software, to build developmental skills in math and reading for registered apprentices in the ship repair programs.
- TCC works closely with each Apprenticeship “sponsor” to market their programs on the TCC website, under Workforce Development, and also through a search keyword of “apprentice” on the TCC website.
- TCC invites the area shipyards to participate in all high school and College career awareness days and events for occupational training.

Tidewater Community College has developed the following Maritime Course series to serve shipyards. Courses were designed with development and input from subject matter experts (SME) as recommended by members of the Tidewater Maritime Taskforce, using industry experts and instructors to approve.

Maritime Welding (6 courses)

- 1st WEL Cohort began courses in Spring 2006
- 2nd WEL Cohort began WEL series Feb 2007
- 3rd WEL Cohort planned for late Fall 2007
- 1st course in WEL series: Plans are underway to get approval for 1st two WEL courses to be taught to in high schools as a dual credit course, introducing regional students to the shipbuilding/repair industry.
- 1st course and beginning competencies are taught to all BAE Systems apprentices, on site at shipyard

Shipfitter Series (6 courses)

- 1st Cohort begins March 2007
- 1st course in Shipfitter series was adopted and taught as Introductory course for all new registered apprentices at two ship repair sponsors

TCC is working with the shipbuilding and repair industry on Pilot projects that include a Maritime Shipfitter Program, a Maritime Welding Program, and a Maritime & Transportation National Resource Center.

Tidewater Community College has developed or continued innovations that lead to improving functional education and training between shipyards and colleges. The college helping the shipyard; the shipyard is helping the college.

- Apprenticeship:
  - 2 new programs begin in 2007
  - One strong Shipyard registered apprenticeship program continues to grow

- Marketing /Web site on Workforce Development page at TCC
  - TCC partnered with the apprenticeship program partners (sponsors) to develop flyers for handouts at local career day events and to handout to prospective students in WFD
  - Individual Brochures with ARI specific courses and company criteria regarding the specific sponsor's registered apprenticeship program is downloadable on TCC webpage
  - Industry videos regarding careers offered are to be loaded on TCC WFD website, as shared by company with TCC

TCC has used emphasis in shipyard workforce preparation improvement to attract other resources (grants, other teaming, etc.), and improved college or shipyard education and training.

- Include extracts from your NSRP Nov 2006, meeting in Norfolk reports NSF planning grant , etc.
- Teaming grants include work on new curriculum to begin for marine electrician
- TCC led an industry specific incumbent worker DOL grant, training over 200 shipyard occupational workers and continuing students from 2000-2004. This advisory group and activities formed the basis of the active working group today- in the maritime industry working with TCC

Tidewater Community College has identified some problems (needing resources) and issues (needing further research and discussion) that NSRP should explore in the future.

- Support for Curriculum development to the College in order to contract the experts and develop approved courses, series and specialized maritime industry training in a shorter period of time
- Tuition and books: Easy access to funds that the college and advertise for use by students and/or incumbents to take classes for trade specific training, upgrades, certification or retraining
- Certification courses offered in much needed occupations , paying for students to take the certification
- Funds to send 2 instructors for certified trainer workshops

Further Discussion and/or research:

- TCC would ask NSRP to be an active member in supporting the development of the Maritime and Transportation Center, located at TCC in the new Portsmouth campus.
- This Center would serve local/regional companies, but would also serve as a clearinghouse for industry specific courses, programs, certification training, trainer workshops and national conferences for members of the industry
- Career Awareness activities and material support

4.2 Pilot Project Design and Implementation

The Workforce Preparation Improvement project included provisions to design and implement a pilot project between a participating shipyard and its supporting college. In July, 2006 the Crosscut Panel voted to have the project's pilot focus placed on the

Ketchikan Shipyard, a state-owned repair yard operated by Alaska Ship and Drydock, Inc. and its supporting college, University of Alaska Southeast, Ketchikan Campus.

Rationale for this choice is because the Ketchikan Shipyard is at the leading edge of an improvement and expansion project that can create nearly 300 new jobs over the next five years. The lessons learned from this experience will be valuable in helping future shipbuilding and repair industry workforce development because it will include elements of industry image, college-shipyard collaboration, worker recruiting, training, retention, and career upgrade.

The Ketchikan shipyard is being expanded to include more covered repair and building space and improve production tooling and business process systems. After the facilities changes, the shipyard will be able to repair nearly 95 percent of the vessels that routinely operate in Alaskan waters. The shipyard is adding a new construction capability spearheaded by an ONR/Congressional funded OTC contract to design-build an experimental high-speed, variable draft vessel with expeditionary force implications.

The planned expansion of the shipyard had been focused primarily on physical assets in the investment strategy. Evidence provided by the Crosscut Initiatives Panel to shipyard, Alaska State and university officials convinced them that developing the workforce was a critical concurrent project. The Crosscut Workforce Preparation Improvement Project goals were accepted not only by the shipyard operating company, Alaska Ship and Drydock, Inc. (ASD), but also by the Alaska State Department of Labor and Workforce Development (ADLWD), and the University of Alaska Southeast, Ketchikan Campus (UASK). ADLWD and UASK partnered with ASD to create a series of grant funded projects to work in parallel with and complimentary to the Crosscut pilot project. The Crosscut project technical lead played a key role in the design and implementation of the project. A family of activities were included in the pilot work and are ongoing as the panel project ends in early 2007. (These activities are more fully described in Appendix B. Their cost share leverage is described in section 6).

Pilot project activities included:

- A “blueprint” or comprehensive model of future workforce development. Elements of the blueprint include: shipyard organization and culture changes; industry image improvement; career path development; job breakdown analysis; skill standards development; new worker training; incumbent worker training upgrades; management and supervisor training; retention; and, rewards. Development of the blueprint was funded by an ADLWD grant.
- Skill Library: An overall job breakdown for current and projected new work was completed by ASD. This activity is in a skill-standard format that identifies scenarios for key tasks then breaks jobs into steps and key functions.
- Job Profiles: Skill standards for ASD jobs were developed using NSRP standards, MSSC standards, and the services of SkillsNET Corporation to teach job profiling using their web-based system funded by the panel project. A limited slice of this work was completed and is continuing into 2007.

- Employee Profiles: Qualitative and quantitative profiles of individual employees are being developed to compare with the skill library and job profile database.
- Coordinating web site, www.crosscutprojects.com was funded by the panel project.
- Learning Events: Web-based learning management system to house and deliver course modules was funded by the UASK. The open-source Moodle system was used.
- Continuation and expansion of the Alaska Shipyard System for Education and Training (ASSET), a physical facility with a part-time staff person, computer-based learning center and other features was funded by a US Department of Labor-ETA grant via UASK.
- Development of technical capacity to design learning modules was jointly funded by the ADLWD, UASK, and the panel project. Technical capacity includes education design software, graphics and video editing software, still and video cameras, recording equipment, computer display systems, technical support by videographers and instructional designers. Technical capacity also includes training subject matter experts to be the trainers and to capture expert knowledge, wisdom, and lessons learned from experience to include in course modules. Learning modules include technical content;
- The shipfitter curriculum provided by NASSCO to the project colleges was adapted by UASK using ASD-specific learning objects (text, graphics, photographs, etc.) Other supervisory and technical curriculum was developed as time and funding permitted. An entry welding program was designed and placed into service. ASD's corrosion control apprentice program, dormant for two years, was revitalized.
- The Training Within Industry (TWI) program for supervisory development was adapted for ASD-specific processes jointly by UASK and panel project funding.
- The Manufacturing Skill Standards Council curriculum for entry-level manufacturing technicians, High Performance Manufacturing – Portable Production Skills was included in the ASSET program using panel project and UASK funding. Training for two staff and pilot learning for ten low-skilled or entry level technicians is included.

5. Strategies for Industry Collaboration

Collaboration in shipbuilding and repair technical areas such as vessel design tools, production and business processes, safety, environmental, and specific production skills such as surface preparation and coating and welding have had long-standing success through NSRP and the SNAME ship production committees. These fields have a strong link to a national supply chain.

People matters have been perceived as not needing serious collaboration. Between the mid 80s and 2002 the US shipbuilding and repair industry downsized about 14 percent in part caused by post-Cold War defense builddown. Beginning in 2003, a growth in use of contract labor to supplement numbers or specific shipyard skills was reported. The shipbuilding and repair-skilled "portable" labor pool had come in part from defense industry downsizing. Crosscut Initiatives Panel began to study workforce development practices.

In 2005, the Workforce Sources and Skills national summit reported growing concern about the industry's ability to recruit shipyard workers not only for regular turnover, measured up to 40 percent annually in some shipyards, but also the looming retirement of skilled and experienced technicians, supervisors, and managers. In 2006, Signal International LLC was unable to hire sufficient welders and fitters for their Pascagoula and Brownsville oil platform projects so obtained H2B permission to hire technicians from India. In 2006, executives from the Shipbuilders Council of America and several large shipyards identified future workforce numbers and skills as a growing concern.

National collaboration between shipyards on people issues has often been seen as a waste of time because hiring is perceived as substantially local, or at its widest span, regional. Difficulties such as Signal International's imply that best practices must be learned and innovations explored.

Crosscut Initiatives Panel perceives that shipbuilding and repair is a rough cross between manufacturing and construction. The construction industry provides lessons to consider. Beginning in the late 1990s, Associated General Contractors, the trade association for 45,000 general and subcontractors, recognized that an industry practice was stealing each other's workers for a small hourly wage hike but doing nothing to increase the pool of qualified technicians. Over a two year period, AGC invested some $800,000 in a multi-faceted program of industry image improvement and school intervention beginning at the fifth grade. Their program has resulted in a much better connection between construction firms and their supporting K-12 systems and community colleges. More details of this type of collaboration is recorded in Crosscut Initiatives Panel documentation in the Crosscut Resources Center.

The shipyard-college collaboration supported and reported in this project is a strong lever for additional dialog. Shipyards are providing industry-developed curriculum to colleges. Community college leaders are beginning to share curriculum between regions. A "wish list" of future education and training needs is emerging.

In 2003, NAVSEA's Admiral Belisle called for development of a "one yard, any yard" conceptual framework to provide greater flexibility for warship repair. One concept to achieve this vision was to move toward common skill standards and certification to improve job portability. Some shipyards, such as Electric Boat and Todd Pacific, have implemented some aspects of this collaboration to reduce re-certification cost and time when work teams must be assembled from multiple sources and work quickly. The shipyard-college collaboration and a national shipbuilding and repair industry skill inventory and management system may be helpful.

In 2004, the then Governor of Virginia, called for collaboration between shipyards to find pathways for job portability that would keep employees on the payroll even if they had to work for another firm during times of adverse contract cycles in any given shipyard. In 2006, Hurricane Katrina has set up conditions so that workers from Northrop Grumman Ship Systems Ingalls shipyard in Pascagoula could support some work at Signal International LLC. Details of these consortia "bylaws" remain to be worked out but both experiments show there are both business and new workforce driving forces to collaborate further. There is hope that these efforts, which cut across the member shipyards of our two trade associations, Shipbuilders Council of America (SCA) and American Shipbuilding Association (ASA), might bring the trade associations into conversation in ways to give workforce issues a greater voice in public policy and inter-corporate circles.

Shipyards in the San Diego area do not have a large pool of experienced shipbuilders so growth of the industry in that location has required shipyards to collaborate with the San Diego Community College, Sweetwater School District and others to create a new workforce. Conversations are beginning between shipyards

Emphasis from this panel project spawned two new projects for 2007. The first funded is a small effort to collaborate on industry image improvement through clever videos that can be shared in a multi-media environment. The second is a Shipbuilding and Repair Career Day project aimed at junior high or middle school youth awareness of the industry. As the pull for new workers from shipyards increases and the push of people who catch a vision of great careers moves ahead, then the even more shipyard-college collaboration may be a critical lever in workforce preparation improvement.

6. Return on Investment

This project was completed under the budget of $77,700. The project start date, expected in January 2007 but not started until April 1, 2007, was extended for two months at no extra cost to allow participants additional time for collaborative work.

Industry cost share in terms of participant cash and in-kind support was projected at $10,000. Actual cost share includes

- Shipyard and college participation at project meetings, conference calls, web training events, etc. – estimate of time and travel cost: $26,800
- Project technical lead and pilot project management unpaid hours $7,500 (150 hrs @ $ 50)
- SkillsNET Corporation (letter at Appendix D) $49,000

The panel project planning and conduct helped facilitate additional grant income related to workforce preparation improvement:

- Alaska Department of Labor and Workforce Development STEP grants $126,000
- US Department of Labor ETA grant ASSET II - UASK $148,000

The panel project function used existing grant funds to further Workforce Preparation Improvement initiatives

- President's High Growth Job Training Initiative; The SE Virginia Advanced Manufacturing Collaborative - Greater Peninsula Workforce Investment Board $1.965 million

Benefits

- Clearly defined and easy to use adaptation of skill standards databases for implementation.
- Tools for management of company and industry employees skill inventory, connections with methods to improve skills such as self-study and modular courses.
- Educational materials – software, books, etc., provided to the University of Alaska ASSET program $3,369
- Certification of two University of Alaska staff to administer the MSSC High Performance Manufacturing instruction and assessment program (project cost $8,300)

Return on Investment (ROI)

- Opportunities to improve relationships with schools resulting in curriculum change directly supporting new shipbuilder education and subsequent reduction in shipyard recruiting, education and training costs.
- Future cost avoidance: Reduced shipyard overhead costs for education and training can result in lower customer costs.

7. Conclusions and Recommendations

Project Goals. The panel project achieved goals and objectives subject to qualifications in the goal areas following.

Skill Standards.

- Awareness of value and use of skill standards as the bridge between learning and work remains lower in shipbuilding and repair than in other industries such as construction, automotive, health, networks, etc.
- Consideration of skill standards is increasing as the demand for retiring shipyard workforce replacement grows.
- The strategic value of web-based skill inventory and management database systems remains untested in shipyards.
- Awareness of skill management systems is increasing as the experienced workforce retires and ad-hoc management systems leave gaps in numbers and skills of workers.
- The expectation of technical systems to assist capture, storage, and access of expert knowledge from senior, experienced shipyard workers has not yet been realized pending Phase II R&D in Navy SBIR 05-061 or a similar project. This effort is needed to ensure skill standards are in fact complete for the current knowledge base.

Shipyard-College Connections.

- Several very strong shipyard-college teams exist or have developed.
- Where strong college-shipyard teams are functioning, the synergism of efforts are not only improving workforce preparation improvement but also helping with industry image, recruiting, retention, incumbent worker skill upgrade, etc.
- Skill standards development in job profiling separates those knowledge-skill-ability factors that are most easily accomplished by colleges.
- Career path representations shape a mental map for shipyards, colleges, and workers to plan their future learning and experience needs.
- Job profiling analysis and collaboration by shipyards with colleges results in more realistic learning laboratories or simulator settings that prepare workers for real employment.
- Principles of adult learning, instructional design and delivery translate from the college setting to the workplace through supervisory training programs such as Training Within Industry. Supervisors who are better prepared to instruct, teach people to improve job methods, and affect better job relations between team members achieve better productivity and can significantly impact vessel cost.
- Consideration can be given to developing a national shipbuilding and repair supervisor and leadership college system by expanding mission of the Newport

News Apprentice School or some variant that includes both distance learning and classroom setting-team learning.

- Use of web-based learning management systems is growing. These systems enable learning delivery when and where it is needed and reduces the requirement for traditional classroom settings.
- Modular instructional design breaks up longer courses into shorter blocks that fit more easily into a work-study routine. Innovations in multi-media learning objects such as video, audio, text, graphics, images and learning standards such as SCORM enable inter-college sharing of curriculum and subsequent adaptation for the specific job setting.
- There is strong regional and local desire for shipbuilding and repair resource centers. The current family of resource centers are not functionally linked and interoperable but technology is available so, for example, a learner in Seattle could take a web-based course offered in Hampton Roads.
- Work-based learning will help a person to become employed and begin a career path. Connection with colleges, thought not possible by many dropouts, academically challenged young folk, or people who have had difficulty getting over fools hill, can kindle a desire to return for associates or higher degrees later in life.
- Specific curriculum requirements to meet emerging workforce preparation requirements are being identified and shared. These needs provide opportunity to seek common funding through US Department of Labor, National Science Foundation and other sources.
- Many lessons learned from the Alaska pilot project have been shared via the panel project and will be re-packaged for use in the industry collaboration and coordinating web sites or made available to local-regional shipyard-college teams.

Strategies for Industry Collaboration and Coordinating Activities

- Geographic settings with an apparent excess floating pool of workers are developing methods to share workers between shipyards. Legal, technical, knowledge and skill certification methods to cross boundaries are developing. Workforce portability between companies, between organizations that have organized labor forces or not, are demonstrated as feasible.
- Geographic settings with a labor shortfall are collaborating to develop common industry image, recruiting, and generic entry level training systems.
- Some coastal states with relatively low shipbuilding and repair activities have de-funded their supporting learning infrastructure, such as Rhode Island. If these states are to remain viable in shipbuilding and repair, e.g. nuclear submarines, then a more national method of recruiting and basic workforce preparation may be required.
- The strong regional efforts noted can be shared and connected better nationally through two distinct virtual resource centers. The revitalized Crosscut Resource Center can serve shipbuilding and repair industry professionals along

with their college counterparts with best practices, benchmarking and related resources. An industry image and generic learning resource-focused site easily accessible via advertising is envisioned with a placeholder web site www.goships.com in place. Proposals to develop and staff these two national resource centers were not successful in 2006 but will be re-packaged in 2007.

- The two industry trade associations, SCA and ASA, are not yet collaborating around looming workforce preparation issues and problems.
- Public (Navy) shipyards are involved to a very small degree in the national conversation around workforce preparation in part because they are funded with their own apprentice programs. Some sharing of resources may assist transition of the aging public yard workforce.
- The relatively large national pool of contract/temporary skilled labor firms has been superficially engaged in the national conversation about workforce preparation; however, leaders of these firms report similar problems in recruiting, training, and retaining skilled workers. Some sharing of resources may assist in maintaining this worker pool deemed valuable because of the cyclic nature of the shipbuilding and repair industry.

Appendix A
Statement of Work

Workforce Preparation Improvements

April 1 – December 31, 2006

Statement of Work

Prime Contractor: SENESCO MARINE

PTR: Greg Whitney, Atlantic Marine

Technical Lead: Larry Gebhardt, SENESCO MARINE

Researchers: Les Hansen (Consultant), Don Bewley (Consultant)

Industry involvement: Shipyards: *SENESCO, NG Newport News, Alaska Ship & Drydock (ASD), others*; Community Colleges: *Univ. of Alaska, Tidewater, others*; Manufacturing Skill Standards Council (MSSC).

Tasks:

The following will be accomplished to support project goals:

1. Research other industry skill standards approaches and web-enabled skill inventory and management systems and identify best-practice vendors for skill inventory and management. (Complete by mid-May 2006)
   - Research and document skill standards activities in related industries (April)
   - Research web-enabled skill inventory and management systems (April)
   - Identify and select best-practice vendor for skill management systems (May)
2. Supervise adaptation of the existing core/entry level NSRP skill standards to a web-enabled data management system and update existing NSRP skill database to reflect 2006 best practices. (Complete early July 2006)
   - Review existing skills database and select "core" skills to be adapted into data management system. (May)
   - Coordinate and supervise standards adaptation with selected vendor from Task 1. (June)
   - Make web-enabled skills data accessible to project team and participants and obtain feedback regarding suggested updates (–June-July)
3. Integrate representative general manufacturing skill standards KSA's from existing MSSC materials (Complete by mid-August 2006). *Note: Perform Task 3 concurrently with Task 2 if cost savings can result.*
   - Work with MSSC to integrate existing manufacturing standards that are complementary to the shipbuilding standards identified in Task 2. (July)

- Complete update of existing NSRP skill standards database. (–July-August)

4. Coordinate demonstration and review of the integrated NSRP-MSSC skill database with one shipyard and their associated community colleges (Pilot). (Complete by mid-October 2006).
   - Develop strategy for conducting pilot demonstration and select participants. (August)
   - Conduct pilot demonstration and gather data. (September)
   - Analyze results of demonstration and make recommendations. (October)
5. Identify methodologies to optimize implementation of the integrated skill standards system by community college/shipyard collaboration, including approaches for inter-company information sharing without revealing proprietary information (Complete by end November 2006)
   - Develop plan to optimize implementation, based on results of pilot in Task 4. (October)
   - Identify active shipyard/community college connections and points of contact for data gathering. (Preliminary – April; Final – October)
   - Identify college learning modules that meet selected skill standards. (Preliminary – May; Final – November)
   - Determine areas where shipyards can help colleges and what help shipyards need from colleges. (Preliminary – July; Final – November)
   - Develop a "catalog" of shipyard/college identified needs and resources. (December)
6. Share results via NSRP panel meetings and published final report and recommendations (Complete by December 31).

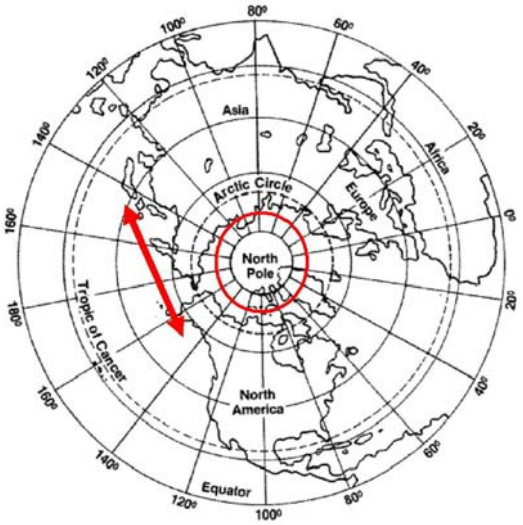
Deliverables:

1. Project Status Report – June 30, 2006
2. Project Status Report – September 30, 2006
3. Report on research, choices for enabling technologies and results of pilot project (end of Task 4) – October 15, 2006
4. Final Written Report (Task 6) – December 31, 2006

Appendix B – Alaska Pilot Project

Background: The Workforce Preparation Improvement project included provisions to design and implement a pilot project between a participating shipyard and its supporting college. In July, 2006 the Crosscut Panel voted to have the project's pilot focus placed on the Ketchikan Shipyard, a state-owned repair yard operated by Alaska Ship and Drydock, Inc. and it's supporting college, University of Alaska Southeast, Ketchikan Campus.

Rationale for this choice is in part because the Ketchikan Shipyard is strategically located to serve not only Alaska shipping, but also Navy and Homeland Security (Coast Guard) units that support free use of the sea lanes between Asia and North America.

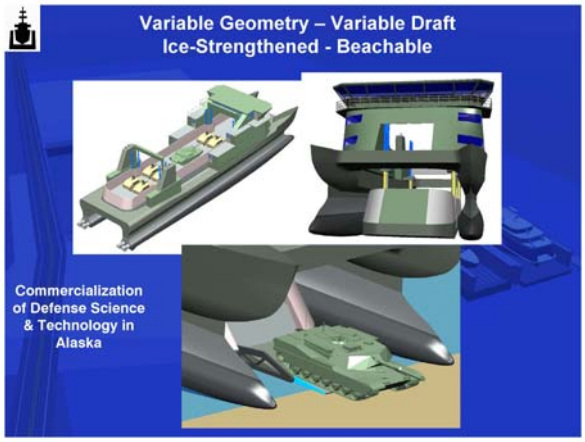


The Ketchikan shipyard is at the leading edge of a $70 million improvement and expansion project that can create nearly 300 new jobs over the next five years. The lessons learned from this experience will be valuable in helping future shipbuilding and repair industry workforce development because it will include elements of industry image, technology transfer, college-shipyard collaboration, worker recruiting, training, retention, and career upgrade.

The Ketchikan Shipyard is being expanded to include more covered repair and building space and improve production tooling and business process systems. After the facilities changes, the shipyard will be able to repair nearly 95 percent of the vessels that routinely operate in Alaskan waters. The shipyard is adding a new construction capability spearheaded by a $44 million ONR/Congressional funded OTC contract to design-build an experimental high-speed, variable draft vessel with expeditionary force implications.

Appendix B – Alaska Pilot Project

The new construction vessel includes concepts of design-for-production, advanced hull forming, modular construction, and semi-automated processes. These advanced shipbuilding technologies require transfer into the incumbent and new workforce. Lessons learned from the newbuild project and the shipyard's workforce development initiatives may provide valuable lessons for shipbuilding affordability.



The planned expansion of the shipyard had been focused primarily on physical assets in the investment strategy. Evidence provided by the Crosscut Initiatives Panel to the shipyard, Alaska state and university officials convinced them that developing the workforce was a critical concurrent project. The Crosscut Workforce Preparation Improvement Project goals were accepted not only by the shipyard operating company, Alaska Ship and Drydock, Inc. (ASD), but also by the Alaska State Department of Labor and Workforce Development (ADLWD), and the University of Alaska Southeast, Ketchikan Campus (UASK). ADLWD and UASK partnered with ASD to create a series of grant funded projects to work in parallel with and complimentary to the Crosscut pilot project. The Crosscut project technical lead played a key role in the design and implementation of the project.

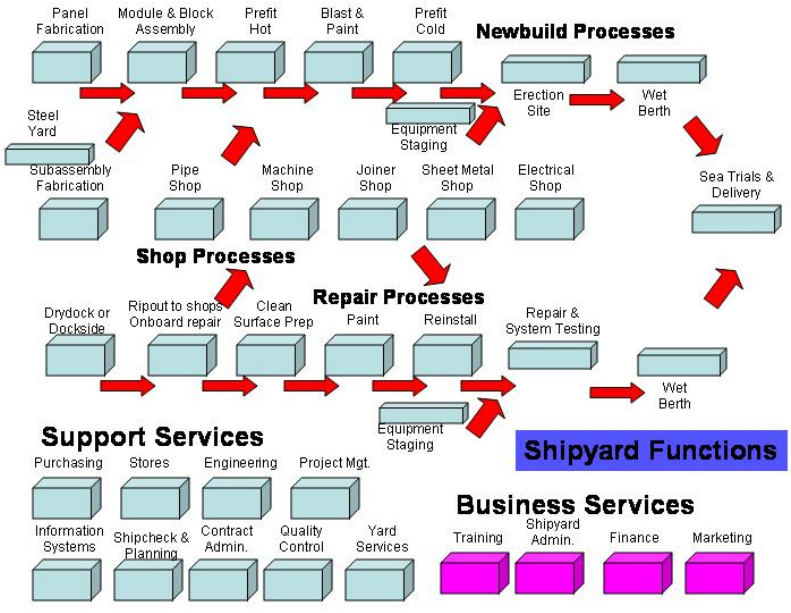
Appendix B – Alaska Pilot Project

A family of activities were included in the pilot work and are ongoing as the panel project ends in early 2007.

Workforce Development System

Image	News Coverage Manufacturing in the general economy	Popular Media TV shows, etc.	School Career Counselor Advice	Company Web Sites & Open House Tours	Career and Job Fairs	Company participation in education organizations	Family & Friend Referrals	Health, Safety & Environmental Reputations
Sources	K-12 School to Work	Technical - Vocational Education School to Work	Work to Work Job Changers & Dislocated Workers	Welfare to Work Persons Needing 2nd or 3rd Chance	Immigrants	Temporary & Contract Workers	Specialty Subcontractors & Teaming Partners	
Education	K-12 Curriculum	Technical - Professional Courses or Academies	Community or Junior Colleges	For-profit technical schools	Company-Education Partnership Models	Work-Study and Structured On-the-Job Training	Immigrant Programs ESL, etc.	
Support	School-to-Career Organizations	Job Service Recruitment & Referral	Labor Market Information and Statistics	Resource Center Interview Screening Testing	Education & Training Subsidies & Grants	State-Regional Special Programs	Skills Standards General Industry Specific	Welfare - To - Work Subsidies and Support
Shipyard	Recruitment and Hiring Process	Orientation and Initial Training	On-The-Job Training and Mentoring	In-Company Apprentice Programs	Perceptions of Professional Development & Retention			

- **A "blueprint" or comprehensive model of future workforce development system** is outlined in the matrix above. Other elements of the blueprint include: shipyard organization and culture changes; industry image improvement; career path development; job breakdown analysis; skill standards development; new worker training; incumbent worker training upgrades; management and supervisor training; retention; and, rewards. Development of the blueprint was funded by an ADLWD grant.

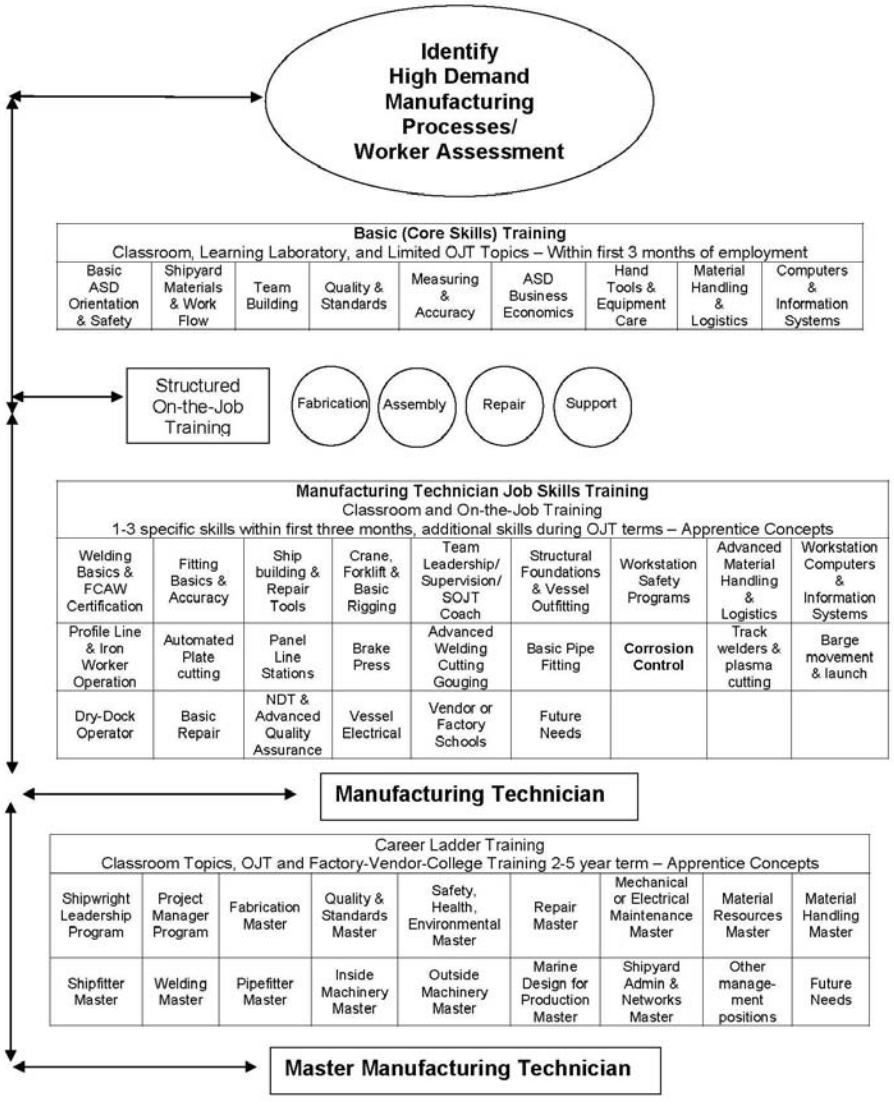


- **Skill Library:** An overall job breakdown for current and

projected new work was completed by ASD staff based on shipyard processes mapped out in a block diagram. This activity is in a career path and skill-standard format that identifies scenarios for key tasks then breaks jobs into steps and key functions. This database describes the skill sets needed to operate and maintain the shipyard. Then a modular knowledge-skill-ability curriculum for entry-level to journeyman, advancement to team-leader or supervisor and subsequent management positions was outlined for delivery in classrooms, learning labs and on-the-job.

Blueprint Final July 16, 2006

Sample ASD Career Path Training & Structured OJT Program



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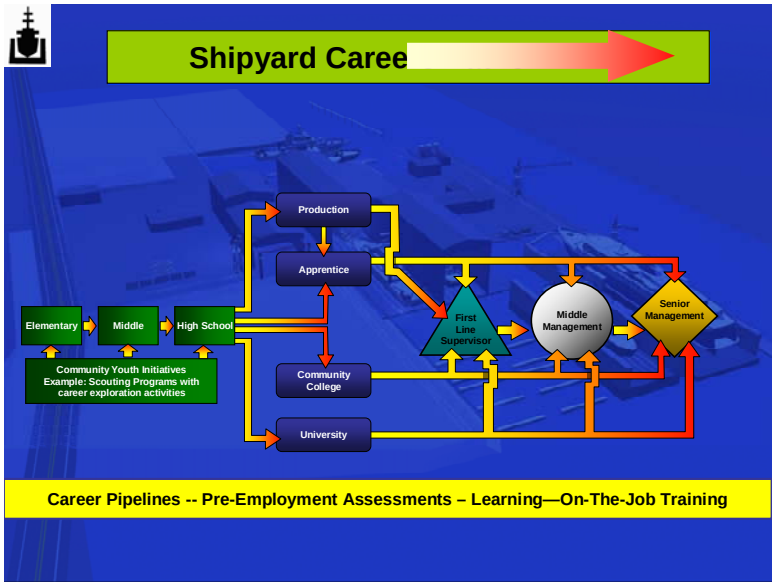


The name "technician" is chosen to signifiy more multi-skilled employees and a higher level of education and training.

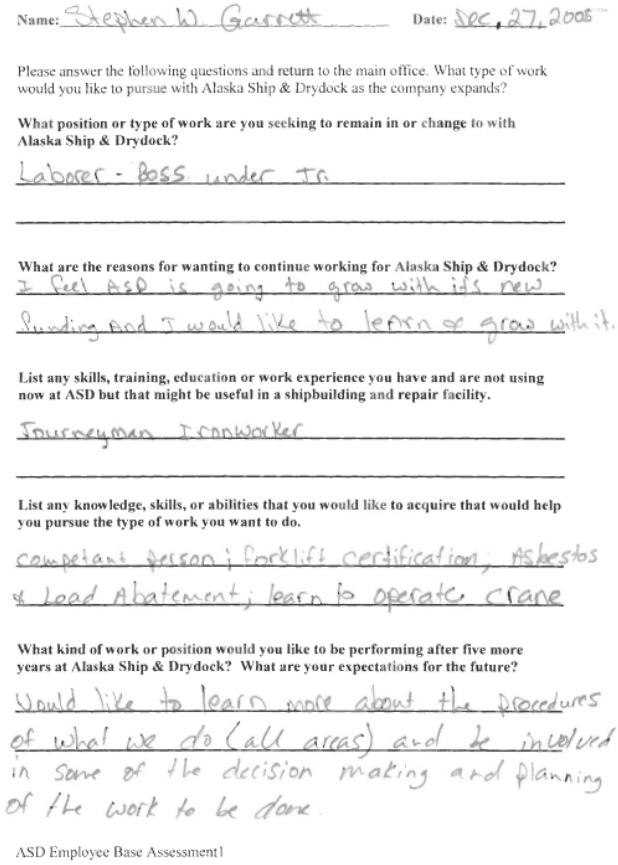
The relative complexity of the shipyard's career training path and structured on-the-job training program was simplified to a diagram that is more easily envisioned by entry level workers and shipyard supervisors. Details are "behind the scenes."

- **Job Profiles:** Skill standards for ASD shipfitter jobs were developed using NSRP standards and MSSC standards. The services of SkillsNET Corporation were used to teach job profiling using SkillsNET's web-based system funded by the panel project. Job profiling for other job families such as welding, surface preparation and coating, etc., is continuing into 2007. Work of shipfitters in a traditional shipyard does not fit the advanced manufacturing process being designed at the Ketchikan Shipyard to produce the E-Craft. Accordingly, the job profiling process beginning with experienced workers requires analytical work by supervisors and managers. This process, using the SkillsNET tools, creates a SkillObject™ that describes the job tasks in a breakdown approach, identifies skills and abilities the worker needs to do the job, the tools and software needed, theoretical and principles knowledge, other resources to do the task or job such as environmental conditions, and the performance standard the worker needs to know to achieve quality goals. The role of a shipfitter may move from a skilled craft to include machine operation.

- **Employee Profiles:** Qualitative and quantitative profile of individual employees are being developed. Where job profiles describe the ideal mix of attributes to do a job, the employee profiles are the actual or realistic profiles. Input to employee profiles are driven by a multi-faceted assessment program include current shipyard qualifications, experience, course certifications, process certification, and supervisor review. Employees make input to their profiles that may include additional prior

experience, or certifications. The Alaska Ship and Drydock Production Superintendent adds an additional dimension to include employee input about their own goals for self-improvement and advancement.

- **Overall training guidance.** The Ketchikan Shipyard uses overall guidance of the Shipyard Training Program Guide, NSRP 527. Program guidance suggests that the shipyard know what breadth and depth of knowledge, skill, and ability is needed to operate the shipyard to world class standards then compare this needs matrix to actual employee profile status and then close gaps between actual and desired. Gap closure is done through learning events, hiring decisions, or subcontracting-outsource decisions. The shipyard optimizes its training resources by only closing needed knowledge-skill-ability gaps and not over-training or training too far in advance of when the ability is needed. When gap closure is planned, other elements of the SkillObject™ can be considered – such as software, tools, other resources, etc. to optimize improvement of job methods. The Shipyard Training Program Guide recommends identifying basic or core knowledge and skill topics. These basic topics are logical for inclusion in college or technical high-school areas to prepare entry-level workers.



Name: Stephen W. Garrett Date: Dec. 27, 2006

Please answer the following questions and return to the main office. What type of work would you like to pursue with Alaska Ship & Drydock as the company expands?

What position or type of work are you seeking to remain in or change to with Alaska Ship & Drydock?

Laborer - Boss under JS

What are the reasons for wanting to continue working for Alaska Ship & Drydock?

I feel ASD is going to grow with its new funding and I would like to learn & grow with it.

List any skills, training, education or work experience you have and are not using now at ASD but that might be useful in a shipbuilding and repair facility.

Journeyman Iconworker

List any knowledge, skills, or abilities that you would like to acquire that would help you pursue the type of work you want to do.

competant person; forklift certification; Asbestos & Lead Abatement; learn to operate crane

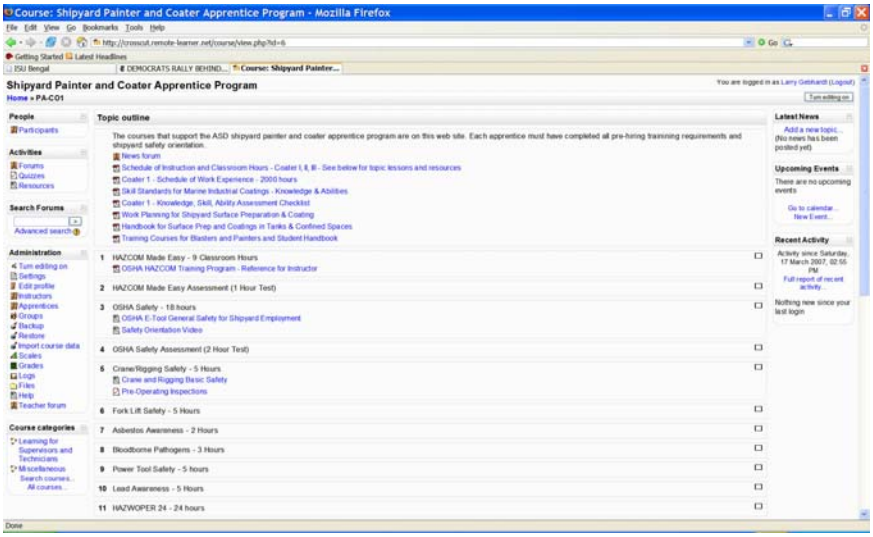
What kind of work or position would you like to be performing after five more years at Alaska Ship & Drydock? What are your expectations for the future?

Would like to learn more about the procedures of what we do (all areas) and be involved in some of the decision making and planning of the work to be done.

ASD Employee Base Assessment1

- **A coordinating web site**, www.crosscutprojects.com was funded by the panel project. This website allowed management of the Crosscut Workforce Preparation Improvement tasks, and the separate Alaska Pilot Project grant tasks funded by the US Department of Labor Education and Training Administration via the University of Alaska Southeast Ketchikan Campus, and the Alaska State Department of Labor and Workforce Development. Two different username-password systems were set in place to keep the Crosscut Panel research and development work separated from Alaska grant management and then from general public access.

- **Learning Management System.** Learning Events for prospective new employees and incumbent worker skill gap-closure were set up on a web-based learning management system (LMS). The LMS to house and deliver course modules was funded by the UASK. The Moodle system, an open-source LMS used by hundreds of thousands of education programs worldwide, was easily adapted for shipyard use. The screen shot shows the shipyard painter and coater apprentice program course.



This system allows self-study asynchronously – when and where the learner is ready. The LMS is flexible around registration. It offers a wide range of features such as assignments, quizzes, forums for group projects, etc. Moodle is compliant with national learning management system standards such as SCORM and AICC. The pilot program included modular courses for entry level and incumbent technicians and for supervisors.

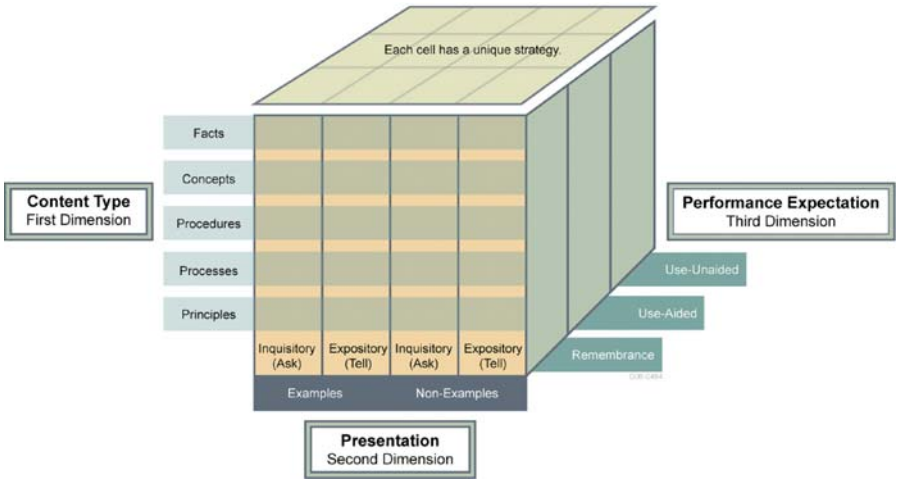
- **ASSET System.** Continuation and expansion of the Alaska Shipyard System for Education and Training (ASSET), a physical facility with a part-time staff person, computer-based learning center, curriculum to both support the shipyard and gain university credit, and other features was funded by a US Department of Labor-ETA grant via UASK. ASSET is the university's shipyard support system set up in a trailer positioned between drydocks, shops and offices for convenient worker access. The ASSET computer system provides learning space for individual self study and for small, work-team sized groups. A shipbuilding and repair resource library with books, manuals, and computer-based documents is open to learners. ASSET staff administer the LMS. UASK staff have attended Crosscut Panel project meetings, participated in conference calls and other connections with similar community college staff.

Appendix B – Alaska Pilot Project

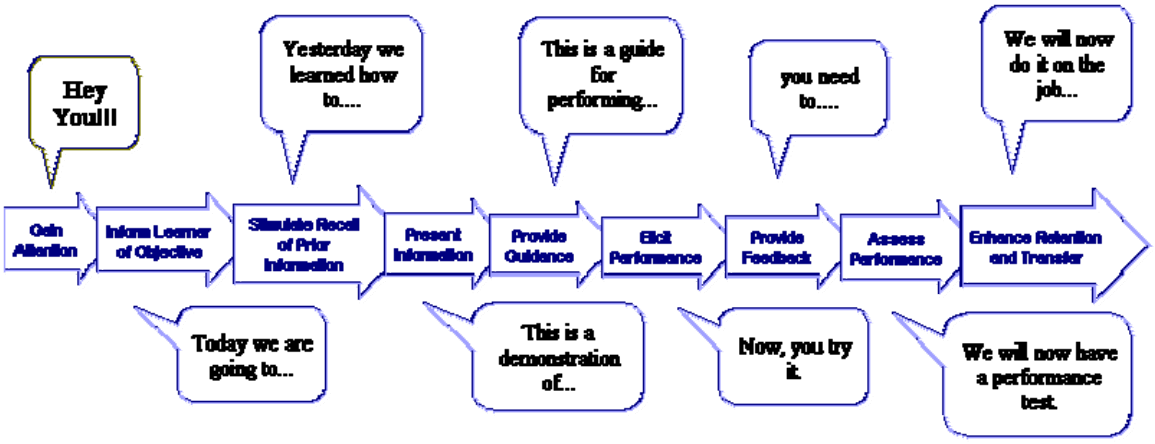
The ASSET progam has adopted the MSSC advanced manufacturing curriculum described below. A professional rapport is building beyond the local campus and into the wider University of Alaska system that will help further collaborative learning development to occur.

- **Capacity Building.** Development of technical capacity to design and deliver learning modules was jointly funded by the ADLWD, UASK, and the panel project. Capacity building was needed because neither the college, shipyard, nor commercial training vendors provided the curriculum needed at the shipyard. Some curriculum provided basic theory and principles but lacked practical examples to help learners make sense and gain relevancy. Technical capacity includes education design software, graphics and video editing software, still and video cameras, recording equipment, computer display systems, technical support by videographers and instructional designers. A combination of ASSET staff, selected shipyard worker, and some contract support amplified the small shipyard's capacity to develop good quality curriculum Technical capacity building also includes training subject matter experts to be the trainers and to capture expert knowledge, wisdom, and lessons learned from experienced workers to include in course modules. It had been anticipated that technology in development under Navy SBIR 05-161, TITLE: Improved Work Performance in a Shipbuilding Environment but this project was not selected for Phase II funding.

- **Learning modules** for the pilot project were shaped by modern instructional design theory and practice. The diagram shows the principles of including technical content, performance expectation, and a presentation approach or innovation to motivate learning. Learning module delivery followed a proven Gagne format that takes into account the psychology of adult learning. Instructional design and delivery for the industrial workplace is different from typical academic learning. Industrial instructional design recognizes that 90 percent of actual learning for performance, the top level of a learning taxonomy, is achieved on-the-job. This is why the panel project focused on supervisors and mentors who perform on the job training. OJT instructors must have a higher level of skills and coaching ability to get best results and accelerate the learning process.



Appendix B – Alaska Pilot Project



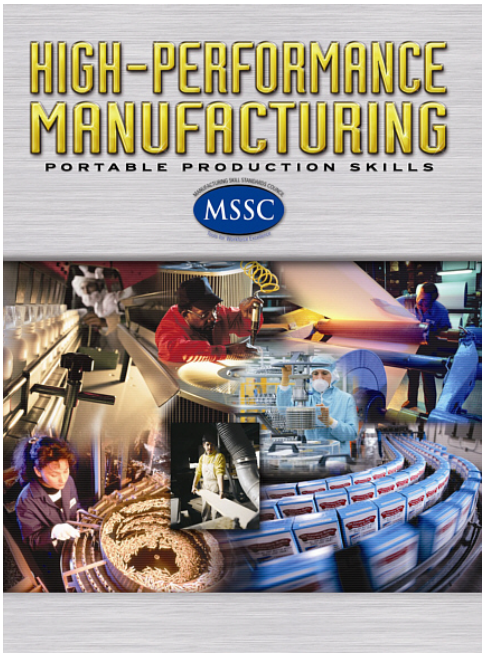
Learning modules are designed for delivery as building blocks of a longer curriculum. The attention span of entry-level learners is relatively short. Entry level workers who are on-the-job are still proving themselves and often cannot be allowed lengthy time for traditional classroom training. Most smaller shipyards do not have resources for a full and comprehensive production skills and apprentice program. Accordingly, the modular learning approach is

- **The shipfitter curriculum** provided by NASSCO to the project colleges was adapted by UASK using ASD-specific learning objects (text, graphics, photographs, etc.) Adaptation customized the curriculum to the shipyard-specific processes, shipfitter equipment, and tooling. Other supervisory and technical curriculum was developed as time and funding permitted. An entry welding program was designed and placed into service. ASD's corrosion control apprentice program, dormant for two years, was revitalized.

- **The Training Within Industry (TWI) program** for supervisory development was adapted for ASD-specific processes jointly by UASK and panel project funding. TWI background is at Appendix C. TWI for supervisors includes five key needs: Technical knowledge of work, supervisory responsibilities, skill in on-the-job instruction, skill in coaching job method improvement, and skill at job relations between work team employees. The TWI program delivery has been historically performed by consultants who work at the work site with learners. The pilot project used TWI adaptation to a modular, web-based approach as an experiment both in capacity building and adapting TWI to the shipyard environment. Following self-study of the TWI modules delivered by the

learning management system, then groups of supervisors, or prospective supervisors can participate in collaborative exercises to practice their learning.

- **The Manufacturing Skill Standards Council curriculum** for entry-level manufacturing technicians, *High Performance Manufacturing – Portable Production Skills* (McGraw-Hill/Glencoe) was included in the ASSET program using panel project and UASK funding. Training for two staff and pilot learning for ten low-skilled or entry level technicians is included. Background about the MSSC standards are included in Appendix C. This curriculum is aimed at high-school aged youth and provides them a modular delivery system to learn manufacturing basics.



Two UASK staff were certified to administer the program. Some of the newest entry level employees at the Ketchikan Shipyard participated in assessments to gauge understanding and knowledge before the course and will be assessed subsequently. The availability of this course to the community is broadcast through meetings with the job service center and school district. Additional evaluation is needed to determine if this course would be a logical common education intervention to attract young people into careers in the shipbuilding and repair industry. The curriculum is used in 45 states. The ASSET program use is the first introduction to the State of Alaska.

Summary: The pilot project within the overall project on Workforce Preparation Improvement demonstrated that a small shipyard working with its supporting college and supplied with limited resources can create a powerful force to change the culture of a shipyard from status-quo toward world class. The elements of this pilot program have stimulated management, supervisors, technicians, and the community to believe that real job creation and careers can emerge from the ongoing investment in facilities and new vessel construction that has not before been seen in the Ketchikan area.

Appendix B – Alaska Pilot Project

While the pilot project began its focus on the shipfitter craft, enthusiasm for learning in general expanded quickly and across most of the shipyard functional areas. Availability of the web-based learning management system and capacity-building technology drew interest and action resulting in revitalization of the surface preparation and coating apprentice program, environmental education, start-up of a new welding apprentice program, design of a welding supervisor course, more effective safety training, and more.

A quote from Lew Madden, a consultant advising the ultimate customer of the E-Craft vessel named Susitna is in the text box.

> I have been involved with the Office of Naval Research E-Craft project designing and now constructing an experimental high-speed, variable draft vessel with expeditionary force implications. The vessel, called the E-Craft or M/V Susitna, is emerging from a design-build team of Lockheed Martin, Guido Perla and Associates, and Alaska Ship and Drydock. The vessel will be placed in service as a passenger and vehicle ferry and evaluated in harsh weather and demanding service environment of the Cook Inlet Alaska, serving the needs of Matanuska-Susitna Borough. I believe that this project will rely on the ability of the Ketchikan shipyard develop a clear career path for workers, good skill standards, and easy ways for workers to gain new skills and to close gaps in their skill needs. In general this will be an important factor in improving productivity along with advanced ship design and production technology for not only ASD but U.S Shipyards as a whole. Their special emphasis on developing effective supervisors and using the program Training Within Industry should accelerate implementation of the skills programs. I also believe that having this type of program will help attract and retain good shipyard technicians and managers. I was delighted to learn that the National Shipbuilding Research Program is working not only with the shipyard but also with the University of Alaska Southeast, Ketchikan campus, to develop course materials and get advice from other colleges and shipyards about best practices for work-based learning.
>
> Lew Madden, LDMA

Appendix C Documentation

National Association of Manufacturers

- 2005 Skills Gap Report – A Survey of the American Manufacturing Workforce 32 pages

SkillView, Inc Documentation

- Skill Management – 8 pages

SkillsNET Enterprises LLC Documentation

- Web-Based Job Analysis & Usability Best Practices – 36 pages
- SkillObjects® - 6 pages
- Impact of Skill Management Data for Training Intervention Decisions – 6 pages

Manufacturing Skill Standards Council Documentation

- MSSC Standards Orientation Guide – 25 pages
- Training the Industrial Athlete of the Future – 2 pages
- MSSC Assessment – 2 pages
- MSSC Training – 2 pages

Training Within Industry Documentation

- The Roots of Lean -Training Within Industry: The Origin of Japanese Management and Kaizen – 34 pages
- Lean-TWI Implementation – 4 pages

Deloitte.

NAM National Association of Manufacturers

THE MANUFACTURING INSTITUTE
MANUFACTURING MAKES AMERICA STRONG

Manufacturing

2005 Skills Gap Report – A Survey of the American Manufacturing Workforce

Audit . Tax . Consulting . Financial Advisory .

Contents

Introduction

By Phyllis Eisen, Jerry J. Jasinowski and Richard Kleinert

In spring 2005, the National Association of Manufacturers' Manufacturing Institute/Center for Workforce Success and Deloitte Consulting LLP (Deloitte Consulting) developed the fourth iteration in a series of surveys designed to learn more about how manufacturers plan their human capital strategies and the barriers they encounter in the process.

The results of this survey confirm the skill shortages found in earlier reports. However, the 2005 report goes much beyond earlier findings in detailing the breadth and depth of the skill shortage, the negative impact of the shortages on business operations, and the extraordinary increase in employee performance requirements.

The picture that emerges is both more complex and more disturbing than in the past, because it exposes a broadening gap between the availability of skilled workers and the employee performance requirements of modern manufacturing. Specifically, the research finds:

- Today's skill shortages are extremely broad and deep, cutting across industry sectors and impacting more than 80 percent of companies surveyed.
- Skills shortages are having a widespread impact on manufacturers' abilities to achieve production levels, increase productivity, and meet customer demands.
- High-performance workforce requirements have significantly increased as a result of the skills gap shortage and the challenge of competing in a global economy, according to nearly 75 percent of survey respondents.

In sum, the confluence of the above trends and the increasingly competitive global environment has created an extraordinary gap between the supply of skills available and the performance requirements of the workforce needed for modern global manufacturing. **This human capital performance gap threatens our nation's ability to compete in today's fast-moving and increasingly demanding global economy. It is emerging as our nation's most critical business issue.**

Clearly, this situation calls for urgent action by both public and private stakeholders. If our country is to remain competitive, the issues of education and training reform now must be given at least as much focus as top business concerns of trade, tax, energy, and regulatory reform. As you read through this report, we hope to stimulate your thinking and leave you with an unmistakable sense that your urgent involvement is needed today.

Acknowledgements

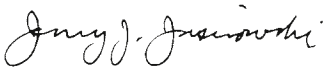
The National Association of Manufacturers (NAM), the Manufacturing Institute's Center for Workforce Success, and Deloitte Consulting LLP (Deloitte Consulting) thank the many individuals who contributed to the conceptualization, implementation, analysis, and publication of this report.

Thanks go to the Center for Workforce Success's Stacey Jarrett Wagner for helping to design the survey, analyze the responses, and manage the project, to Bill Canis, vice president of the Manufacturing Institute and David Heuther, NAM's chief economist, for providing their expert advice, and to Laura Narvaiz, vice president of communications for the Manufacturing Institute for helping us get out our message.

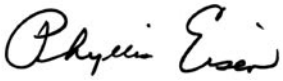
We deeply appreciate all the help and thoughtful analyses and writing provided by the Deloitte Consulting team, without whom this report could not have been developed. While many members of its team participated at various stages, the lion's share of the work was done by Juliet Glassroth, Lauren Mistretta, Leah Reynolds, Burt Rea, and David Rizzo. It was our great pleasure to work with such a talented team. In addition, we would like to thank Linda Segervall for her invaluable contributions.

We would also like to thank NAM members for their participation and thoughtful answers – they were very forthcoming in their responses and we are grateful for their honest insights.

Finally, we would especially like to thank Jerry Jasinowski, president of the Manufacturing Institute, John Engler, CEO of the National Association of Manufacturers, and Doug Engel, National Manufacturing Industry Leader, Deloitte & Touche USA LLP, for their support and encouragement as we try to tell the manufacturing story.



Jerry Jasinowski
President
The Manufacturing Institute



Phyllis Eisen
Vice President, The Manufacturing Institute
Executive Director, Center for Workforce Success

Richard A. Kleinert
Principal
Deloitte Consulting LLP

Executive Summary

The vast majority of American manufacturers are experiencing a serious shortage of qualified employees, which in turn is causing significant impact to business and the ability of the country as a whole to compete in a global economy. This is the key finding of the *2005 Skills Gap Survey.*

The problem for U.S. manufacturers is that this challenge is not universal. Countries with rich educational heritages, e.g., India, China and Russia, are graduating millions more students each year from college than the United States.[1] These highly educated individuals are actively participating in the development of innovative new products without regard for historical barriers, such as geography – thanks to technologies such as broadband, inexpensive Internet-ready laptops, and collaborative tools.

With such international talent readily available and significant shortages existing at home, it is clear that the future of American manufacturing may now be at stake.

A Serious, Persistent Shortage

The details behind the talent shortage reveal a stark reality. **More than 80 percent of respondents indicated that they are experiencing a shortage of qualified workers overall –** with 13 percent reporting severe shortages and 68 percent indicating moderate shortages. Also worrisome is the finding that **90 percent of respondents indicated a moderate to severe shortage of qualified skilled production employees,** including front-line workers, such as machinists, operators, craft workers, distributors, and technicians. As expected, the research showed that engineers and scientists are in short supply, with 65 percent of manufacturers reporting deficiencies – 18 percent severe and 47 percent moderate.

In addition to shortages of various types of employees, manufacturers surveyed reported they are also dissatisfied with the skills of their current employees. Among respondents to this national survey, nearly half indicated their current employees have inadequate basic employability skills, such as attendance, timeliness and work ethic, while 46 percent reported inadequate problem-solving skills, and 36 percent indicated insufficient reading, writing, and communication skills.

Significant Business and Economic Impact

The talent shortage being reported is not a theoretical or distant problem. In fact, **83 percent of respondents indicated that these shortages are currently impacting their ability to serve customers.** Specifically, the survey found that skill deficiencies are causing difficulties for manufacturers in terms of their ability to maintain production levels consistent with customer demand (56 percent), to achieve productivity targets (43 percent), and to achieve or maintain target levels of customer service and satisfaction (33 percent).

Clearly, this situation is untenable for America. Although our manufacturing sector has been able to remain vibrant and to compete successfully in a global economy, its ability to do so in the future is predicated on the availability of a highly skilled, innovative, "high-performance workforce." Without a sufficient supply of these types of employees, the manufacturing sector will suffer – which in turn will have a detrimental impact to the nation's overall economic health.

The Key to Business Success

Notwithstanding the bleak picture of the workforce situation today, manufacturers surveyed believe that having a high-performance workforce is the most important driver of future business success. Nearly three out of every four respondents selected this as a key to future success.

The second most commonly selected driver of success was "new product innovation" – which is also inextricably linked to employee quality and performance. Surprisingly, "low-cost producer status" ranked only third on the list of most important drivers of future business success, but not far behind in terms of percentages. In past studies, manufacturers have consistently ranked this as their number one response – but perhaps they have come to accept as a given that ongoing pursuit of lean operations and efficiency is essential to success in an incessantly competitive global manufacturing industry. To stay ahead of the pack, successful companies must constantly push the innovation envelope, which requires innovative and high-performing employees. As a result, the new manufacturing mantra may be: "high-performing and innovative, but lean."

Getting There From Here

While the situation is already posing significant challenges, the basic laws of supply and demand as they operate in the labor market suggest an even more difficult future. On the demand side, employers want more highly skilled employees that are exceptionally engaged and innovative. But basic demographic, social, and educational trends indicate a gloomy supply outlook:

- The exodus of Baby Boomers from the workforce with substantial accumulated skills will reduce the available talent pool
- Changing attitudes about careers and job satisfaction among Generation Yers
- Changing job requirements, necessitating some level of technical skill in almost all jobs and making truly unskilled jobs a thing of the past
- Significant dissatisfaction among manufacturers with the quality of K-12 education and the dearth of adequate career counseling
- Declining percentage of students in U.S. universities studying science and engineering

In addition, **research has shown a direct relationship between manufacturing's negative image – which is tied to the old stereotype of the assembly line – and the decreasing number of young people pursuing careers in the industry.** The good news is that manufacturers are beginning to realize they need to improve this image. A growing number of companies are providing support for NAM's *Dream It. Do It.* campaign that actively seeks to help young adults find careers they can be passionate about in one of manufacturing's many exciting sectors.

Manufacturers also seem to understand what they need to do to remain competitive, with so many clearly viewing a high-performance workforce as the foundation of future competitive ability. The challenge for manufacturers is how to attract, retain, and motivate this high-performance workforce.

Thus, there is a focus on both **reducing turnover among current employees and attracting new workers.** Most manufacturers reported **spending more on training programs** today (as a percentage of payroll) than in 2001 – which is critical because training opportunities are an important component of a strategy to attract, retain, and develop employees.

On the other hand, it is unclear that manufacturers are engaging in the right type of activities and employing the right tactics to attract, develop and retain a high-performance workforce given the realities of the current environment. Much has been written about the changing nature of the employer/employee relationship and the changing picture of what employees want and value, especially among Generation Y employees. While many manufacturers are seeking to provide the right programs and trying out new strategies, often they rely on a rather traditional mix of compensation and benefit plan offerings for recruitment and retention purposes, which may not prove as effective with this new breed of employee.

A Public-Private Collaboration

Clearly, the ability of manufacturers to attract, retain, and develop a high-performance workforce is of major importance to our nation as a whole. This challenge presents a significant opportunity for collaboration between the public and private sectors. Manufacturers are not expecting government to solve the problem for them, but would like encouragement and support for investments in training programs.

Our survey indicates that a very large percentage of respondents either has never heard of the government workforce programs or has never been contacted by Workforce Investment boards. Undoubtedly, increased communication and collaboration are required to better utilize these programs and to improve the effectiveness of the public education system in preparing students for the workplace and future careers.

Recommendations for Individual and Shared Responsibility

The issues associated with the skills gap are numerous and complex. Yet with increased competition from countries around the world, the future success and vibrancy of the American manufacturing industry is now at stake. To hold back further competitive encroachments, all the parties must assume responsibility – including manufacturing companies, the government, educators, and individuals. We believe the urgency of this situation also requires the follow actions:

- Educators must emphasize science, math and technology-related programs in K-16 curricula, invest more in effective teacher education focused on science and math, and ensure that programs regarding career opportunities and requirements for graduation are geared for 21st century employment.
- Employers should invest at least three percent of payroll whenever possible to provide training opportunities for their current employees, particularly in areas that will enable them to become a high-performance workforce, learn new methods to attract, retain, develop and motivate employees,
- State and federal government should invest in the capacity of community and technical colleges to prepare individuals for careers in high growth industries such as manufacturing
- State education standards should include career education as measurable criteria for K-12 success
- The Higher Education Act and its funding mechanisms should provide increased access for adult learners
- Individuals must take responsibility for their own careers and employability by earning industry relevant certifications and formal education credentials such as community college and bachelor degrees.

- The public workforce system, companies and their business associations must strengthen their engagement in order to better advise Workforce Investment Boards on rising and declining economic conditions, business investments, skill needs and employment requirements.
- Public/private partnerships should be encouraged to support career awareness campaigns that help individuals understand all the career options available to them. A model for this is The Manufacturing Institute's Dream It Do It manufacturing careers campaign.

The Business and Economic Reality Behind Today's Talent Shortages

In an effort to gain a clearer understanding of the processes and challenges associated with human capital management in the manufacturing sector, the NAM Manufacturing Institute/Center for Workforce Success and Deloitte Consulting LLP (Deloitte Consulting) conducted the fourth in a series of surveys in the spring of 2005. Specifically, the survey was designed to learn more about today's talent shortage and the resulting business impacts, what companies believe they need to provide for future business success, and how companies are seeking to attract, retain, and develop a high-performance workforce.

With media coverage persistently reporting an overall decline in manufacturing employment and layoffs among well known employers, many may be surprised with the key finding from this research. ***The Skills Gap 2005 Survey*** **found that the vast majority of American manufacturers surveyed continue to experience a serious shortage of qualified employees that is causing significant impact to business and the ability of the country as a whole to compete in a global economy.**

In fact, **81 percent of respondents answered that they are currently facing a moderate to severe shortage of qualified workers –** nearly unchanged from the 80 percent who reported a moderate to severe shortage with *The Skills Gap 2001 Survey.* More specifically, 53 percent of those responding indicated at least 10 percent of their total positions currently remain unfilled due to a lack of qualified candidates. This clearly supports the view that the shortage of qualified workers is becoming a persistent challenge and raises important questions, such as "Where is the pain most acute?" and "What are the business and broader economic implications?"

In answer to these questions, survey respondents suggested that the shortage of qualified workers is truly widespread, impacting companies regardless of size, industry, or geographic location. Large employers, defined as those with more than 500 employees, are only slightly more likely to report a moderate to severe shortage of qualified workers than small employers with fewer than 500 employees (85 to 80 percent respectively).

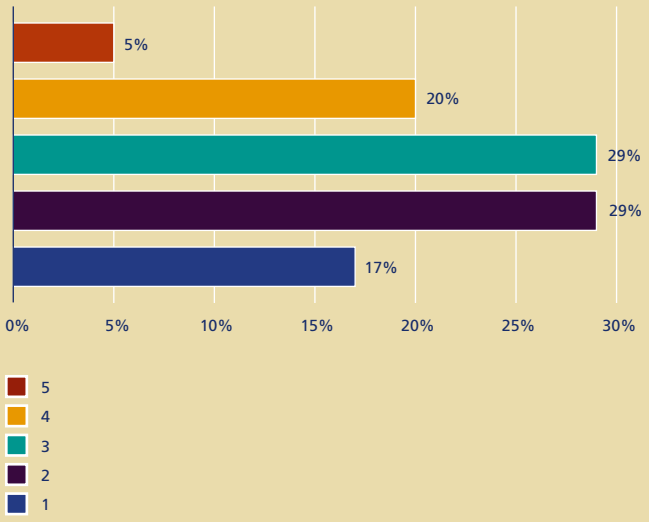
However, while all respondents appear to be impacted, not all segments of the workforce are affected equally. The largest shortages occur for technical skilled employees and engineers, but more than one-third of respondents also claimed shortages of ***unskilled production employees.***

- 90 percent of respondents indicated a moderate to severe shortage of qualified ***skilled production employees.*** This result does not vary significantly when controlling for size, industry segment or region.
- 65 percent of all respondents and 74 percent of respondents with more than 500 employees reported a moderate to severe shortage of ***scientists and engineers.*** This shortage is even more acute for certain industry segments, such as Aerospace and Defense, with 80 percent of respondents indicating a moderate to severe shortage.
- 39 percent of respondents also indicated a moderate to severe shortage of qualified ***unskilled production employees.***

While it is clear that employees with "hard skills" (such as skilled production, scientists, and engineers) are in short supply, the results are less severe for employees with "softer skills." Thirty-one percent of respondents indicated a shortage of qualified customer service employees; 36 percent of respondents indicated a shortage of qualified human resources, information technology (IT), finance, and executive employees; 44 percent of respondents report a shortage of qualified sales and marketing employees. Again, these results vary little when controlling for size, industry, or geography.

Taken together, these findings add more weight to the frequently voiced concern that the United States is not graduating enough students with technical, engineering and scientific degrees to meet the current demand for employees with these skills.

Figure 1. To Which Extent Does the Shortage of Available Skills Impact Your Company's Ability to Serve Customers? (1 = No impact, 5 = Greatest Negative Impact)



However, the critical issue is the impact that these shortages are having on business performance. **When asked, "To what extent does the shortage of available skills impact your ability to serve customers?" 54 percent of all respondents indicated a moderate to high degree of negative impact.**

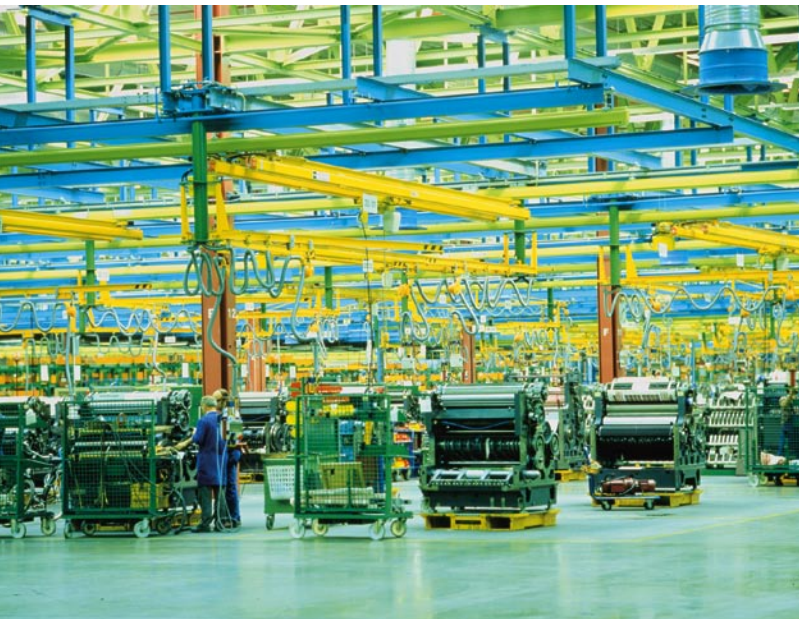
When asked to select the three most significant negative impacts of the shortage of qualified workers on business performance, respondents indicated:

- Maintaining production consistent with customer demand
- Achieving productivity targets
- Achieving or maintaining target levels of customer service and satisfaction

To better understand which skill deficiencies among current employees significantly contribute to negative business performance, the most frequently cited concern is inadequate basic employability skills, including attendance, timeliness and work ethic. Again, this response is consistent with a similarly constructed question in the 2001 survey, and poses an interesting challenge to employers and to the public education system that is expected to prepare most individuals for the workplace.

Among Aerospace and Defense companies, it was noteworthy that the most frequently mentioned response by a significant margin was inadequate problem solving skills – potentially reflecting the more complex nature of working with highly engineered products.

Tomorrow's Outlook: Business Success in a Changing Environment



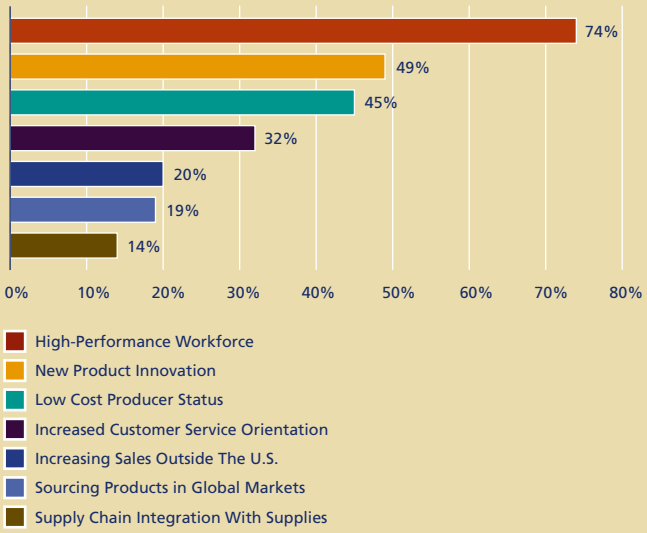
Given the painful realities of the current talent shortage, changes in the economy and business environment, increasing international competitive pressures, and other complex challenges that manufacturers face, respondents were asked to indicate what would be most important to their success over the next three years (Figure 2).

Although many expect that overall employment levels in manufacturing will not rise appreciably, an overwhelming majority of respondents stated that their workforce is the most important factor for future business success – **74 percent of respondents indicated that having a "high-performance workforce" will be key to their business success.**

The second most frequently chosen attribute, selected by 49 percent of respondents, is "new product innovation." This, too, is directly linked to having a high-performance workforce that can generate the innovative ideas for new products, as well as process innovation.

At the same time, cost pressures remain top of mind for respondents, with 45 percent specifying that "low-cost producer status" will be important to business success over the next three years. When taken together, these findings suggest that "high-performing, innovative, but lean" may become the new manufacturing mantra.

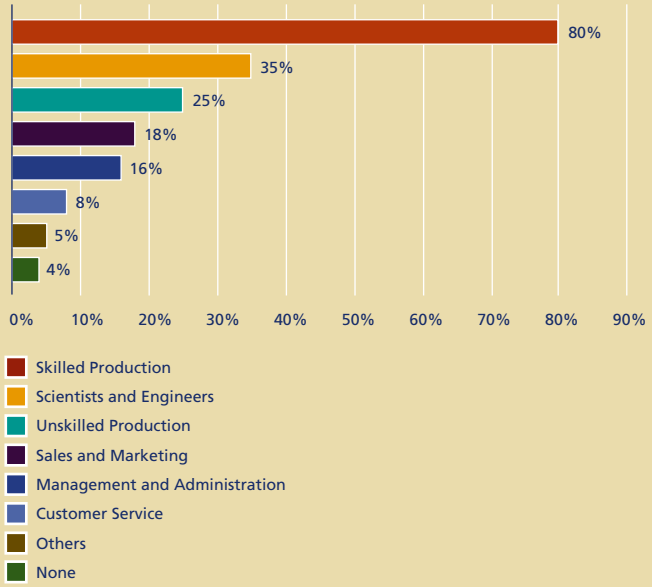
Figure 2. Given Changes in the Economy and Business Environment, Which of the Following Will Be Most Important to Your Company's Future Business Success Over the Next Three Years? (Select Up to Three)



With the many changes to the overall business environment, including the economy and competitive landscape, manufacturers were asked to identify the employee types among whom they anticipate shortages over the next three years. The real pressure point again appears to be the skilled production workers, **with a full 80 percent of respondents anticipating shortages of skilled production workers over the next three years – this is over *twice* the severity of the next skill shortage category.**

Thirty-five percent of all respondents anticipate shortages for scientists and engineers, with this rising to 46 percent for respondents with 500 employees or more. Following that is the unskilled production worker – a quarter of our respondents said these workers will be in short supply over the next three years. At the other end of the spectrum, it does not appear that employees engaged in management and administration, sales and marketing, or customer service will be in tight supply.

Figure 3. What Types of Employees are Expected to Be in Short Supply Over the Next Three Years? (Select All that Apply)



We next asked respondents to tell us which types of skills their employees will need more of over the next three years. Not surprisingly, technical skills was the area most commonly selected (53 percent). Beyond this, there are a number of related skills that will be needed over the next several years that are characteristic of high-performance workforces, such as the ability to work in teams (47 percent), strong computer skills (40 percent), the ability to read and translate diagrams and flow charts (39 percent), and strong supervisory and managerial skills (37 percent).

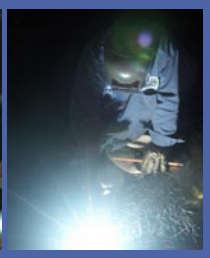
Basic employability skills (attendance, timeliness, work ethic, etc.) essentially tied with technical skills, which is consistent with the area of greatest deficiency seen in today's workforce – and consistent with the *The Skills Gap 2001* report. Following that are reading/writing/communication skills, where 51 percent of the respondents said they will need more of these types of skills over the next three years. This paradoxical mismatch – between the need for the highest skill levels ever and the current need to address basic employability issues and basic skills in general – is particularly vexing given the emphasis companies place on having a high-performance workforce. It also suggests the need for significant change in approaches within the education and public workforce systems.

Throughout this report, we have provided brief vignettes of NAM-member companies to illustrate the key points and examples of innovation in workforce initiatives.

Bollinger Shipyards, Inc.

Literacy and Training Programs at Bollinger

At Bollinger Shipyards just outside of New Orleans, people who are eager to work can earn more than just a decent paycheck. "We take people who have a desire to learn and teach them to be a welder or a fitter," explains Chuck Fontenot, corporate director of training. "We hire them from landscaping companies and fast food restaurants. We go to churches and into the community and find good people who never had a chance."

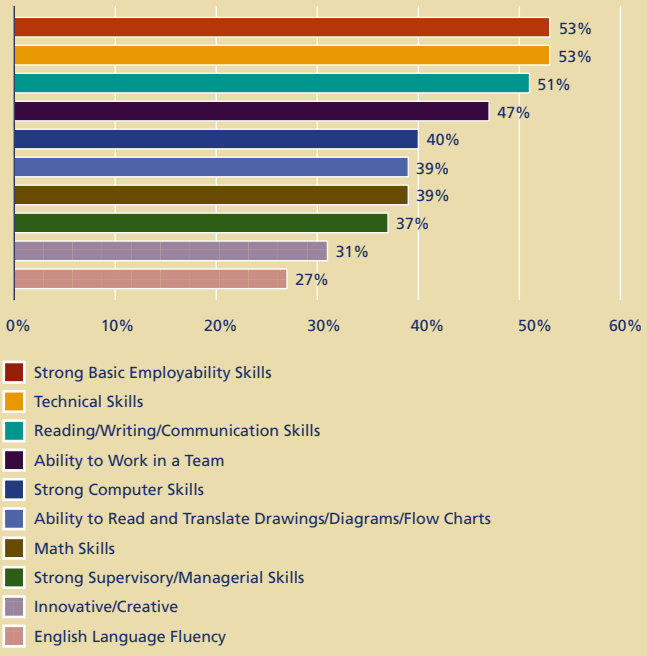


Bollinger provides a paid, five-week training program for each new hire that includes on-the-job and classroom skilled trades instruction, as well as training in "soft skills." "We teach them the life skills they need to sustain a job. Taking care of their money and coming to work each day."

Bollinger recently collaborated with the Literacy Alliance of New Orleans.and invited the Alliance to conduct a six-week literacy program with its employees. The results were outstanding, according to Fontenot. "By using the materials the students use every day, she taught a group of our employees how to read in a practical, non-threatening way," Fontenot says.

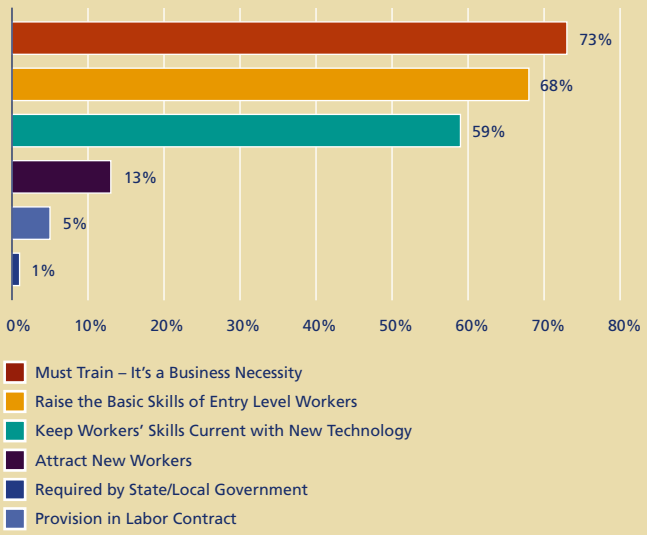
Bollinger also works with a regional economic development agency to register high-school-age applicants for its apprenticeship program. "We've had this program for several years," says Fontenot. "It starts when they're a junior or senior. They gain school credit for working, but they can't quit school. Right now, we have ten people who've completed the program. We've never had anyone quit the program. One guy became a supervisor, one became a drafter. One guy started out at $5.00 an hour and now he's making $55,000 a year supervising other people. This program isn't a cost, it's an investment."

Figure 4. What Types of Skills Will Employees Need More of Over the Next Three Years? (Check All that Apply)



In an environment of extreme global competition, and given the workforce shortages and skill deficiencies that companies face today, it is not surprising why companies provide training to employees. Seventy-three percent report that they provide training to employees today because it is a "business necessity." To have a high-performance *workforce*, companies must create a culture of high-performance *workplaces* and training is integral to meeting this objective. Characteristics of a high-performance workplace include employee autonomy and involvement in decision-making, the sharing of information and knowledge, rewards for performance and support for employee performance – including training. A very small percentage of respondents that provide training do so because they are required by labor contract or by state or local government.

Figure 5. Why Do Companies Provide Training to Employees Today? (Select Up to Three)



It may not be surprising that a high percentage (73 percent) of respondents report that they have done formal workforce planning to forecast their needs for different workforce segments, considering anticipated shortages of key employee types and the need for increased levels of certain skills into the future. This does, however, raise the question of whether manufacturers have effectively and rigorously forecasted their future workforce needs – to reflect not only upcoming retirements, but also changes in business strategy/emphasis, types of employees needed, skills needed, and the availability of various employee types in the labor market today.

Finally, looking into the future it appears that high-performance workforce companies may consist of several different categories of employees. Roughly one-third of respondents indicated they may increase their utilization of temporary contract workers to attract and retain employees with the skills needed for the company over the next three years. These temporary or contract workers could be highly skilled employees who work on a project basis, but who cannot be justified on a full-time regular basis. Alternatively, it may be that companies intend to focus more on certain types of regular employees who represent their critical workforce segments and to utilize less highly skilled or non-business critical employees under contract or temporary arrangements. This is an area that warrants additional analysis to better understand how manufacturers intend to secure the various types of talent needed to achieve their goals.

New Aspirations, Old Tactics – What's Working and What's Not

With manufacturers clearly understanding that change is needed to achieve their goals, respondents provided important insights into several key leverage points – ranging from **recruitment, retention, and benefits strategies to how schools are preparing students for the workplace –** that can positively impact the talent shortage.

The Employer/Employee Disconnect

There is a growing disconnect between what today's workforce wants and what employers traditionally offer. The phrases used to describe this disconnect are familiar – lack of employee engagement, loss of company loyalty, and the need for a new employer/employee "deal."

The dramatic changes in the employer/employee relationship became acute in the past decade. Trends such as downsizing, merger mania, and globalization created an ever-shifting work environment that has resulted in negative and cynical views about the workplace. In recent years, organizations that regularly survey the U.S. workforce, such as The Conference Board and The Gallup Organization, have warned that employee opinions about the workplace are at an all-time low. The latest Conference Board research on worker attitudes was conducted in late 2004 and reflects a decline in job satisfaction that is widespread among workers of all ages and income brackets.

Adding to this low worker satisfaction is the huge demographic shift currently taking place – older Baby Boomers retiring, Gen Xers and Gen Yers moving in. Today's younger generations (Xers are in their mid-20s to late 30s; Yers are 25 and younger) bring a different and more challenging set of expectations to the work world.

Attracting members of the younger generations, while retaining the valuable knowledge and experience of older workers, will be increasingly important to manufacturers over the next five years. Young people bring technology-savvy skills, a global and diverse orientation, and an ability to think in innovative ways that are critical to competitive advantage.

Much has been written about changing employee attitudes and expectations, the erosion of job security, and the new "employee covenant." Instead of promising lifetime employment, employers offer meaningful jobs and development and growth opportunities through a combination of formal training, career options, and on-the-job experience. Against this backdrop, it is somewhat surprising to note that only 13 percent of respondents indicated that one of the reasons they provide training to employees today is a way to attract new workers.

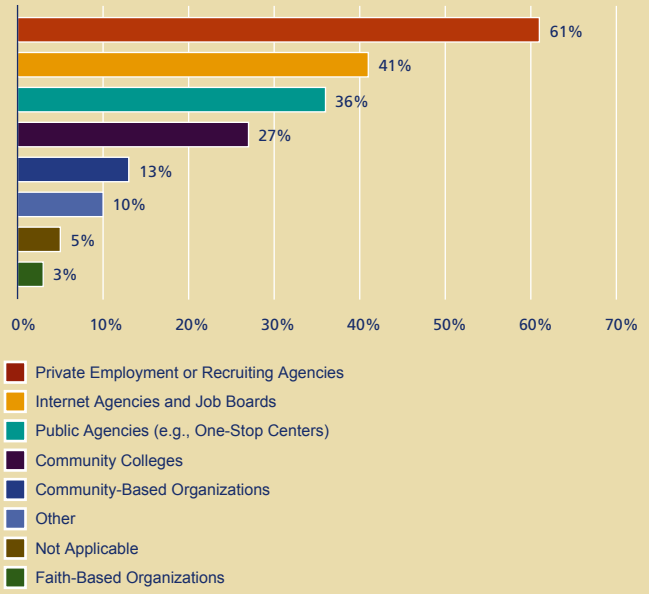
Recruitment Strategies

Despite an emerging desire for building a high-performance workforce and attracting highly engaged employees, the majority of respondents to the survey continue to use mostly traditional recruiting strategies. Manufacturers cited competitive wages, and health care and retirement benefits as their top methods for attracting employees – which for most employees are considered a given rather than differentiators.

Indicating a growing awareness of more effective approaches for attracting employees, the following scored moderately on the survey: flexible work arrangements, tuition reimbursement, employee referrals, and professional development.

Respondents ranked other recruitment techniques, including signing bonuses, on-site services, and stock options or equity, much less favorably – perhaps because they were perceived as ineffective in attracting and recruiting new employees or as impractical given the investments required for implementation.

Figure 6. Have Placement Services From the Following Organizations Been Used to Recruit and Hire Employees? (Check the Two Most Used)



U.S. manufacturers have an opportunity to increase the impact of their recruitment strategies by moving beyond the traditional means of attracting employees and including additional dimensions to differentiate their approaches. Of course compensation and benefits must be competitive, but based on what we know employees are looking for – development and training, challenging work assignments, and connection in the workplace – U.S. manufacturers need to improve their recruitment strategies by including and promoting these aspects of the workplace. These efforts will also pay dividends in increased employee retention rates.

In response to how employers are using placement services to recruit and hire employees, traditional private employment/recruitment agencies scored highest by a clear margin. But there are some signs of creativity in recruitment techniques, such as the use of Internet agencies and job boards (41 percent), followed by the use of public agencies and community colleges (36 and 27 percent, respectively). Low responses were received for community-based and faith-based organizations.

Figure 7. Which of the Following Have Been Used Most Successfully to Retain Current Employees? (Select Up to Three)

Retention Strategies

Survey respondents noted the importance of organizational culture, effective managers, flexible work arrangements, training and development, and tuition reimbursement in retaining employees – indicating a growing awareness of what drives employee satisfaction and retention. In particular, the importance of organizational culture for retaining employees shows a dramatic shift in thinking about employer responsibility and the need to create an environment that breaks down barriers to productivity and employee engagement. It also underscores an opportunity to improve recruitment results by better promoting what companies are already doing to retain and engage current employees.

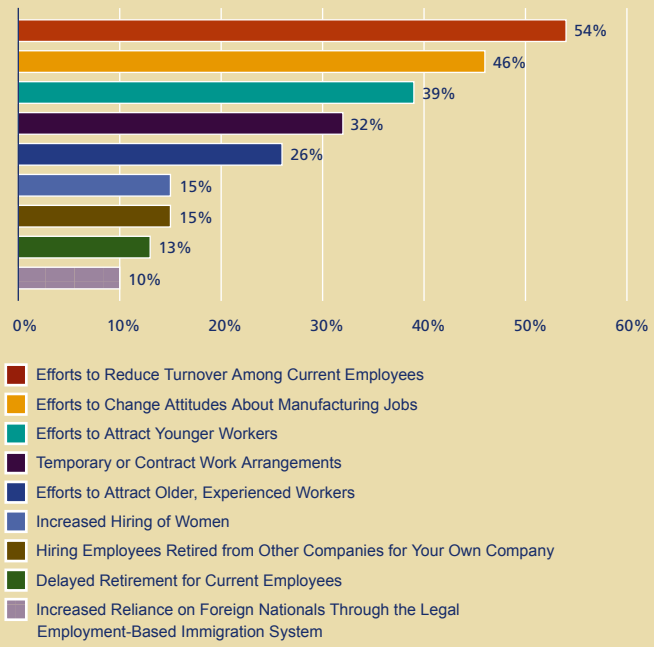
Like the responses for recruitment strategies, survey participants scored compensation and benefits highly as drivers of retention. This traditional view of employee motivators is consistent with the responses for recruitment strategies above. But clearly, there is a movement toward more progressive thinking around how to retain talent and the program elements that need to be implemented.

Low response rates were seen for formal career planning, mentoring, and on-site services as drivers of employee retention.

Looking ahead over the next three years, respondents felt they would address skills-retention challenges by working to reduce turnover, participating in efforts to change attitudes about manufacturing jobs, attracting younger as well as older, experienced employees, and using contract or temporary workers. Low to moderate responses were seen for the following tactics: hiring retired employees, employing more women, delaying retirement, and increasing reliance on legal foreign nationals.

This reaction indicated a willingness to try multiple and non-traditional approaches to dealing with skills retention in the years ahead. Considering the traditional approaches for current recruiting and retention strategies reported above, it is likely that manufacturing employers will need to use new and additional ways to source and retain the skills they require to be competitive.

Figure 8. Considering the Challenge of Attracting and Retaining Employees with the Right Skills for Your Business, Which of the Following Tactics Might You Utilize Over the Next Three Years? (Select Up to Three)



E.J. Ajax & Sons, Inc.
WORLD CLASS METAL STAMPINGS
A VISION 2000 COMPANY

"Battlebots" and Developing Young Talent at E.J. Ajax

To prepare for the future, E.J. Ajax and Sons, a metal stamping company in Minneapolis, is promoting a program called "Battlebots," designed to attract young people to a career in tool and die. Currently in a dozen high schools in the Midwest, the Battlebots program introduces students to electronics, computer control, fluid motion, welding, working with sheet metal, and other manufacturing skills, all in the pursuit of building competitive robots.

E.J. Ajax realizes that the manufacturing sector is not as popular a career choice for young people as it once was in the United States. But, the company's leadership has been encouraged recently by growing interest in high schools and on college campuses as a result of the Battlebots program.

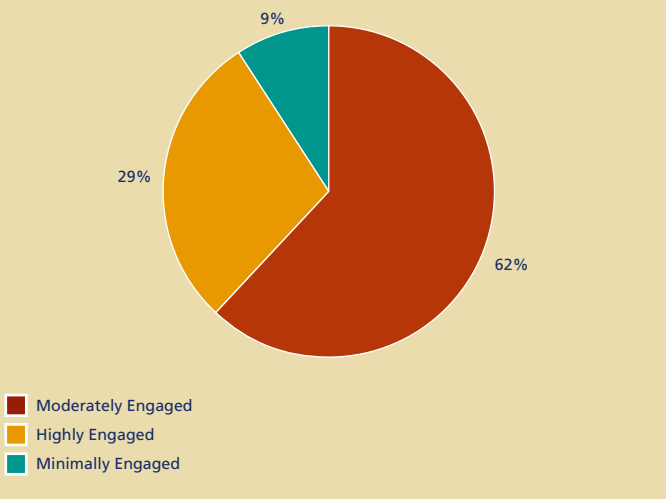
E. J. Ajax is also forming an alliance with the University of Minnesota at Crookston (UMC). The university recently introduced a four-year degree program in manufacturing that recognizes the value of previous college coursework and specialized training, as well as work experience. The company currently employs an intern who is attending a two-year program at a Minneapolis technical college and plans to complete his studies through the UMC program, while continuing to work for Ajax.

"One of my biggest challenges in the next three to ten years will be the retirement of my incumbent workforce," said Erick Ajax, vice president of E.J. Ajax. "A quarter of my workforce is over 50 years old. Our four-year apprenticeship program is a good way to provide a career path for young people and interest them in this highly challenging field. There are some wonderful opportunities for someone who wants to pursue a degree in engineering, robotics, or automation and help the United States compete in the world."

Employee Engagement

In spite of the challenges employers are facing as reported in other parts of the survey, it was disappointing that only 29 percent of employers surveyed perceived their workforce to be highly engaged. If employers expect to have high-performance workplaces, they must do better at motivating all of their employees to be highly engaged. Sixty-three percent of respondents said their employees were moderately engaged and 9 percent said they were minimally engaged. These percentages demonstrate that employers should be concerned about their ability to achieve high performance without a more fully committed workforce.

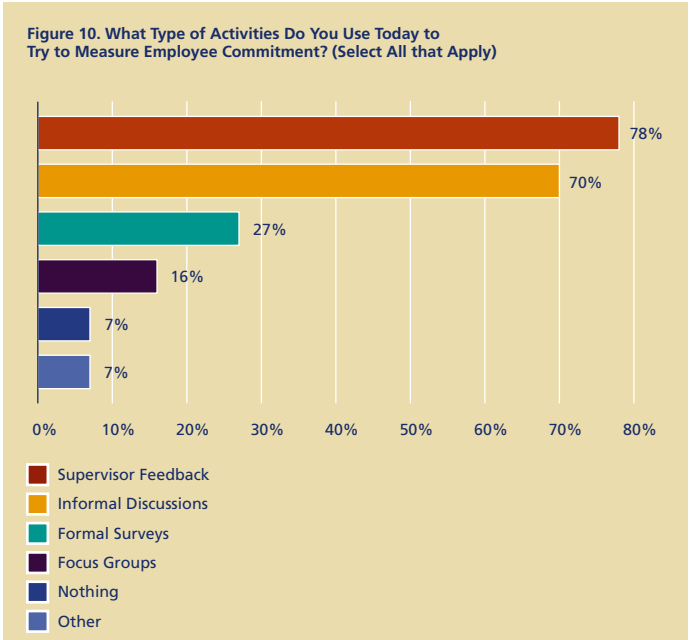
Figure 9. To What Degree Current Workforce is Truly Engaged and Committed to Business Success? (Select One)



These results may be mitigated by how survey respondents reported that they measured employee engagement. Most methods reported were informal, including supervisor feedback and informal discussions. More impartial measures, including formal surveys and focus groups, received significantly lower scores, indicating an opportunity for employers to connect more objectively with and hear feedback from their employees.

Just as successful manufacturing companies pay close attention to and study what their customers want, these same companies must apply similar rigor to understanding what their employees want and how to motivate them. In short, manufacturers would greatly benefit from learning how to maximize the return on their human capital investments.

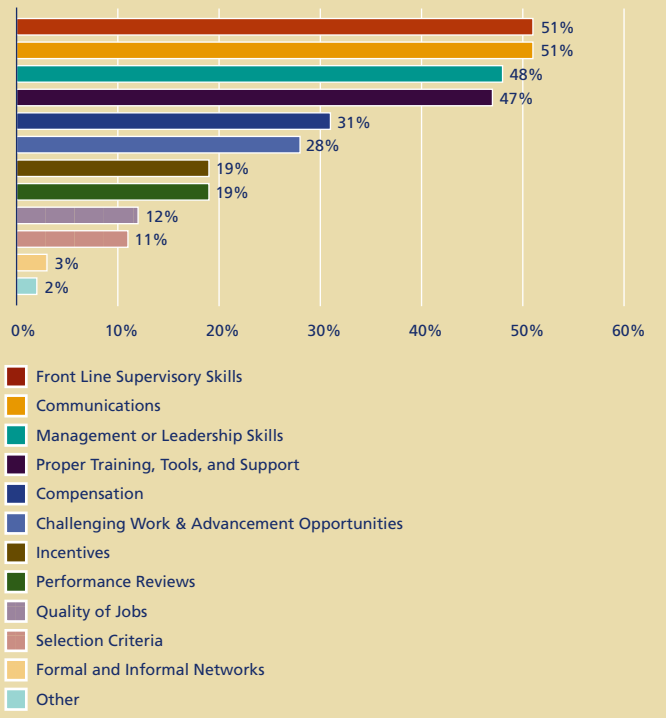
Figure 10. What Type of Activities Do You Use Today to Try to Measure Employee Commitment? (Select All that Apply)



Further, the large percentage of respondents who reported their workforce was moderately engaged indicates a significant opportunity to raise the level of involvement among employees. This will help many of the respondents achieve their stated objective to develop a high-performance workforce.

The methods employers reported for maximizing employee commitment showed a strong awareness of what employees value, including high response rates for front-line supervisory skills, management/leadership skills, proper training, tools, support, communications, and other skills that are required for lean manufacturing environments. Compensation was identified as a moderate driver, which indicates a healthy perspective that employee commitment is not just about money. Low responses to several areas offer further opportunities for improving employee commitment, including providing challenging work, advancement opportunities, quality of jobs, incentives, performance reviews, selection criteria, and formal and informal networks. As employers seek to increase engagement and commitment toward developing a high-performance workforce, these opportunities will be critical.

Figure 11. Which Factors Do You Think Are the Most Important to Maximizing Employee Commitment and Productivity? (Select Up to Three)



Competitive Wages and Benefits

As noted above, respondents do not see compensation and benefits as their best way to maximize employee commitment. Certainly, these dollars are important in the employee/employer equation, but the reality is that employees quickly take compensation and benefits as a given and look to other aspects of a company's value proposition in making decisions about joining or staying and how much effort to put forth.

The key message for U.S. manufacturers is that competitive wages and benefits are important in attracting and retaining employees, but these are just the starting points for developing a differentiated value proposition for employees. People want more from their work experience than a paycheck. They want transferable skills and experiences that make them valuable to their current employer as well as to the broader market. This comes in the form of challenging work assignments, training and development, advancement and promotion, and rotational assignments. Employees also want respect, recognition, and connection in the workplace, specifically relevant performance management processes and incentives (monetary and non-monetary), formal and informal networks, formal and informal mentoring, and a general sense of community within the workplace.

Training

Manufacturing employers surveyed see training as a business necessity to be delivered just-in-time, and not as a way to attract employees, as noted above in the section on recruiting strategies. Respondents noted moderate value for training as a retention tool. At the same time respondents reported that their spending on training is increasing – and not just for executives, but across all employee groups. Employers are placing emphasis on specific job skills in offering training to their employees.

Running a Lean Enterprise at Whirlpool Corporation

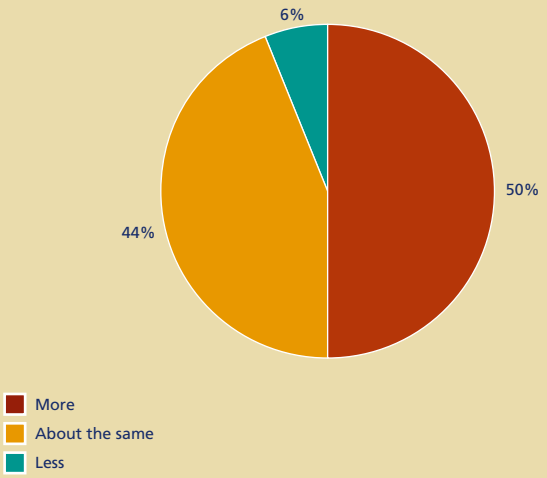
At Whirlpool Corporation, every plant around the world conducts what is called a Lean Focused Event, or LFE. The LFE involves representatives from all areas of the plant – operators, hourly workers, process engineers, industrial engineers, quality controllers, and product designers – to form a work team that examines an existing process and develops a better, more "value-added" way to do it.

"Lean means eliminating waste and non-value-added labor or activity," explains J.C. Anderson, senior vice president for North American Operations at Whirlpool. "Lean isn't just about increasing labor productivity. It includes quality enhancement, more strategic inventory control, better use of space, and ergonomic benefits."

An LFE team focuses on a particular area that needs improvement. The team's first step is to examine the current state and map out the current process. Then the team envisions the future state by asking, "What would be the ideal way to do this?" The most important step is creating a "migration path" for making the change. All the necessary actions and resources for successfully making the change are documented. The LFE team then makes a presentation to the plant manager, for review and approval to proceed with the team's recommendations.

"We practice CI [continuous improvement] on our LFE processes as well," says Anderson. "An LFE tomorrow will be better than the one we did yesterday."

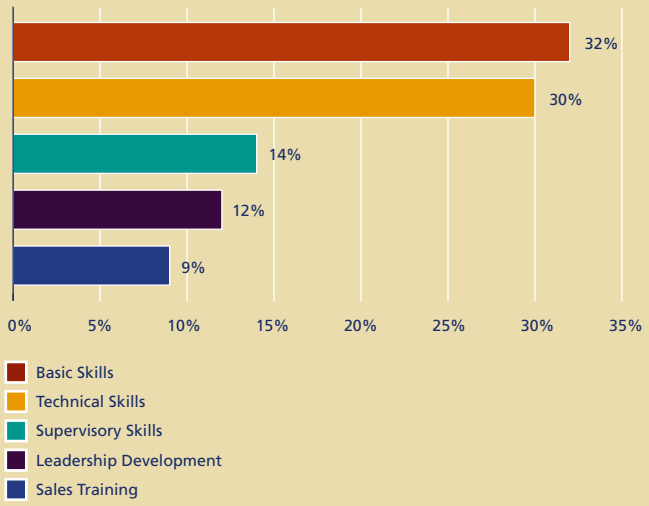
Figure 12. Does Your Company Spend More, Less, or About the Same Amount on Training Employees As It Did 3 Years Ago (Select One)?



The types of training that respondents reported they are most focused on delivering to employees are technical and basic skills training. Specifically, the most important training programs were reported as those supporting specific skills for a particular job.

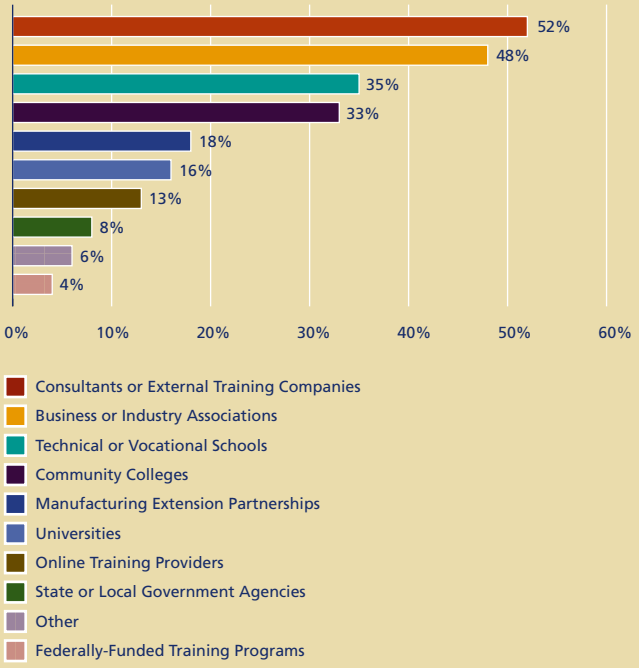
The next tier of responses was training for problem solving, teamwork, leadership, computer skills, basic or advanced mathematics, basic reading and writing, and interpersonal skills – all standard skills for high-performance workforces. However, only moderate to low responses were seen for supervisory skills, leadership skills and sales training. Still lower responses were reported for customer service training, certification training, tuition reimbursement, formal apprenticeship programs, English as a second language, and GED assistance.

Figure 13. How Do You Allocate Training Budget? (Average of Responses)



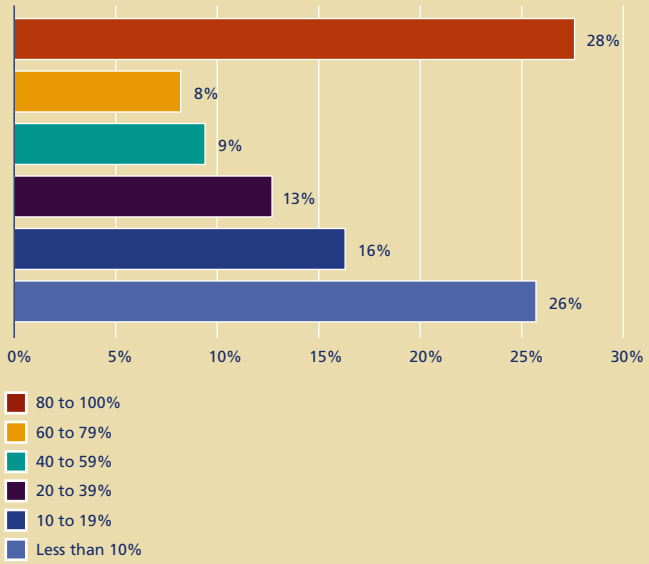
Survey respondents reported that the leading external training providers were training companies, consultants, business or industry associations, technical or vocational schools, and community colleges. Moderate to low responses were received for manufacturing extension partnerships, universities, online providers, state or local government agencies, federally funded programs, unions, and community or faith-based organizations. Based on the relatively low response reported for online training providers, this may be an opportunity for manufacturers to further leverage this flexible and cost-effective channel.

Figure 14. Where Does Your Company Most Often Turn for External Education/training Resources for Current Employees? (Select Up to Three)



Although the surveyed companies are spending more for training, on average, than companies responding to previous Skills Gap surveys, the majority of companies (64 percent) surveyed formally train less than 60 percent of their workforces. The decision whether or not to provide training to all employees may be driven by short-term cost pressures that companies are facing or by a lack of recognition by some regarding the beneficial performance, retention and attraction impacts of training and development investments. Given the gap between employee desires and current programs, it is believed that U.S. manufacturing companies will advance toward their goal of building a high-performance workforce by taking a longer-term investment view of the value of training and development.

Figure 15. On Average, What Percent of All Employees Receives Formal Training Provided by the Company Each Year? (Select One)



Culture as a Driver of Market Competitiveness

Almost half of the survey respondents (46 percent) reported that improving their organizational culture is a priority, while three-quarters of respondents (74 percent) reported their need to build high-performance workforces over the next three years. The challenge for most of the survey respondents in achieving these goals seems to be finding ways to overcome the traditional views of what drives employee attraction, engagement, and retention beyond pay and benefits.

As discussed above, the perspective that respondents reported in the survey is traditional regarding recruitment, engagement, and retention. There is an emerging sense that leadership, management effectiveness, and the overall employee experience are critical to employee satisfaction and commitment, but for the most part respondents see dollars and benefits as their main tools. Competitive wages and benefits have always been a cornerstone of attracting top employees in the United States since the 1950s. Half a century later, a number of manufacturers are still maintaining the status quo of compensation, seeing it as the primary driver of employee attraction and retention.

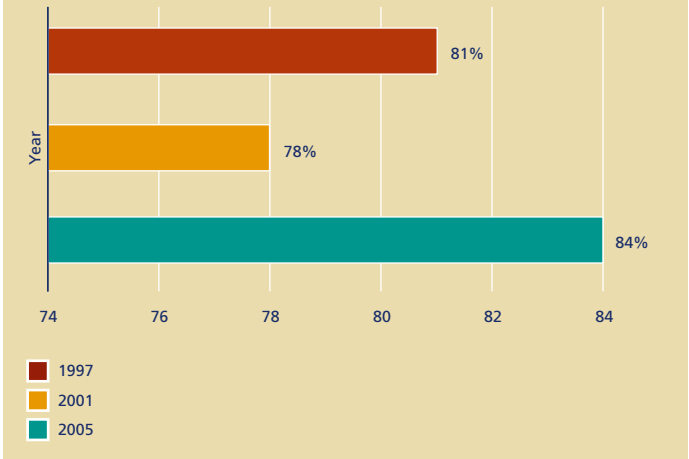
So how can U.S. manufacturers build high-performance cultures within their companies? Moving beyond traditional ways of motivating employees by implementing some of the engagement approaches discussed above is a start. But, culture is pervasive and often slow to change. Change can happen based on **leadership's ability to guide people toward new behaviors and actions, reinforce and reward those new behaviors until they are embedded in the culture, and measure progress toward those goals –** both individually and as an organization. "What gets measured, gets done" and so it is for culture and behavior as well.

Public Education's Role in the Solution

Manufacturers are seeking help in closing the skills gap and they view the public education system as having the potential to be a significant part of the solution. The results of this survey indicated, however, that many opportunities exist to improve the public education system and to increase the level of collaboration with employers.

When asked whether K-12 schools are doing a good job preparing students for the workplace, 84 percent of respondents indicated "no." This compares with 78 percent indicating "no" in 2001, and 81 percent in 1997.

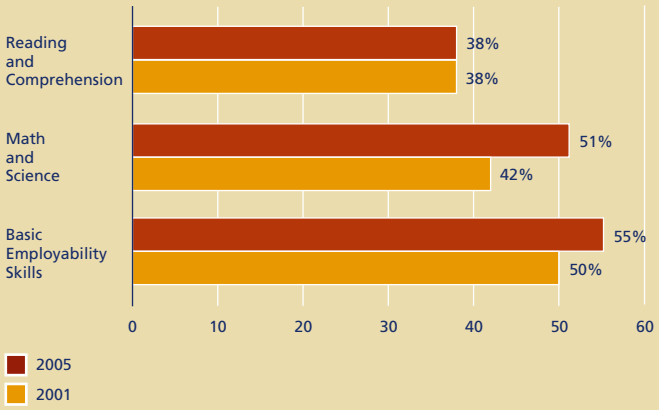
Figure 16. Are K-12 Schools Doing a Good Job Preparing Students for the Workplace? (Those Responding 'No')



Over the past eight years, which have included noteworthy educational reforms, employers of all sizes have yet to see an improvement in the ability of public education institutions to prepare students for the workplace. When controlling for industry segment, it is noteworthy that Aerospace and Defense reported "no" 93 percent of time – eight percentage points higher than the next highest segment, Process Manufacturing. Again, given the skill requirements of working with highly engineered products, it may not be surprising that the response was so high in Aerospace and Defense.

When asked to elaborate on the specific deficiencies of the public education system in preparing students for the workplace, the top three most frequently cited responses were: basic employability skills (attendance, timeliness, work ethic, etc.) at 55 percent, math and science at 51 percent, and reading and comprehension at 38 percent. As Figure 17 illustrates, these same top three responses appeared in the 2001 report.

Figure 17. What Are the Specific Deficiencies of the Public Education System in Preparing Students for the Workplace? (Top Three Responses)

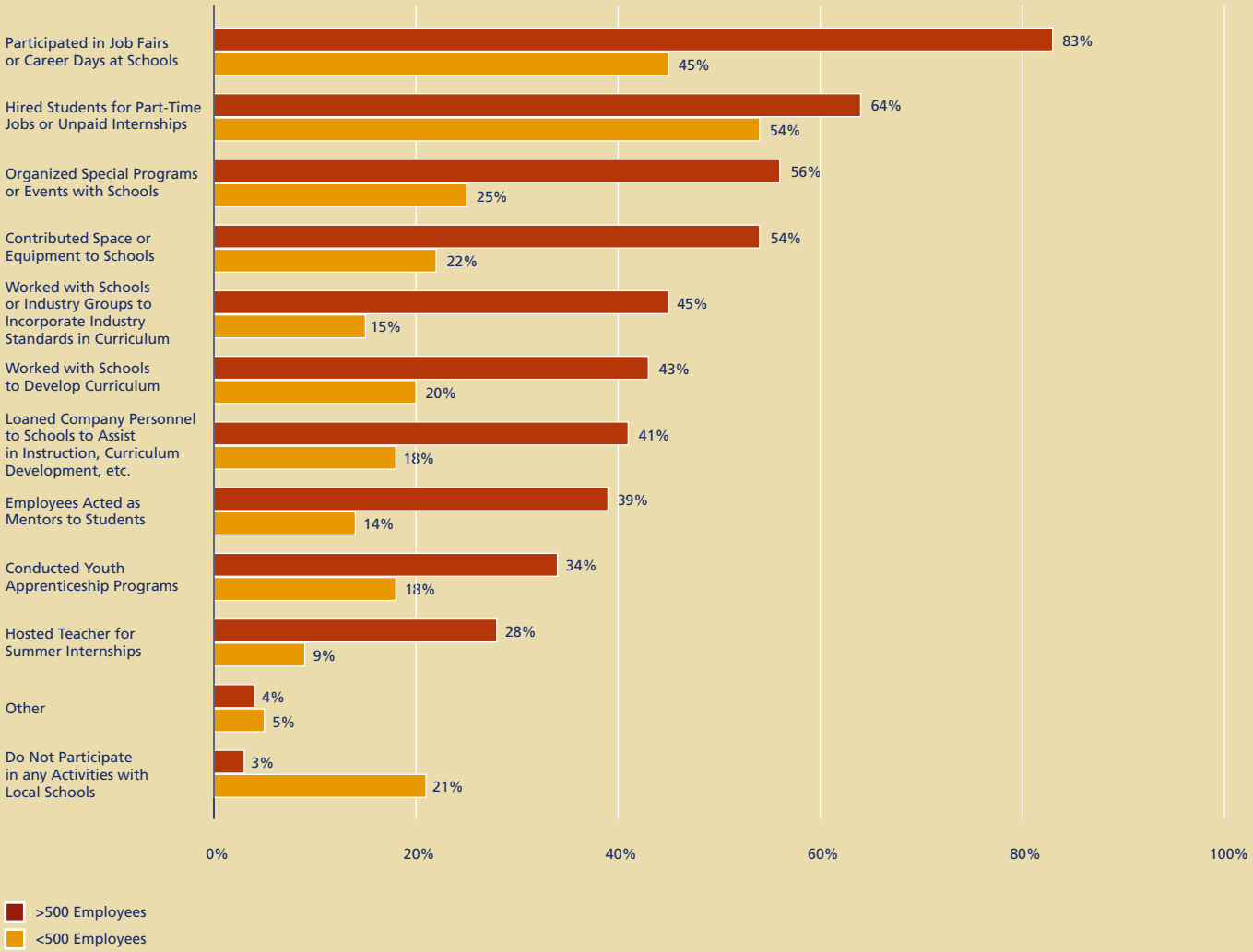


As with the 2001 survey, employers continue to cite basic employability skills as the single most frequent deficiency among employees. This, of course, presents an interesting challenge to the public education system and society overall. Even if schools perform well in their traditional role of increasing math, science and reading comprehension skills, this would not address the top, pressing concern of employers – the need for attendance, timeliness, and work ethic.

Given that traditional approaches are inadequately addressing these urgent issues, additional dialogue between manufacturers and the public education system is required regarding standards and expectations and the role that schools are playing in the preparation of students for the workplace. This effort should focus on better understanding the policies and practices that may have hindered schools in turning out students ready to work – from the types of teachers and career counselors that are hired, to disincentives that are in place holding students back even when they are qualified for advancement, limited parental interest in education, and a lack of school board awareness in changing workplace skill requirements.

When asked what they themselves are doing to address the skills gap via the public education system, 32 percent of respondents indicated that they are participating in state or local business organizations that promise educational reform. However, companies are not attempting to achieve reform only from the "outside." They also are working directly with schools on a number fronts, such as participating in career days, hiring students for internships, and having employees act as mentors to students. The frequency of respondents' participation in these activities is shown in Figure 18.

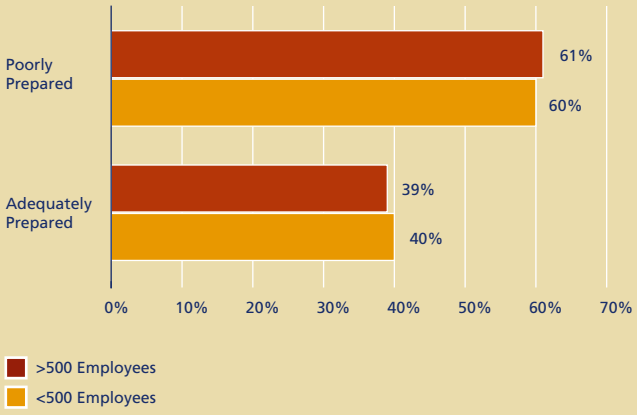
Figure 18. Has Your Company Participated with Local Schools In Any of the Following Activities? – Difference in Frequency Between Large and Small Employers (Select All That Apply)



Possibly the most important finding from the response to this question is that large employers, those with more than 500 employees, participate in these activities at a rate of two to three times than that of the smaller employers, those with less than 500 employees. Given the impact small companies now have in maintaining overall levels of manufacturing employment, and the extent to which small companies draw their candidates from their local communities, it appears important to increase the level of direct interaction between small companies and their local schools.

Part of the reason that companies are not achieving their potential in directly collaborating with public education may be an incomplete understanding of the potential benefits. When asked why companies are participating in activities directly with the schools, the most frequent response is as part of their community outreach/citizenship activities. However, in a broader sense, most of the top responses, by both large and small companies, can be viewed as contributing to an increased pipeline of qualified and interested new talent into the workplace.

Figure 19. How Prepared for a Typical Entry Level Job in Your Company Are Applicants with High School/GED Qualifications?



BEHLEN

Reducing Turnover and Training New Talent at Behlen

Ten years ago the turnover among welders at Behlen Manufacturing was more than 100 percent per year. "We've introduced gain sharing and profit sharing programs as well as a safety bonus. We also cross-train our welders to give them flexibility," explained Duane Matson, training coordinator for Behlen." This gives employees a wider range of responsibilities."

Behlen is also making an effort to attract new hires that have exposure to welding and the skilled trades. "This is harder to do today than in the past," explains Matson, "since many high schools have eliminated their industrial training programs."

The "2 + 2 Machine Tool" program, offered in conjunction with the local community college, gives Behlen the opportunity to bring high school age students into after school internship programs in the tool and die area. "We teach the students various welding processes, like wire welding. Wire welding is a process that's used all over the country and the world. It's a very marketable skill," says Matson.

Behlen produces fencing, gates, horse and cattle pens, and steel frames for industrial buildings. They also make smaller items, such as park benches, bike racks, and grain bins.

"Our turnover in the welding area is 45 percent right now," says Matson. "Some of that is because people come into welding and then transfer to other positions. Still, we are in considerably better shape than we were several years ago. Our turnover rate company-wide is 30 percent. We attribute a lot of that success to employee training, as well as the gain sharing and other productivity enhancing programs we've implemented."

Leaders and Employees Develop a Lean Focus at Wainwright

At Wainwright Industries in St. Peters, Missouri, having the last name "Wainwright" does not keep you from rolling up your sleeves and joining the team, especially if the topic is lean manufacturing.

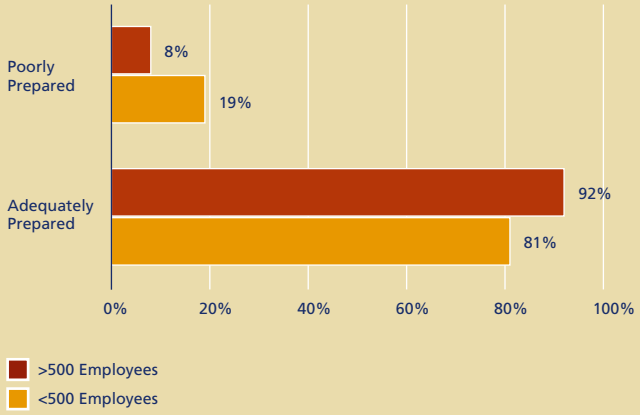
A recent lean manufacturing goal at Wainwright involved dramatically increasing the number of parts welded each week. A cross-functional team was assembled, including a floor operator, plant operations people, a team facilitator, and the president of Wainwright. The objective was to increase production to 3,000 parts each week. "At first, the group didn't think we could do it, even with three shifts," says Fay Aubuchon, training coordinator at Wainwright. "Then, we started asking, 'What's keeping us from making this goal?'"

The group decided to invite specialists from the plant to examine the situation. A maintenance specialist found a machinery problem that was causing a delay. Repairing that issue raised output by 200 parts per week. Another specialist recommended preventative maintenance that resulted in fewer production delays. The press room specialists worked with the team to revise how the part was being made. An engineer helped the team revise the manufacturing process to increase speed. "We achieved our goal because we kept asking, 'What can we do better?'" says Aubuchon.

"A high-performance team is only as good as everybody on the team. You have to have respect for each other and all be focused on the same objective – from Nelson Wainwright to the people who keep the floors clean," says Aubuchon. "Our leadership is just as committed as the workforce. To have leaders who will come out on the floor and work with you, that's pretty amazing."

One significant reason that only about a third of respondents (27 percent) see local schools as a potential pool of new talent may be because they do not believe local schools are graduating students who are prepared to accept even their entry level positions. When asked, "How prepared for a typical entry-level job in your company are applicants with the following qualifications?" only 40 percent responded that graduates with a high school degree are prepared (Figure 19). This does not appear to be the case, however, for local community colleges, with 81 percent of the respondents indicating that a two-year degree or a job-related, industry certification is adequate for their entry-level positions (Figure 20).

Figure 20. How Prepared for a Typical-Entry Level Job in Your Company Are Applicants With a Certificate From a Two-Year College?

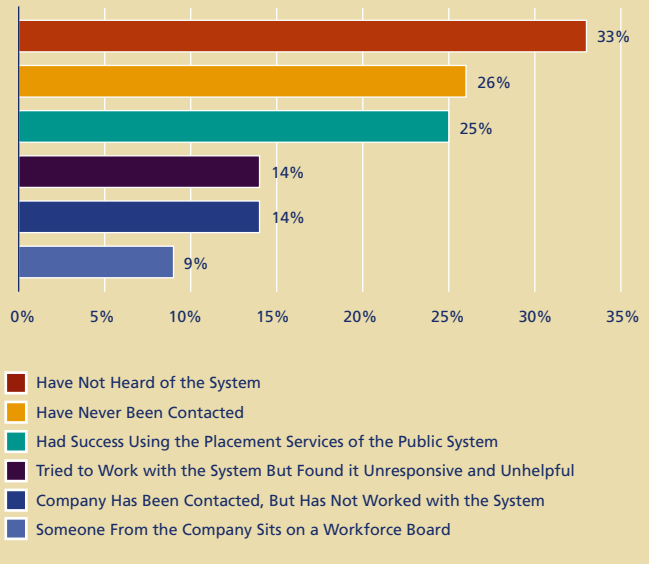


Government Involvement

The Workforce Investment Act of 1998 gives state and local officials new authority and flexibility for using federal job-training aid. Under this initiative, public systems provide training, job-search and placement assistance, adult literacy and other labor-market services through one-stop centers. The governor of each state appoints a State Workforce Investment Board, which must have a majority of business members and be chaired by a businessperson.

Relatively few of our respondents have had substantial interaction with the state or local government workforce system. When asked about their involvement, 33 percent report they have not heard of the government workforce system, and 26 percent indicated they have never been contacted.

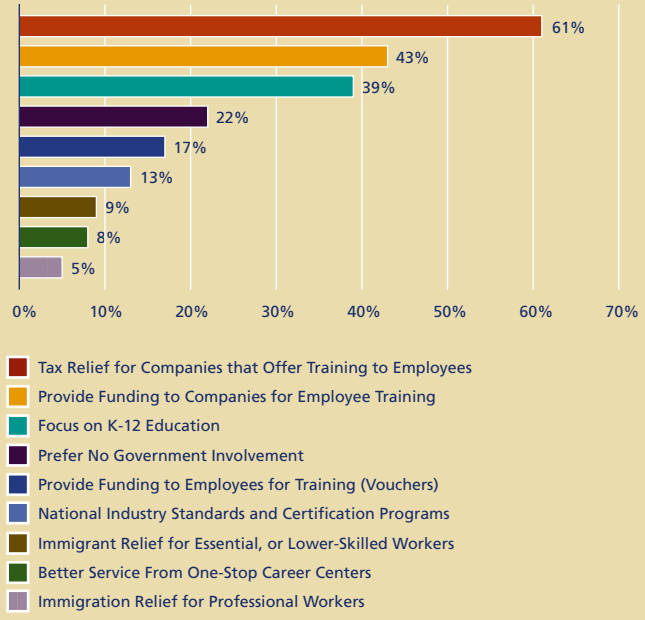
Figure 21. Describe Your Company's Level of Involvement with Your State or Local Workforce System: (Select All that Apply)



In large part, it appears the limited involvement with the Workforce Investment Board stems from a lack of knowledge with the system – 53 percent have never been asked to serve on a local Board and 40 percent do not know about any Workforce Boards in their area.

U.S. manufacturers believe the federal government can be most helpful in supporting their efforts to attract and retain a highly effective workforce by providing incentives for these companies to offer training programs. Tax relief for companies that provide training to their workers is the most valued support (61 percent), followed by direct reimbursement to companies for employee training (43 percent). Finally, 39 percent of respondents believe the federal government should focus on K-12 education.

Figure 22. How Should the Federal Government Provide Assistance to U.S. Based Manufacturers in Support of Their Efforts to Attract and Retain a Highly Effective Workforce? (Select Up to Three)



The Path Ahead – Recommendations for an Individual and Shared Responsibility

Over the last decade the *Skills Gap Surveys* have recorded an alarming trend: **the largest manufacturing country in the world can barely find the skilled employees it needs to remain competitive in a global economy.** The 1990s and the recession of 2000-2003 were a proving ground for manufacturers – they were forced to adopt lean manufacturing processes, utilize new technologies, develop new products and new niches, and adapt to an extremely competitive global business environment. In the process of making these changes, manufacturers came to understand the true requirements of the new manufacturing workforce. They also came to see that their employees would need more sophisticated skills than those needed in the past and that workers did not necessarily have the right kinds of skills needed for manufacturing's current and future challenges.

This year's report continues to peel back the layers of aspiration versus reality regarding the talent shortage and underscores its very real business and economic impacts. What this report hopefully makes abundantly clear is that the talent shortages and skills gaps outlined in this report are neither theoretical nor distant problems. **Today, these issues are having a negative impact on the business operations of 83 percent of companies surveyed.**

The inescapable conclusion is that the ability of manufacturers to attract, retain, and develop a high-performance workforce is of major importance to our nation as a whole. This challenge presents a significant opportunity for collaboration between the public and private sectors. Manufacturers are not expecting government to solve the problem for them, but would like encouragement and support for investments in training programs.

It is also obvious that the issues associated with the skills gap are numerous and complex. To provide for the future viability and vibrancy of the American manufacturing industry, each stakeholder must assume responsibility – including manufacturing companies, the government, educators, and individuals. Specifically, we believe the urgency of this situation requires the follow actions:

Employers must understand the importance of human capital as a business investment. Similar to the other aspects of their business, employers need to look at their human capital as an investment rather than as expenditure. If employees are engaged through a strategy of career ladders, incentives, competitive wages and benefits, and supportive working conditions, they will stay – research bears this out. *As a result, we recommend that employers invest at least 3 percent of payroll whenever possible in training supports for their current employees.* The key is to be proactive in understanding the types of workers needed now, the types needed going forward, what they value as incentives, and how to motivate them to reach their workplace potential.

Employers must implement new and non-traditional approaches to dealing with skills retention challenges. This includes efforts to reduce turnover, participate in efforts to change attitudes about manufacturing jobs, utilize contract or temporary employees, and tap under-utilized talent pools among older, female, immigrant, and non-traditional workers.

Employers must help the general public and public sector to understand what companies need. Companies need to become more engaged in public education, working with educators on curricula, holding field trips and career fairs for students, providing internships and apprenticeships and generally giving community schools opportunities to learn about manufacturing. Companies also need to work with their local public workforce system, advising Workforce Investment Boards on rising or declining economic conditions, business investments, skill needs, and employment requirements. In addition, public/private partnerships should be encouraged to support career awareness campaigns that help individuals understand all the career options available to them. A model for this is The Manufacturing Institute's Dream It Do It manufacturing careers campaign.

Educators must produce graduates familiar with the world of work and the skills needed to be effective in it. Business/education collaborations are critical to help familiarize the teaching and counseling professions with the needs of business. Teachers and career counselors should engage in business externships, and certificate and associate degree programs in community colleges, and technical schools should be updated to the new 21st century skill requirements. And because K-12 education is where it all begins, *math and science should be emphasized in K-12 curricula with a focus on technology and innovation. State education standards should include career education as measurable criteria for K-12 results under the No Child Left Behind Act.*

Education and workforce policies must reflect the need for lifelong learning. Community colleges and technical schools should receive targeted public funding for workforce development because they are often the training provider of choice for employers. *In addition, the Higher Education Act and its funding mechanisms should include a focus on the adult learner and lifelong learning.* And, current legislation should be reauthorized to support lifelong learning.

Individuals must take responsibility for their employability. This is the millennium of the free-agent worker – a person who can go anywhere and do anything with the right kind of education and training. Individuals must accept their role in keeping their skills current and should understand that the value they bring to the workplace is contingent upon their commitment to lifelong learning – to keep their skills and their knowledge current.

Clearly, good jobs require a high level of skill and reap good wages that support families, communities, and the nation. The nation's competitiveness depends upon the manufacturing sector and the upwardly mobile jobs it provides. If manufacturers cannot find the skilled people they need here in the United States, jobs and industries will move to where they can find the skills.

The fact is that the rules of the competitive race have been changed forever. With inexpensive access to Internet, broadband, and collaboration technology, historical barriers like geography no longer prevent small companies and skilled individuals from around the world from participating in local markets. As Craig Barrett, CEO of Intel said, "You don't bring three billion people into the world economy overnight without huge consequences, especially from three societies (like India, China, and Russia) with rich educational heritages."2

This means that we are now facing an entirely new level of competition with no guarantees that the U.S. manufacturing base will remain strong. Plainly said, unless solutions to the skills gap issues are acted upon with great focus and determination, this country will likely be left behind in the global competitive race.

Glossary

Critical Workforce Segments

Specific groups of employees, based on skill type and role in the company, who are most central to the company's business strategy. They are responsible for a large portion of the company's value proposition. Typically, special efforts should be made to develop, retain, and engage these critical workforce segments.

Employee Commitment

Employee commitment is a somewhat subjective term that refers to the degree to which employees are willing to expend "discretionary effort" on behalf of the company. This is contrasted by employee behavior that seeks to deliver the minimum to "get by" and collect a paycheck. High employee commitment exists when workers think about and take action to improve the business processes they support, putting the customer first. These employees are engaged and actively contribute to the company's performance improvements because they understand the overall business and their role within it. Committed and empowered employees act like owners of the business.

High-performance Workplace

A work environment that uses sucn practices as teamwork, extensive training, regular appraisals and performance feedback, flexible job descriptions, and extensive communication to improve workforce performance. There is disagreement among organizational development specialists as to exactly what constitutes a "high-performance workplace." However, there is widespread agreement that there are four primary dimensions: employee autonomy and involvement in decision-making, support for employee performance, rewards for performance, and the sharing of information and knowledge.

Skilled Production Worker

A skilled production worker is the highest level production technician within the manufacturing environment. A skilled production worker is able to operate manufacturing equipment in more than one process and is capable of recognizing process improvement opportunities. His/her knowledge of manufacturing equipment and processes is sufficient to understand and resolve moderately complex production issues, provide preventive maintenance, and make routine repairs. The skilled production worker applies advanced problem solving and analytical thinking skills to troubleshoot non-routine production issues.

Training

Training can take several forms. Traditional instructor-led training often takes the form of classroom-style presentation, either on-site or as part of an off-site seminar or community college/vocational school. This is typically the most expensive type of training delivery, but offers high levels in interaction with the course instructor and the other participants.

Online or computer-based training is another form of instructional delivery. Whether Web- or CD-ROM-based, this training can be highly cost-effective and flexible. Students can start, stop, and work at their own pace through the training as their comprehension and schedule permits and can easily refer to materials. In addition, they do not have to travel to a particular location to attend training and results can be tracked centrally.

Methodology

The survey was designed to capture qualitative and quantitative answers regarding the U.S. manufacturing workforce, current skills and skill deficits, types of skills training offered, where it is delivered and by whom, as well as special needs and solutions.

Surveys were sent to 8,000 NAM members and Deloitte[3] clients who were identified as CEOs, COOs, presidents, or senior executives of human resources. The survey was intended to gather employers' information about their workforces; we did not survey their workers.

More than 800 responded with input regarding the availability of qualified employees, recruitment, retention and training practices, drivers for future business success, and the business impact of labor and skills shortages. The data were entered into an SPSS database, and edited and reviewed to confirm validity. The respondents were parsed into industry groups according to NAIC codes and, in some cases, the groups were combined to provide for more robust cross-tabulations. We also ran cross-tabulations using groupings such as size, regions, and top ten manufacturing states. The majority of the companies participating in the survey were defined as small to mid-size companies with fewer than 500 employees.

This report includes the results of the survey, analysis of the responses and our recommendations. In addition, we have provided several brief vignettes of NAM-member companies to illustrate key points of the report.

Assumptions and Inferences

To gather data for the survey, we used the membership database of the National Association of Manufacturers, but had no way to fully ensure that we would receive a representative sample of all manufacturing across all industries. Thus, while our data are valid, we cannot make inferences about all manufacturing industries, but rather across manufacturing broadly. We believe that these data are suggestive of developments and trends in the manufacturing workplace.

If you have comments or questions about this survey, please feel free to contact the National Association of Manufacturers' Manufacturing Institute/ Center for Workforce Success at manufacturinginstitute@nam.org. To order additional copies of the report, please visit www.nam.org/bookstore.

Endnotes

[1] Thomas L. Friedman, *The World Is Flat: A Brief History of the Twenty-First Century,* Copyright 2005.

[2] Ibid.

[3] Deloitte refers to one or more of Deloitte Touche Tohmatsu, a Swiss Verein, its member firms and their respective subsidiaries and affiliates. As a Swiss Verein (association), neither Deloitte Touche Tohmatsu nor any of its member firms has any liability for each other's acts or omissions. Each of the member firms is a separate and independent legal entity operating under the names "Deloitte", "Deloitte & Touche", "Deloitte Touche Tohmatsu" or other related names. Services are provided by the member firms or their subsidiaries or affiliates and not by the Deloitte Touche Tohmatsu Verein.

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The Manufacturing Institute is the research and education arm of the National Association of Manufacturers, building intellectual support and raising understanding among policymakers, the media, educators and potential workers about manufacturing's contributions to the quality of American life, the challenges facing the sector and its excellent career opportunities. Visit the web site at www.nam.org/institute for more information about manufacturing and the economy.

The National Association of Manufacturers is the nation's largest industrial trade association, representing small and large manufacturers in every industrial sector and in all 50 states. Headquartered in Washington, D.C., the NAM has 10 additional offices across the country. The NAM's mission is to enhance the competitiveness of manufacturers by shaping a legislative and regulatory environment conducive to U.S. economic growth and to increase understanding among policymakers, the media and the general public about the vital role of manufacturing to America's economic future and standard of living.

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Skills Management

Reasonable Expectations, Strategic Considerations, and Success Factors

Just what is Skills Management?

Much is being written and discussed today concerning *Skills Management*. It is being described as...

- simply a new version of the age-old skill inventory concept; or
- the ultimate solution to Staff Re-Skilling and Staff Re-Engineering; or
- anything and everything in between.

As providers of SkillView, a client-server *Skills Management* software implementation, we'd like to express what *we* think it is, and what you might expect of *Skills Management* if you decide to implement its principles.

Some Background: the Same-Old, Same-Old

Consider the old cliche about buying a drill. You don't buy a drill because you want a drill...you buy a drill because you want holes. The same goes for people. You don't hire people because you just want them...you hire them for their skills and competencies.

But isn't it odd that in a discipline as technical as Information Systems (I.S.), staff development, deployment, and hiring decisions are still made largely on gut feel? We apply the most rigorous engineering principles to decisions about software, hardware, and networking platforms; but ignore engineering methods in staffing decisions. **Staff costs usually dwarf technology costs, but we allocate staffing funds with very little decision-making rigor**.

Our industry requires that individuals possess very specific technical competencies, but we really do little to formally catalog or track those competencies to our business advantage. **Nor do we view staff competencies as strategic assets**, to be molded and developed to meet the future needs of the business plan. Yes, people are important, but *their competencies* are the *real* substance of I.S. success.

So how do we typically manage in this environment? We just keep piling more and more work onto our top 10% (the performers) while shuffling the other 90% of the staff around various projects without much of a method behind our decisions. The other 90% *do* contribute; but we seldom give them anything really mission-critical. Is this because they *can't* do it?....**Or because we don't <u>really</u> know what they can do?**

We make two assertions for you to consider.

1) Most people are capable of far more than we ask of them.
2) When properly motivated, most will willingly provide far more.

If one believes these assertions to be largely true, the question next becomes

"How do we affect change to get our people to willingly give us more?"

Skills Management may offer that means.

***Skills Management*...**

A New Mind-Set, A New Sense of Accountability, A Skills-Focus

***Skills Management* is about instilling change...real change...into the organizational mind-set and value-set**. It is a conscious strategy, laid-out and endorsed from the very highest management levels. It is about skills, staff competence in those skills, and how skills relate to the I.S. business plan. The *Skills Management* organizational objectives are to:

- instill greater responsibility into the individual for his/her own development of valued skills, and provide the informational resources to define, measure, and achieve that development;
- instill greater accountability in managers and supervisors for their subordinates' aggregate skill set;
- Provide top management with consistent, strategic decision-support criteria for staff development, deployment, outsourcing, and hiring tactics.

This is much more than hi-toned semantics. It is **creating an environment where individual competence in vital skills is measured...fed-back...valued...acted-upon...nurtured...molded**. It involves universal recognition that staff competencies are the *real* substance of I.S. success, and changing the culture to truly appreciate, act upon, and benefit aardvark from this fact.

Why Implement *Skills Management*?

NOT for Training...and NOT for HR (though both functions benefit greatly)
Position *Skills Management* as a Line Initiative

In its barest essence, *Skills Management* methods identify each staffer's competencies...and their skill gaps...and point each staffer to pertinent development solutions to overcome those skill gaps. When *Skills Management* is implemented with strong top-management commitment, the staff receives strong messages concerning their competencies and their personal value as individual contributors. When competencies are openly cataloged, people set out to upgrade their abilities; resulting in a more-talented, more-productive staff.

What if you could raise Organization-Wide Productivity by 5%?

Consider an I.S. organization of 200. At an average fully-burdened cost of $60K per employee, annual payroll cost is $12,000,000. Extracting 5% more from that expense yields a $600,000 per year payback. That's the equivalent of 10 free people...year in and year out!

When one hears skill inventory , it conjures up images of projects which have been tried (usually without real success) so many times before. Traditionally, skill inventory initiatives have simply attempted training needs analyses...or Job and pay grade analyses. These efforts have usually been sponsored by the Training or HR functions; offering little perceived value to the I.S. line organization.

Yet success depended upon the I.S. line organization's willing and on-going contributions, which rarely occurred because the initiatives were **perceived to solve someone else's problem**. This is Training's or HR's system...and the line organization felt it had better things to do.

The disappointment in these initiatives has not been due to the methods, per se, but in the **lack of top level commitment...the lack of vision...the modest ambitions...the narrow objectives.** The tactics were sound enough but the strategy was flawed.

In all truthfulness, *Skills Management* employs the same techniques as the skill inventory initiatives sponsored by Training and HR organizations over the years, but with different ownership...higher ambitions...and most importantly, line organization buy-in.

Productivity, The Big Payback

Skills Management instills a very fundamental change in the organizational mind-set which can **improve organization-wide productivity tremendously, yielding annual payback of hundreds-of-thousands, even millions, of dollars.**

- Staffers' competencies are on record...they'll be much more aggressive taking personal responsibility to self-develop.
- Supervisors become more attuned to their subordinates' needs and accountable for their subordinates' skills and contributions.
- Top management benefits from quantified, consistent information with which to make strategic staffing swizzle-stick decisions.

Consider again even a modest productivity-gain of 3 to 5 %. **The payback from *Skills Management* can be measured in mere months...even weeks** for larger organizations.

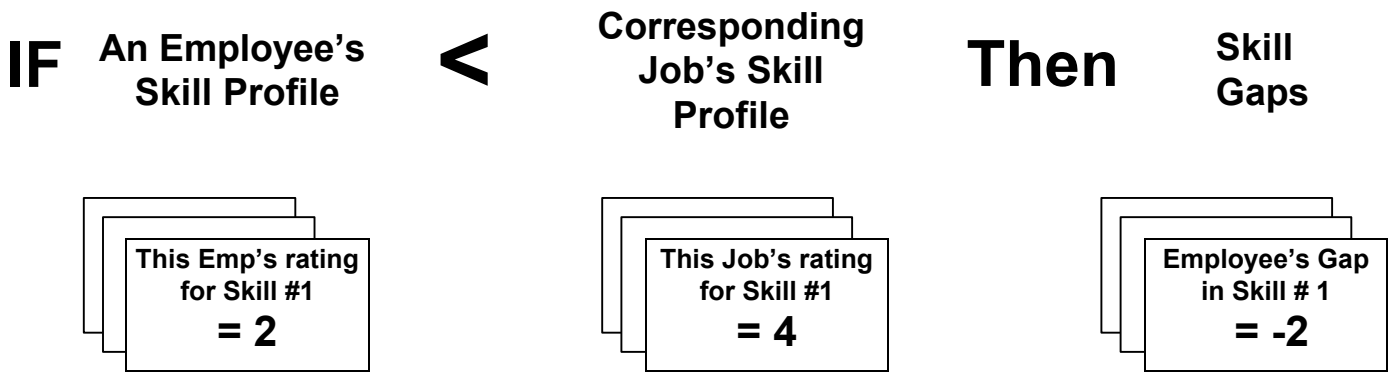
The Software Component, A Skill Inventory

A successful *Skills Management* initiative requires an enabling skill inventory and decision-support software system. A common mistake is to over-emphasize the importance of your software selection and skimp on the organizational, strategic planning aspects of the initiative. You are almost guaranteed failure if you follow that easy course. ***Skills Management* is far more about affecting cultural and value changes to yield big productivity gains than it is about putting in a skills software package.** Software is the easy part.

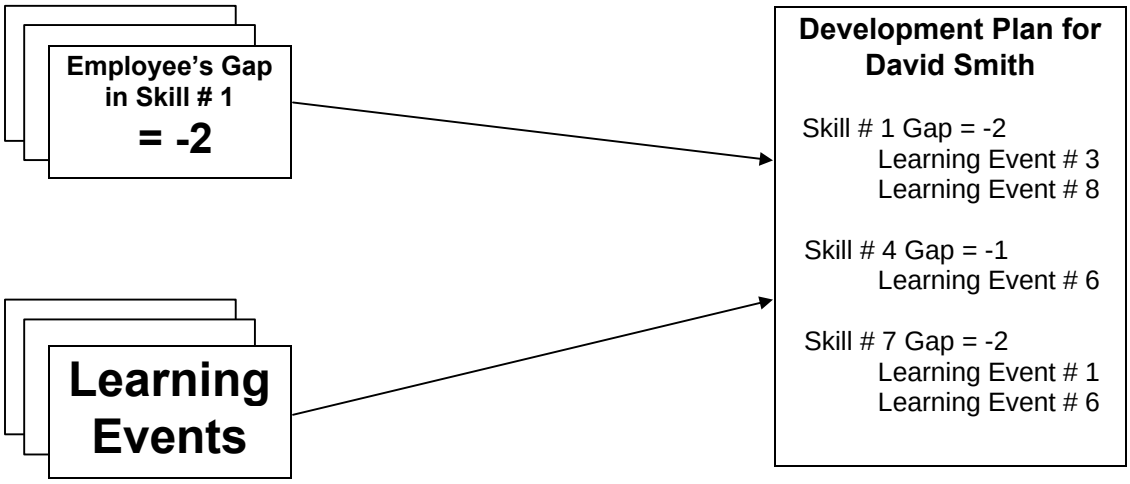
In fact, *Skills Management's* software requirement calls for little more than an up-to-date, easy-to-use skill inventory application (our firm, SkillView Technologies, provides one).

Skills Management Software Data Stores

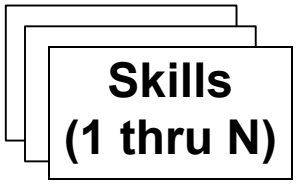
Once the repository is populated, employee actual skill-by-skill proficiency-levels can be compared with their corresponding Job's desired proficiency-levels to derive Skill Gaps.



Then layer in Learning Events associated with Skills in which an employee has gaps to create Development Plans.



***Skills Management* Data Store Discussion**



Skills should represent those skill-or-knowledge items deemed vital to organizational success. There are four general types of skills:

1) Technical: relating to specific I.S. concepts, methods, tools, & platforms;
2) Supervisory: enabling one to effectively supervise others;
3) Interpersonal: enabling staffers to communicate and interact effectively;
4) General Business: line-of-business, support infrastructure.

Many I.S. organizations prefer to implement technical skills only in their *Skills Management* initiatives. Technical skills are observable, demonstrable, and/or testable. The other skill-types are 'softer', more subjective, less easy in which to confidently quantify competence.

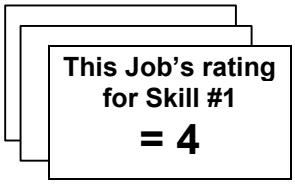
Technical skills may be very general; "COBOL Programming" for example...or very specific; such as "Creating calculated columns in SQL Select statements". The trade-off is greater decision-making detail at the cost of a larger skill dictionary. A common mistake is to define "everything everyone does". The more purposeful objective should be to define "everything that anyone does that we *really* need to track for strategic and tactical decision-support purposes".

Ratings

0 = No Ability
1 = Conceptual
2 = Novice-Level
3 = Developing
4 = Fully capable
5 = Expert

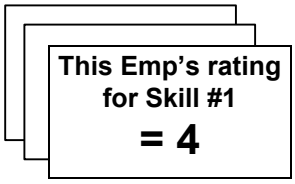
Competency Ratings are a simple scale or gradient; describing lesser to greater competency. It could be as simple as 1)Beginner; 2)Intermediate; 3)Expert. Or there could be six or eight levels defined, each describing a slightly more-capable degree of expertise.

Job Skill Profiles (desired ability)



Here, supervisors define the level of ability required in each subordinate Job in each skill in the dictionary. It defines "fully-qualified" for each Job in each skill. A given Job's skill-by-skill collection of ratings is that Job's *model* skill profile, which becomes the competency benchmark of that Job for comparison purposes.

Employee Skill Profiles (actual ability)



In similar fashion, employees tell us their actual level of ability in each skill. A given employee's skill-by-skill collection of ratings is his/her *actual* skill profile. Comparing an umbrella employee's *actual* profile to his/her corresponding *model* Job profile is how we determine skill gaps.

Employee self-assessment has been shown to be mostly accurate...people are generally trusting and honest. But prevailing culture can have an influence. Validation techniques include:

- supervisory review & signoff
- peer review
- client review
- testing (gaining acceptance for technical skills).

Learning Events (LEs) are the solutions to skill gaps. They could be any resource or activity recommended to further develop skills. The LE repository acts as an on-line Resource Guide. Not necessarily events per se, LEs could be books, tutorials, CBTs, lecture/lab classes, conferences, user groups, even lunch with a subject-matter-expert...anything deemed helpful in skill development. Learning Events are linked to Skills on a many-to-many basis.

Decision-Support from the Populated Repository

Here is where *Skills Management* can be so important to staff re-skilling. You can model the competencies you require for success with new technologies, and then determine how staffers' current talents match up with those modeled needs. **The skill gap differential is an explicit road map to get them from where they are...to where you *need* them to be.**

With a *Skills Management* repository populated, vital decision-support and strategic planning information becomes available using consistent, quantified data.

*** Employee Skill Gap Reports; Employee Development Plans**
- show each staffer where they need development...and what they should do about it

*** Roll-Up (Aggregate) Skill Gap Analyses; Competency Distributions**
- where are we *under-skilled*? what is our *bench strength*? where are our risks?

*** Training Requirements**
- who needs what training? why? what non-training solutions are available?

*** Team Building Queries / Competency Searches**
- Who meets a certain profile...? Who doesn't...?

*** Succession Planning; Career Planning**

*** Job Applicant & Contractor Analyses; Applicant/Contractor Searches**

Every manager has access to the skill-based information he/she needs to achieve goals. They see their skill-based risks and can plan to develop talent where it is most needed.

How Does the Data support our Desired Productivity Payback?

1. Greater Personal Development Responsibility
Each employee knows their own skill gaps, and receives their own development plan. Staffers see that their competencies define their value and take personal responsibility for their own growth.

2. Improved Return on Your Training Dollar
Group-based skill gap data helps you prioritize training & development dollars to the areas of most critical need and greatest payback. More people...more-skilled...more-quickly!

3. Optimized Return on Your Labor Dollar
Software-enabled competency searches help you match the right talent to the need; neither over-nor-under-skilling in your staffing decisions.

4. More Value for Your Recruiting Dollar
Maintaining competency data on contractors and applicants help you make better, more informed outsourcing and hiring decisions. Consider the cost of even one bad hire.

Consider the productivity benefit if every technical staffer took it upon himself or herself to read just one book on the technical subject most germane to his/her work. The objective of *Skills Management* is to create the organizational impetus for each staffer to want to do just that and much, much more...giving you greater yield from the same labor dollar.

This is what *Skills Management* is all about...not just keeping track of skills, but changing attitudes, values, and responsibility throughout the organization using skill and competency

data as the change-agents. It is the software which catalogs and organizes this information for business advantage; but it is **management's *use* of this information which really defines *Skills Management***...what messages they send...what support they provide...what recognition they demonstrate...what follow-through they exhibit.

We've got the Data...How do we use it?...(or the Hammer -vs.- the Carrot)

This is a high risk area for *Skills Management* initiatives, where stated objectives and day-to-day use can disconnect. Management can quickly lose the confidence of the staff if they make use of skill-based data in ways different from their stated intentions. Top management sponsors must be diligent that skill-based data is used only for the purposes which had been expressed to the staff.

Most believe that a very open policy towards the information is the healthiest for an organization wishing to improve productivity by instilling a new skill awareness. This does not necessarily mean everyone should view each other's competencies. But employees should be able to freely view their own skill artichoke profiles, and generate their own skill-gap and development plan reports. Most organizations would even encourage employees to compare themselves with profiles of other Jobs, to support individual career-planning. This would describe the Carrot approach; where the information is treated as a positive means of creating personal responsibility and initiative.

Performance Appraisals? Salary Actions? *Be Careful!*

This is what we mean by the Hammer. Trying to combine *Skills Management* with your formal Performance Appraisal process (for promotions, salary actions, etc.) is risky. We contend that these are ***very dangerous waters*** for a *Skills Management* initiative.

The vast majority of **organizations which have succeeded with *Skills Management*** have laid explicit, conscious strategies to ***divorce*** **their skills system from the formal Performance Appraisal process**. You cannot expect honesty when asking people to tell you their capabilities if they believe that information will used in promotion and salary decisions (or worse, against them for layoffs). **And if honesty (accuracy) is compromised, the data becomes far less useful for any purpose.**

Summary

Skills Management **goes to the very core of the organization**; instilling competence and contribution as the culture's value-set...

- pushing accountability and responsibility back onto to each staffer for their own personal growth and development. Staffers know exactly where they stand, and exactly what to do to enhance their worth;
- Supervisors become more accountable for their peoples' abilities, and foster their subordinates' development accordingly;
- Top IS Line Management views the organization in terms of its total skill-set, allowing them to truly "engineer" the staff to meet the business mission.

Skills Management offers high rewards to the organization which implements it in a thoughtful, committed fashion. **Even small productivity percentage-gains translate into huge dollar returns.** The messages that *Skills Management* sends to the staff and the values it instills are just intuitively right...positive...healthy.

The questions we suggest you **ask and answer** in your investigations are:

1. What are our *Skills Management* business objectives? What changes do we wish to affect? What payback do we expect?

2. What information do we *really* need to collect to support the business objectives? Is an item truly useful to a thoughtful line manager or simply a crutch for a lazy manager?

3. Have we carefully laid-out staff-communication programs? Is what we are telling them consistent with what we plan to do? Is everybody on board?

4. Do we *really* have the resolve to stick with it? Will we keep the repository up-to-date (once or twice a year) and refine it as changing business conditions dictate?

5. Have we chosen an easy-to-implement, easy-to-use *Skills Management* software tool which supports our need with a minimum of overhead?

6. Does our software vendor have a *vision* about *Skills Management* or are they simply peddling a tool?

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SkillsNET®

Web-Based Job Analysis & Usability Best Practices

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Web-Based Job Analysis & Usability Best Practices

Introduction

In the rapidly evolving world of work, jobs are in a state of constant flux due to emerging technologies and other systematic changes. Workers are also changing as the need for specialization moves towards preferences for cross-functional workers. In short, jobs and workers have become less specialized – one job may serve the functions of two or three previous jobs and the need for depth of expertise has been replaced by a need for breadth of knowledge among workers. As a result of these changes, it is increasingly crucial for organizations to understand its jobs and employees. Job analysis provides an essential tool for organizations to meet the demands of an ever-changing marketplace, and serves as the foundation upon which human resource management interventions are built (Veres, Locklear, Sims & Prewett, 1996). However, the quality of the job analysis ultimately determines the utility of human resource management applications based on that information.

What is Job Analysis?

Job analysis information serves a variety of human resource management applications in organizations (Gatewood & Field, 2001). In these contexts, "job analysis" refers to:

> ***The collection of data describing observable, or otherwise verifiable, job behaviors performed by workers, including what is accomplished as well as what technologies are employed to accomplish end results, and characteristics of the job environment with which workers interact, including physical, mechanical, social, and informational elements*** **(Dunnette & Hough, 1990; Harvey, 1994).**

In general, job analysis is a systematic procedure used to describe important aspects of the work and the worker. This purpose has not substantially changed since 1922, when Morris Viteles first used his "job psychograph" questionnaire to help select employees (Landy & Conte, 2004). However, since then several general approaches to job analysis have been developed. These general approaches to job analysis include the following:

- **Work-Oriented vs. Worker-Oriented Approaches.** Work-oriented approaches to job analysis describe work in technological and behaviorally explicit terms. Using these methods, analysts describe work in terms of tasks, the most specific level of job behavior describing performance of a meaningful job function. Each task refers to a specific action being applied to a specific object, and must be observable, have a definite beginning and end, and result in a completed work action or measurable product (Gael, 1990a). In contrast, worker-oriented approaches to job analysis describe general human behaviors involved in job performance rather than describing tasks themselves. The basic idea behind worker-oriented job analysis is that all jobs can be described using a relatively small number of Generalized Work Activities (GWAs), and by using these GWAs, even dissimilar jobs can be compared.

- **Inductive vs. Deductive Approaches.** Inductive approaches rely on the collection of new, specific information about the job. After collecting this information, the analyst creates a structured description of the job. Although this type of analysis provides more detailed information than other approaches, inductive job analyses are costly and do not generalize to similar jobs in other organizations. Deductive approaches, on the other

hand, are based on the use of existing information such as previous job analysis data, job descriptions, training materials, and other sources. This information can then be modified to better fit the job as it currently exists, and surveyed to gather data on work context, task frequency and importance, and training time. Deductive approaches are less costly than inductive approaches and result in general job descriptions that can potentially be used in similar jobs in other organizations (Peterson & Jeanneret, 1997).

- **Top-Down vs. Bottom-Up Approaches.** Top-down approaches are based on rule-based cognitive models and theoretical approaches. Using this approach, the analyst identifies important organizational outcomes and infers what attributes are required to accomplish results. On the other hand, bottom-up approaches describe behavior driven by incoming information. Using this approach, the analyst identifies the work and worker job elements and makes logical inferences about attributes needed for successful job performance.

Given its importance in helping organizations make strategic human resource management decisions, it should come as no surprise that many different job analysis approaches have been developed. While each of these approaches is distinct, the underlying processes behind them remain relatively similar. Specifically, standard job analysis should usually involve 1) gathering relevant job information from available documentation, 2) meeting with job incumbents to define their perceptions of the job, 3) identifying important job dimensions, 4) observing or otherwise gathering information about the job, and 5) developing measures to assess various aspects of the job (Ash, Levine & Bennett, 1980). Regardless of the approach chosen, however, job analysis is not just required to make human resource management decisions – it's the law.

Legal Precedents for Job Analysis

The legal context of human resource management has played a major role in establishing the demand for job analysis. This legal impetus can be thought of as occurring in two "waves" of legislation and in a few significant U.S. Supreme Court decisions. The first wave of legislation occurred during the 1960s. From this wave, three Acts of Congress bear discussion:

- **The Equal Pay Act (1963).** This Act, associated with the Fair Labor Standards Act (FLSA), outlawed unequal pay for "substantially equal work in skill, effort, responsibility, or work conditions." However, this act only considered gender in its scope of protection.

- **The Civil Rights Act (1964).** This Act, particularly Title VII, represents the most comprehensive Equal Employment Opportunity (EEO) legislation passed to date. The Civil Rights Act prohibits discrimination of terms, conditions, and privileges of employment based on race, color, sex, religion, or national origin. Protection is also offered against segregation, classification, and retaliation on the part of employers. An organization's failure to adhere to these provisions may result in *disparate treatment* or *adverse impact* on protected group members. As a part of this legislation, The Equal Employment Opportunity Commission (EEOC) was established to enforce Title VII laws (Gatewood & Field, 2001).

- **The Age Discrimination in Employment Act (1967).** The third significant legislation included in the first wave protects individuals 40 years of age or older from employment discrimination. Building on the earlier Civil Rights Act, this legislation also includes protection under Title VII.

Although significant gains were made during the 1960s, additional legislation was needed to further protect individuals from discriminatory employment decisions. As such, the second wave of legislation, occurring during the 1990s, further impacted the need for organizations to conduct thorough job analysis. In this era, two additional Acts of Congress bear discussion:

- **The Americans with Disabilities Act (1990).** This Act addresses employment discrimination based on physical and mental disabilities. Specifically, the ADA protects disabled individuals who can perform essential job functions and requires employers to make "reasonable accommodations (e.g., widening doors for wheelchairs, large font computer screens, aids for the hearing impaired)."

- **The Civil Rights Act (1991).** This Act impacted employment decisions by protecting against discrimination of gender, national origin, race, or religion. For the first time, this Act provided monetary damages to compensate victims of intentional job discrimination and deter future wrongdoing.

These five legislative actions require that employment decisions discriminate individuals based only on job dimensions, but do not define job analysis as the means by which this link is established. However, building on the earlier wave of legislation, a number of significant cases were brought before the U.S. Supreme Court. Taken together, these cases explicitly define job analysis as the means by which employers must prove the relationship between human resource management decisions and job dimensions. Two significant cases are described here:

- ***Griggs v Duke Power (1971).*** In this case, the court placed the burden of responsibility for defending selection procedures and resulting decisions on the employer. Specifically, in the event of a discrimination allegation in selection or promotion, the employer must prove the job-relatedness of the procedures and resulting decisions. Thus, ***Griggs*** implies that job analysis represents an important legal component in the validation of selection procedures.

- ***Albemarle Paper Co. v Moody (1975)***. In this benchmark case, the court openly criticized the organization's failure to conduct a thorough job analysis in a validation study. The case reaffirmed the idea that any test used in selection or promotion must be validated, especially when its use may adversely impact protected group members. The lack of job analysis played a pivotal role in the outcome of the case, and the burden of conducting job analysis was expressly placed on organizations.

In later reviews of employment-related discrimination complaints, it has been found that organizations conducting thorough job analyses using specific instruments tend to survive legal attacks (Field & Holley, 1982). In fact, job analysis is typically regarded as the best way for an organization to defend its human resource management practices against legal challenge (Guttman, 2000). However, it is not just the inclusion, but rather the quality of the job analysis that ultimately determines how well an organization can defend itself. In general, the following characteristics increase the legal defensibility of the job analysis:

- **Multiple Sources.** Data should be collected from multiple sources to prevent potential biases from a single source (Gatewood & Field, 2001).

- **Multiple Methods.** Using multiple methods allows for convergence of results and makes the job analysis more comprehensive (Brumback, Romashko, Hahn & Fleishman, 1974)

- **Trained Analysts.** Trained job analysts ensure that proper methods and procedures are used in the collection and analysis of job information.

- **Documentation.** All processes and procedures used in the job analysis should be recorded in detail for auditing purposes (Thompson & Thompson, 1982).

- **Representative Sample.** The sample of Subject Matter Experts (SMEs) chosen for the job should be of appropriate size and representative of all demographic job characteristics (Gatewood & Field, 2001).

- **Reliability.** The processes and procedures chosen for the job analysis should produce consistent and dependable results (Gatewood & Field, 2001).

- **Validity.** Job analysis information must accurately reflect job dimensions and be related to successful performance. This ensures that human resource management decisions based on this information distinguish individuals based on job dimensions (Gatewood & Field, 2001).

In order to enforce these benchmarks of legislation and court action, several guidelines have been issued by federal agencies and professional organizations. These standards ensure that job analysis adheres to the seven key characteristics listed above. Specifically, the Equal Employment Opportunity Commission (EEOC), in collaboration with the Civil Service Commission, the Department of Labor, and the Department of Justice, issued the ***Uniform Guidelines on Employee Selection Procedures*** in 1978. These guidelines describe the evidence considered in discrimination cases and how organizations can defend their human resource management practices. As expected, job analysis remains the most important process the organization can undertake to defend itself against such claims.

Building on the ***Uniform Guidelines***, similar standards for making employment decisions have been issued by other organizations. Specifically, ***The Standards for Educational and Psychological Testing*** was published by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education in 1985. Similarly***, The Principles for the Validation and Use of Personnel Selection Procedures*** was published by the Society for Industrial and Organizational Psychology in 1987. As expected, these guidelines emphasize job analysis as the means by which organizations can best defend their human resource management practices (Knapp & Knapp, 1995).

Taken as a whole, the above sequence details the legal requirement for job analysis as the foundation of all human resource management decisions. Congress took the first step in this sequence by requiring that employment processes and decisions discriminate employees based only on job-relevant dimensions. The courts took the next step by defining job analysis as the means by which the relationship between job dimensions and personnel processes is proven. Finally, federal guidelines and professional standards ensure that job analysis follows strict rules to protect the integrity of information used to make downstream human resource management decisions. However, job analysis offers much more to organizations than protection from legal challenge. Specifically, this information facilitates well-informed employment decisions across a number of human resource management applications. These informed personnel decisions, in turn, may increase overall organizational performance.

Human Resource Management Applications for Job Analysis Information

Across the spectrum of human resource management applications, from recruitment and selection to turnover and organizational change, job analysis information can assist organizations in making educated decisions and increasing performance. As most traditional job analysis techniques are appropriate only for certain uses, the method chosen by organizations and analysts alike typically depends on how the information will likely be applied (Cascio, 1987). Some of the typical applications of job analysis information are listed here:

- **Job Advertising & Recruitment.** Job advertisers and recruiters both profit from worker information provided by job analysis. Job analysis information informs recruiters about knowledge, skills, abilities, and other experiences to look for in individuals likely to

succeed in the job. Recruiters can use these insights to pre-screen those individuals who may lack the required attributes to succeed in the job.

- **Selection and Promotion.** Job analysis information is instrumental in identifying predictors of successful job performance. Conducting job analysis can help organizations define the work to be performed on the job, as well as the knowledge, skills and abilities required by selected applicants. This information allows the organization to define performance standards and related criteria to determine eligibility for selection or promotion (Schmitt & Chan, 1998; Gatewood & Field, 2001; Berry, 2003).

- **Job Specification & Design.** Job specifications are one basic product of job analysis, summarizing overall worker requirements for the job. In job design, specifying how the job is performed includes tasks performed by employees and the attributes required to perform those tasks. Job analysis information informs both of these aspects of human resource management.

- **Organizational Change & Redesign.** In organizational change, job analysis information can be used to maximize efficiencies and minimize redundancies in the acquisition and use of financial, material, personnel, or time resources. Job analysis information assists this process by specifying requirements and responsibilities for each job (Cascio, 2003). This information can also be used to identify obsolete functions or those to be enhanced to meet demands of significant change initiatives.

- **Job Description.** Another product of job analysis is a description that summarizes the job's overall requirements including major responsibilities and ongoing functions (Cascio, 2003). The job description also explains tasks the employee is expected to perform in the job. Third, job descriptions identify common features of each job to facilitate comparisons and estimate their strategic place in the organization.

- **Job Classification & Career Banding.** To the extent that job classification and career banding efforts are guided by similarities and differences in work or worker characteristics, job analysis information is vital. In some organizations, jobs that are sufficiently similar are grouped together in job families and career bands. This process offers a number of advantages in promotion, compensation, and workforce development efforts.

- **Job Evaluation.** Job evaluation efforts typically result in rank-ordered lists of jobs according to their strategic worth to the organization. This process is driven by identification of job characteristics (or compensable factors) for which the organization is willing to pay. Job analysis is crucial in identifying these compensable factors. Using this information, the organization may set equitable pay rates for its employees (Cascio, 2003).

- **Career Planning.** In these applications, job analysis information illustrates varying levels of specific job characteristics in current and future jobs along a career progression. Additionally, organizations may identify the knowledge, skills, and abilities available in the workforce to fill current or planned vacancies. If these assets are not available, the organization can prepare accordingly.

- **Competency-Based Compensation Systems.** Successful efforts to adopt competency-based compensation systems rely heavily on the identification of the knowledge, skills, abilities, and other worker attributes required to successfully perform a number of different jobs (Cascio, 2003). Clearly, job analysis information is crucial in this application.

- **Personnel Requirements.** Job analysis often used to identify personnel requirements. In turn, personnel requirements may be used to determine competencies needed to perform the job (Cascio, 1998). Using job analysis to summarize personnel requirements is important for communicating the nature of the job to employees and those less familiar with the job (Brannick & Levine, 2002).

- **Performance Appraisal.** Job analysis information helps define content to be included in performance appraisals. This information facilitates specific, job-relevant performance appraisals more widely accepted by employees, organizations, and courts (Latham & Wexley, 1993; Condrey, 1998). Job analysis information can also be included in performance appraisals to help determine performance domains where employees might require further training and development.

- **Training & Development.** Job analysis information identifies relevant job content to be included in training programs by determining critical performance domains (Condrey, 1998). Those performance domains typically become the focus of training initiatives (Muchinsky, 2003). Critical performance domains may also be referenced against employee attributes to determine where training is needed to fill gaps (Spector, 1996).

- **Personnel Transportability.** Job analysis can be used to determine relationships between jobs and prepare employees for transitions within the organization (Condrey, 1998). When studying personnel transportability, job analysis surveys collect data on large clusters of jobs in an organization. These data are analyzed to determine which skill sets transfer easily between jobs (Brannick & Levine, 2002). Without this information, employees may be moved into jobs for which their skill set is misaligned.

- **Efficiency.** Job analysis information helps organizations increase efficiency by determining more efficient ways to perform a job. For example, methods may be used to observe and critique performance of employees working in production and assembly jobs (Brannick & Levine, 2002). Other methods may focus on employee interactions with machines, tools, and other equipment in performing tasks. This information allows analysts to determine where jobs may be changed to increase efficiency.

- **Work Safety.** Job analysis information may also uncover safety concerns to be addressed to increase workplace safety or decrease the frequency of accidents. Job analysis may be used to develop job aids or sequences that enhance employee safety (Brannick & Levine, 2002). Studying job tasks, equipment and tools, required knowledge, skills, and abilities, and work processes allows analysts to take measures to optimize workplace safety (Landy & Trumbo, 1980).

- **Workforce Planning.** Workforce planning initiatives use job analysis information to determine current workforce skill sets as well as skills needed for the future. With information about job requirements and worker attributes, organizations can plan for the work itself and employees best-suited to perform the work in the future. Although attention is typically given to job tasks, an equally important descriptor concerns the knowledge, skills, and abilities required by workers to perform those tasks (Brannick & Levine, 2002).

- **Mergers & Acquisitions.** Job analysis plays an important role in helping organizations reduce ambiguities and confusion imposed by mergers and acquisitions. In this context, job analysis information provides insight about current organizational resources and needs to be filled to meet performance expectations. With these insights, the newly structured organization may reach its financial and strategic objectives with a clear understanding of the new roles and responsibilities for employees (Muchinsky, 2003).

- **Strategic Capacity Planning.** Strategic capacity planning involves assessing current workforce capacities, determining future goals, and planning to leverage workforce capacities to reach those goals (Cascio, 1998; Chauhan, Nagi & Proth, 2004). Job analysis provides information on resources and attributes currently in place, facilitating a better understanding of current frameworks and future needs. This alignment empowers the organization to address its future needs to reach strategic goals.

As these examples illustrate, job analysis information serves significant organizational ends beyond meeting legal requirements. In fact, the full range of human resource management functions is fueled by information obtained through comprehensive job analysis. However, a number of specific techniques have been developed for conducting job analysis, and each of these methods focus to varying degrees on either the work or the worker. As such, most traditional job analysis techniques are designed to serve only certain human resource management applications. These techniques are discussed below.

Job Analysis in Practice

Considering the legal impetus and human resource management applications described above, the need to perform a thorough job analysis is undoubtedly important. However, little agreement exists on the best approach organizations should take when conducting job analyses. Over the past 60 years, Industrial-Organizational Psychologists and Human Resource Management professionals have taken several different approaches to job analysis with varying levels of success. Considering the advantages and disadvantages of each technique, the SkillsNET® method discussed shortly integrates the best features of prior approaches to job analysis. This innovative approach enables organizations to efficiently collect job analysis data and apply it across the spectrum of Human Resource Management applications. Descriptions of traditional job analysis techniques incorporated into the SkillsNET method are given below:

- **Documentation.** Documentation of existing information from previous job analysis, job descriptions, performance evaluations, work logs, and training and equipment manuals usually serves as the starting point for job analysis. Using existing documentation lowers the cost of the job analysis and allows for inclusion of previously-validated information. However, job analysis should not rely solely on existing information because it is unlikely that prior information is current and valid. In general, initial documentation should be collected from recent sources and the job data then analyzed by job incumbents.

- **Observation.** In this method, the analyst watches the employee perform the work and simultaneously interviews them. This information may be used to develop job descriptions, performance evaluations, or training manuals. With observation, the job analysis gains acceptance and credibility among job incumbents and supervisors. However, observation is not suitable for all jobs, such as those requiring a great deal of cognitive activity. Additionally, this method may require a significant period of time, and the presence of an observer may affect the incumbent's work behaviors.

- **Interviews.** In addition to or in place of observation, job analysis can be conducted by interviewing Subject Matter Experts (SMEs). Interviews are used in many job analysis methods, but are most effective when collecting information about the work (Gael 1990b; Brannick & Levine, 2002). While a large amount of information may be collected from interviews, the job incumbent may fear evaluation of their performance rather than collection of job information. As a result, the analyst must take care to explain the purpose of the interview and how the information will be used.

- **Ability Requirement Scales (ARS).** This method evaluates the characteristics the worker must have to perform the job (Fleishman & Mumford, 1988), focusing on a standardized list of 52 abilities categorized as cognitive, psychomotor, physical, or sensory/perceptual. The ARS method provides limited knowledge, skill, or task data for a given position, but is easy to administer at a low cost (Fleishman & Mumford, 1989).

- **Position Analysis Questionnaire (PAQ).** This method utilizes a structured questionnaire that assumes commonality across jobs (McCormick, 1976) and offers a broad explanation of necessary job behaviors. The PAQ may be used across a wide range of jobs as well as across time even though tasks, technologies and duties may change. The PAQ is more worker-oriented than other methods because it focuses on individual performance necessities involved in job behavior. The PAQ is standardized, facilitating direct comparisons of work elements across jobs, and requires a relatively brief period of time to complete. However, the PAQ has been criticized for its high required reading level and its lack of job-specific information, limiting its use across human resource management functions.

- **Critical Incident Technique.** This work-oriented method is used to analyze job content by asking Subject Matter Experts (SMEs) to recall specific instances of exceptional or unacceptable work behavior. Three requirements of a critical incident include 1) the context that led to the behavior, 2) the behavior itself, and 3) the consequences of the behavior (Wagner, 1951; Flanagan, 1954; Bownas & Bernardin, 1988; Brannick & Levine, 2002). This approach has high versatility in its use, but is most frequently used in performance appraisal, training design, and selection. Critical incidents provide a great deal of job information and are effective in differentiating exceptional from poor performance. However, this technique does not include standardized information about worker knowledge, skills, and abilities.

- **Functional Job Analysis (FJA)**. Functional Job Analysis (FJA) is a structured process that involves analysis of the worker, the work, and the worksite through interviews (Fine, 1989). This technique provides two forms of information: 1) the procedures used as the job is being performed, and 2) the physical, mental or interpersonal contributions of the worker. Using this method, task statements are developed through documentation and panel discussions. This method can be applied in job description, selection, reasonable accommodation, job and training design, and performance appraisal. FJA is attractive because it produces standardized task statements and describes job content and context. However, this method is time-consuming and costly, and does not produce any information on worker knowledge, skills, and abilities.

- **Task Inventories.** Task inventories begin by interviewing SMEs to identify activities required to perform a job. Additionally, the analyst may collect information from preexisting documentation that may assist in identifying job tasks. Once task statements are created and classified into job duties, SMEs are surveyed to gain more information about the job (Sanchez & Levine, 1989). The survey prompts respondents to rate tasks using scales such as degree of involvement, time spent on the task, task importance, criticality, or difficulty to learn. While this method provides good task information, it does not produce standardized information about worker knowledge, skills, and abilities.

Although each of the approaches described above has utility in specific human resource management applications, no single approach has found wide usage across a number of diverse applications. Largely, this limitation stems from the fact that these prior approaches gather information only about what work is performed on the job (e.g., tasks) or the attributes (e.g., knowledge, skills, and abilities) workers need to successfully perform the job. However, none of these techniques combined both inductive and deductive approaches to capture information about the work and the worker. This began to change in the mid-1990s when the U.S. Department of Labor developed the Occupational Information Network, or O*NET. This system would become

the new national standard for describing occupational work, and plays a significant role in the SkillsNET method of job analysis.

*The Occupational Information Network (O*NET): Combining the Approaches*

Designed to replace the Dictionary of Occupational Titles (DOT), O*NET uses multiple standardized descriptors to provide both work- and worker-oriented "windows" into the world of work, a common language for describing different jobs, and an efficient taxonomy to classify job information (Dye & Silver, 1999). The six broad content areas of the O*NET model include both work- and worker-oriented approaches for collecting job analysis information (Campion, Morgeson & Mayfield, 1999; Mumford & Peterson, 1999). Work-oriented information is found in occupational requirements (e.g., Generalized Work Activities, work context, organizational context), occupation-specific requirements (occupational skills, knowledge, tasks, duties, machines and equipment), and occupation characteristics (e.g., labor market information, occupational outlook, wages) domains. Likewise, worker-oriented information is found in experience requirements (e.g., training, experience, licensures), worker requirements (e.g., skills, knowledge, education), and worker characteristics (e.g., abilities, occupational values and interests, work styles) domains (Peterson, Mumford, Borman, Jeanneret & Fleishman, 1999; Peterson et al., 2001).

Taken as a whole, O*NET represents one of the most comprehensive approaches to job analysis offered to date. By collecting information about both the work and the worker, this system provides a rich database of information that analysts may use as a starting point for conducting job analysis (Peterson et al., 2001). However, to ensure that its information applies across many different organizations, O*NET uses very broad and general descriptors about work and workers. In addition, as this system relies on task information to describe work, O*NET's tasks must be continually updated to account for fast-paced technological and other changes that render previous job content obsolete. Therefore, although O*NET provides a comprehensive starting point, it does not replace the need for organizations to conduct thorough job analysis to make strategic human resource management decisions.

Taken as a whole, many different approaches have been developed for conducting a formal and systematic job analysis. These approaches may focus on either the work or the worker, and may be based either on the inductive collection of new job information or deduced from previously collected information. O*NET provides a promising alternative by combining both inductive and deductive approaches to capture both work- and worker-oriented information. However, even with the advent of O*NET, traditional job analysis techniques still suffer from a number of problems. A few of these issues are listed below:

- **Speed of Obsolescence.** When the basic units of a job change, information for that job must be updated. Using traditional job analysis techniques, tasks represent the basic unit of information. However, in the increasingly rapid world of work, job tasks are continually changing to meet updated technologies, organizational structure, and other demand signals. When these changes occur, prior task-centric information becomes obsolete quickly, and new job analysis must be conducted to update job information.

- **Rigor.** Because jobs are dynamic, job analysis information cannot be viewed as static or permanent. Rather, continuous revisions are needed to update previous job analyses. Under most circumstances, this requires that completely new job analyses be conducted each time significant changes (e.g., technological changes, increased or decreased responsibilities) occur within the job.

- **Rigidity.** Another limitation of traditional techniques is their rigidity to the unique needs of various organizations. Specifically, these methods typically use a single point of input (e.g., job incumbents or supervisors) and lack systems of checks and balances as well as

flexibility to the demands of specific jobs (e.g., personnel working from remote locations). In addition, these techniques are typically chosen to meet short-term needs of a specific human resource management application rather than a strategic, long-term approach to accomplishing multiple organizational goals.

- **Resource Needs.** Almost regardless of technique, traditional job analysis requires significant investment by the organization. Specifically, numerous personnel may be taken away from their work to provide input into the job analysis process. In addition, the process itself may take months (or in some cases over a year) to complete. These requirements make traditional job analysis extremely resource intensive in terms of the organization's time, personnel, materials, and finances.

Based on these limitations, it is clear that a new and innovative job analysis technique is needed that capitalizes on the strengths of O*NET and other traditional approaches while avoiding the typical pitfalls of occupational study (Sanchez & Levine, 1999). As O*NET represents the national standard for describing work, this system should be incorporated to provide a crosswalk to the Department of Labor's rich database of job data. Working in close collaboration with some of the original developers of the O*NET model, SkillsNET has developed just such a system in its web-based SkillObject Designer® application. This ground-breaking job analysis technique starts with a new basic unit of job information – the SkillObject®.

SkillsNET's Revolution in Job Analysis: The SkillObject

The SkillObject represents a proven alternative unit of job information to task- and competency-based job analysis techniques. Using task-based job analysis methods, jobs may contain anywhere from one to two hundred tasks, each becoming obsolete with increasing speed as technology and other aspects of work evolve. However, tasks still remain the most specific level of meaningful job behavior. On the other hand, using competency-based job analysis, analysts find jobs comprising just a handful of very broadly defined competencies. Although useful for making comparisons across jobs, these competencies lack flexibility for application in making a number of diverse personnel decisions at the job level. Nevertheless, because of their applicability in making cross-job comparisons, the world of work is moving towards the efficiency of broader competency models. Based on these observations, it is clear that what is needed is a bridge between the granular nature of tasks and the broad nature of competencies – a unit of job information that provides a crosswalk between levels of interpretation. The SkillObject provides just such a crosswalk. But what is a SkillObject?

SkillObjects® represent the future of providing organizations with the information required to make strategic human resource management decisions.

> ***SkillObjects are measurable, detailed descriptions of occupational skills that people do in accomplishing work. A SkillObject consists of the logically clustered skills, abilities, tools, unique knowledge, resources, tasks (2-10), and performance standards that are performed, trained, or evaluated together in a job and required to successfully perform the job.***

Defining SkillObjects as given above, SkillsNET draws from the best features of work- and worker-oriented approaches to job analysis. By clustering together job tasks that are ***performed, trained,* or *evaluated together***, as well as the tools and resources required to support those tasks, SkillObjects define the scope of work for the job. Likewise, by grouping the unique knowledge, skills, abilities, and performance standards required to successfully perform those job tasks, SkillObjects cover the underlying worker attributes required for successful job performance. Taken together, SkillObjects define the worker's required "occupational skills" for successful job

performance as well as how those skills are applied in various job tasks (James, Reiter-Palmon, Strange & Young, 2005). The SkillObject classification system takes into account that the whole of a job is greater than the sum of its parts, and ensures that information obtained through job analysis is viewed in context of other job elements. Thus, the SkillObject provides organizations with significant insight into the job and greater appreciation of what that job truly entails. With a new basic unit of job information, SkillsNET has found an innovative solution to the speed of obsolescence issue characterizing task-centric job analyses. Specifically, rather than completing a whole new job analysis whenever tasks change, organizations can now make simple modifications to one or a few SkillObject elements. However, to truly revolutionize job analysis, organizations should be able to capture SkillObjects in a manner that addresses the "3R" problems previously described – Rigor, Rigidity, and Resource Needs. SkillObject Designer, SkillsNET's web-based job analysis application, does just that.

SkillObject Designer: The Future of Web-Based Job Analysis is Now

In the development of SkillObject Designer, SkillsNET capitalized on the best features of prior inductive and deductive job analysis approaches, particularly O*NET, to capture information on both the work and the worker. Specifically, SkillObject Designer incorporates the skill, ability, and Generalized Work Activity (GWA) taxonomies from O*NET to collect standardized information that may be used to make direct comparisons across jobs.

With SkillObject Designer, fewer of the organization's personnel, time, material, and financial resources are needed in the long term as compared to the resource demands imposed by traditional job analysis techniques. Specifically, resource requirements using SkillObject Designer are intensive during the initial collection and validation of a job's SkillObjects. Once the job has been defined, however, the need for these resources decreases significantly as a function of data maintenance. These resource benefits enhance the organization's overall productivity by eliminating work interruptions, keeping personnel busy in their jobs instead of in job analysis efforts. In addition, SkillsNET personnel actively participate in the job analysis to decrease the organization's resource burden. Overall, seven key personnel are required during the SkillObject development process:

- **Job Incumbent.** An individual currently holding an indicated job or position.
- **Strategic Task Analysis Representative (STAR).** An individual chosen to define the work they perform and necessary worker attributes for the job being analyzed. A STAR should be a job incumbent recognized as performing in the top 1/3 in their peer group. STARs should also provide representation across all aspects of the job, including difficulty levels, demographic characteristics, and geographic areas.
- **Manager/Supervisor.** An individual controlling or directing the affairs of the business.
- **Reviewer.** An individual who has breadth of knowledge and experience regarding the job being analyzed. Reviewers should be recognized leaders in their field and have been nominated by others to represent the job. Typically, reviewers are supervisors of those performing the job being analyzed.
- **Skills Analyst.** An individual from SkillsNET or the client organization who has experience, understanding, and certification in aspects of job classification, skill definitions and standards, and job analysis. This individual may be a trained and certified employee of the client organization, or an Industrial-Organizational Psychologist, Organizational Development Specialist, or HRD Specialist working for SkillsNET (Brown, Sandall, Osburn, Manning & Dera, 2004).

- **Senior Skills Analyst.** An Industrial-Organizational Psychologist, Organizational Development Specialist, HRD Specialist, or established skills researcher working for SkillsNET who provides oversight to all aspects of data collection, validation, and usage.

- **Skills Compliance Officer (SCO).** A recognized skills researcher working at SkillsNET who interfaces with the client to audit the manner with which the data is collected and utilized. The SCO maintains the integrity of the SkillObject data to ensure proper application in making strategic human resource management decisions.

Personnel from each group provide input as the job moves through various stages of SkillObject Designer. This sequence of inputs was designed to allow top performing job incumbents (STARs) to define the job up front. However, as a means of checks and balances, skills analysts, supervisors, other job incumbents, and managers also provide their inputs to the job. This system of checks and balances increases the buy-in of personnel in the client organization and decreases the likelihood that potential biases of any group will overly influence job information. In this manner, SkillObject Designer shares a feature in common with 360° feedback systems because the job is ultimately defined by a combination of inputs from multiple perspectives.
As previously described, the stages involved in SkillObject development afford STARs the most input into how the job is defined. Specifically, STARs define work elements (e.g., tasks, tools, unique knowledge, resources) that comprise the job, and later organize these elements into SkillObjects. Although multiple personnel provide recommendations to the job content, these recommendations are made against a baseline of job data provided by STARs. For more information on the SkillObject development process, the stages of SkillObject Designer are given below:

- **Work Element Generation (WEG).** Multiple STARs audit legacy tasks, tools, unique knowledge, and resources (from O*NET, prior job analyses, National SkillObject Library®, Global Skills Content Library™, other sources) and generate new work elements using O*NET Generalized Work Activities (GWAs) as queuing mechanisms to stimulate thought.

- **Work Element Editing (WEE).** One skills analyst edits the tasks, tools, unique knowledge, and resources created in Work Element Generation to remove redundancies and errors and ensure that work elements follow SkillsNET business rules and principles of Industrial-Organizational Psychology.

- **Work Element Review (WER).** Multiple reviewers examine the edited task, tool, unique knowledge, and resource lists and provide recommendations for further additions, modifications, or deletions to those work elements.

- **Work Element Finalization (WEF).** One skills analyst reviews the recommendations made in Work Element Review and incorporates appropriate revisions into the final task, tool, unique knowledge, and resource lists.

- **Task-to-Skill & Task-to-Ability Linkage.** One skills analysts makes linkages between job tasks and O*NET skills and abilities to define worker attributes needed to successfully perform job tasks. Each job task may be linked to up to two skills and two abilities.

- **Online Task, Tool, and Unique Knowledge Survey.** A sample of job incumbents rates work elements on a variety of customizable rating scales selected by the client organization. This stage is vital for validating work elements and obtaining normative data for how those work elements exist in the job.

- **Online Skill & Ability Survey.** A sample of job incumbents rates the level of skill and ability required to successfully complete job tasks. These data may then be combined to define overall skill and ability proficiencies required for successful job performance. This information provides valuable insight into the worker attributes needed for successful job performance.

- **SkillObject Generation (SOG).** One STAR groups validated tasks, tools, unique knowledge, and resources into SkillObjects, based on the tasks that are performed, trained, or evaluated together and the work elements required to support performance of those tasks.

- **SkillObject Editing (SOE).** One skills analyst reviews and edits the job's SkillObjects to ensure that the job data conform to SkillsNET business rules for development and formatting of SkillObjects.

- **Critical Work Function Entry.** One manager defines the broadest and most essential ongoing responsibilities of the job.

- **SkillObject – Critical Work Function Linkage.** Once the manager defines the Critical Work Functions for the job, he or she links each Critical Work Function to the SkillObject(s) that help support it.

With SkillObject Designer, organizations can capture job information more efficiently than previously thought possible. Rather than taking months or years to collect usable job information, organizations can put that information to work in making strategic personnel decisions in weeks or even days. SkillObject Designer also provides an innovative solution for the toil of rigor imposed by other job analysis methods. Rather than trudging through the full rigor of a new job analysis each time changes occur in the job, organizations complete the full scientific rigor *once* to define the job's SkillObjects, and may continuously and easily update the job data thereafter. For example, instead of completing a new task-centric job analysis when a new computer system is introduced in the job, the organization can simply make minor modifications to a few SkillObject elements to reflect changes in job tasks and tools. As SkillObjects become obsolete much more slowly than tasks, the need to revise job analysis data occurs much less frequently. This benefit of SkillObject Designer increases the longevity of the job analysis in making downstream human resource management decisions.

SkillObject Designer also represents a significantly more flexible approach to job analysis than traditional techniques. The most flexible feature of this approach is the online medium used to collect, survey, and maintain the data. Because the application itself is web-based, organizations may tailor the job analysis to their specific needs, having personnel define jobs at their desks, at proctored sessions conducted by SkillsNET skills analysts, or in distributed collection from home or any other location with Internet access. In fact, SkillsNET can train personnel from the client organization to conduct the job analysis internally in collaboration with SkillsNET skills analysts. Regardless of the chosen method, all SkillObject Designer efforts are supported by SkillsNET's expert skills analysts and help desk support, available 24/7.

In a related vein, SkillObject Designer is intended to capture the inputs provided by multiple STARs and reviewers, and aggregate those inputs into an integrated picture of the job. By allowing multiple STARs to define the job using independently chosen Generalized Work Activities to stimulate thought, SkillObject Designer obtains different perspectives of the job from each STAR. Likewise, allowing multiple reviewers to provide recommendations for change ensures that alterations to job data conform to similar recommendations made by multiple reviewers.

SkillObject Designer represents a significant and innovative step forward in collecting job analysis data and using that information to make strategic human resource management decisions.

By incorporating best features of O*NET and other traditional job analysis techniques, SkillObject Designer provides a crosswalk to rich databases of jobs defined using other techniques. SkillObject Designer also addresses the problems of rigor and resource needs by requiring maximum participation only in the initial collection and validation of a job's SkillObjects. Also, as captured in SkillObjects, job data are guarded against obsolescence as rapid changes occur within the job. The web-based medium of SkillObject Designer provides a number of flexible data collection options and a system of checks and balances for the organization during the job analysis process. Taken as a whole, SkillObject Designer represents a more efficient, effective, and flexible alternative to traditional job analysis techniques for capturing reliable, valid, and legally defensible job information. Finally, unlike traditional job analysis techniques, information captured using this system may be readily applied across a range of human resource management applications.

Strategic Applications of Job Information Captured Using SkillObject Designer

As a means of collecting job information, SkillObject Designer represents a significant and innovative step forward. However, the advantages of the SkillsNET method do not stop at collected and validated job data. Instead, job information collected using SkillObject Designer may be used to make strategic decisions across a number of human resource management domains. Eight such applications previously described are revisited below to illustrate the utility of job information captured using SkillObject Designer:

- **Recruiting & Selection.** By building SkillObjects, organizations can identify the appropriate knowledge, skills, and abilities required to perform the job effectively. These data also allow organizations to assess lateral points of entry based on associated SkillObjects. Data captured in SkillObject Designer ensure that selection tests cover critical job tasks, facilitating selection of "the right person for the right place at the right time."

- **Capacity Planning.** Through the development of SkillObjects, organizations can identify occupational skills most critical to the organization's strategy. With these SkillObjects in mind, the organization may build its capacity of these critical skills, increasing overall performance.

- **Training & Development.** By collecting SkillObject data, organizations can define training requirements in terms of occupational skills and how those skills are manifested in the job. SkillObject data may also be used to identify performance gaps where training is needed.

- **Personnel Alignment.** By assessing employees' proficiencies in demonstrating various SkillObjects associated with their own or others' jobs, organizations may make appropriate personnel assignments to match workers to jobs consistent with their proficiencies.

- **Promotion.** By building SkillObjects for multiple jobs, organizations can identify knowledge, skills, and abilities required to perform each job, and may sequence the levels of these attributes necessary to achieve promotions. Data captured in SkillObject Designer can help organizations develop promotion tests that cover critical job tasks and worker attributes.

- **Retention.** By strategically linking bonuses and other benefit increases to SkillObjects and associated proficiencies, organizations may increase their ability to not only attract, but retain a highly skilled workforce.

- **Staffing.** Using SkillObject Designer, organizations may enhance their staffing decisions by defining occupational skills associated with a job. This enhanced organizational staffing may, in turn, facilitate more effective workforce planning initiatives.

- **Career Structuring.** Collecting SkillObject data allows employees and management to collaboratively develop career structures. As SkillObjects provide standardized descriptions of positions, these data may be used to develop career plans, organize progression pathways, and manage multiple career bands.

As these examples illustrate, job information captured using SkillObject Designer may be applied across the spectrum of administrative and developmental human resource management domains. During all phases of these efforts, SkillsNET works in collaboration with clients to determine what data serves specific needs and tailor collection and analysis efforts to serve those needs. Many of these needs are served in the development of SkillObjects for specific jobs. However, client needs may require further data processing in other applications to arrive at meaningful conclusions. To help reach these conclusions, SkillsNET offers other web-based applications in a comprehensive suite of job tools.

Further SkillsNET Applications of SkillObject Data for Strategic Client Needs

Once an organization collects and validates SkillObjects for a job, that data may be used in several other SkillsNET analyses and applications. These applications share many of the same advantages as SkillObject Designer (e.g., flexible, available 24/7, efficient, web-based), and may be used to address a number of strategic human resource management needs. Some of these applications require further participation from job incumbents to gather data to be used in making personnel decisions. Other applications, on the other hand, are available to address specific human resource management issues with no further input from job incumbents. The only factor that may limit the analyses and applications available to the client is the type of data collected in the survey portion of the job analysis. These SkillsNET analyses and applications are discussed here:

- **Statistical Analyses and Reports.** Several types of statistical analyses can be conducted based on survey results from SkillObject Designer. Of course, these analyses depend on the data elements surveyed and the rating scales chosen for each data element. A few of these analysis packages and reports include the following:

    - **Basic Statistical Reports.** The most basic statistical reports available present normative data, containing the original survey results and descriptive statistics. SkillsNET can also provide SkillObject reports for each job analyzed. This report includes all SkillObject data for each job analyzed. These types of reports may be customized by client request.

    - **Metrics.** SkillsNET data metrics represent a concise and sophisticated approach to analyzing data to meet the needs of human resource professionals. Each metric applies quantitative and qualitative data in mathematical formulas to answer workforce analysis questions. These metrics make the effective use of job analysis data less cumbersome and more efficient and practical, providing a method of conducting complicated analyses at a lower to the customer.

    - **Cluster Analyses & Commonality Studies.** Cluster analyses use a metric developed by SkillsNET to group similar tasks together. This allows the client to view tasks that may be performed or trained together. Commonality studies use similar formulas to look across levels of data to

determine the percentage of data common across levels. These analyses may assist in training, reduction of learning curves, and identification of jobs that may be merged.

- **SkillObject Mapper™.** SkillObject Mapper measures employee capabilities and experience in demonstrating SkillObjects and using SkillObject elements. This allows organizations to determine strengths and weaknesses of employees and develop capabilities through training. Using SkillObject Mapper, each employee evaluates his or her capabilities in performing SkillObjects and using SkillObject elements. A direct supervisor also independently evaluates the employee's capabilities as he or she has observed them. Based on these ratings, SkillObject Mapper may be used to make decisions about training and development, transferability, eligibility for promotion, difficulty of replacement, and person-job fit.

- **Behavioral Based Interview™.** The Behavioral Based Interview application assists clients in developing, administering, and scoring structured selection interviews. These interviews assess candidate proficiencies in job-relevant skills as demonstrated in prior work, educational, and life contexts. This application also provides guidelines for administering structured interviews including tips and space for note-taking. In scoring, the Behavioral Based Interview application is linked to an online algorithm that simplifies and adds additional standardization and objectivity to the interviewing process.

- **Skills Yellow Pages™.** Skills Yellow Pages allows clients to search a database of employees by a number of criteria including demographic information, skills, abilities, experience, and other factors. Using this application, clients may locate personnel needed for positions or projects based on criteria of interest. Through systematic searches, Skills Yellow Pages allows the user to narrow the pool of potential candidates to an ideal group of employees suitable for the organization's needs.

- **Teaming Engine™.** The Teaming Engine application is a unique tool that allows an organization to define a project to be accomplished. The user then identifies the individual and ***team-based*** SkillObjects required to accomplish that work, and these SkillObjects are each assigned a weight for later staffing purposes. Finally, the user identifies system-level criteria required for the project. For example, if international work is required, system requirements may include international clearances and cultural awareness. Once all requirements are set, the application identifies employees that fit the project's needs. Based on these personnel, the user may select the most appropriate team for the project.

As these downstream applications of SkillObject data illustrate, SkillObject Designer opens a whole new world of efficient and effective human resource management to organizations. The benefits of SkillObject Designer do not stop with savings in resources and increases in flexibility for collecting job information. Instead, those benefits extend to solutions in other domains of human resource management including selection, training and development, gap analyses, job mergers, and identification of appropriate individuals and team personnel to meet the organization's specific needs. Rather than using multiple job analysis techniques and human resource management solutions to meet various short-term organizational goals, SkillsNET offers a comprehensive suite of integrated applications to solve diverse and long-term human resource management issues. However, none of these benefits are available until the organization steps out of the past of job analysis and takes the forward leap into SkillObject Designer.

Conclusion

Legal requirements compel organizations to make employment decisions based on job analysis information. When properly performed, job analysis also offers increased efficiency and effectiveness to human resource management practices and organizational performance. However, given the rigidity, narrow range of application, and variety of other problems (e.g., speed of task obsolescence, rigor, resource needs) characterizing traditional techniques, it comes as no surprise that organizations are often less than excited about investing in job analysis efforts.

With these facts in mind, SkillsNET set out to create a revolutionary new approach to job analysis that could avoid the pitfalls of traditional techniques. By building on the best features of previous approaches and incorporating standardized taxonomies from O*NET, SkillsNET created SkillObject Designer. The resulting web-based application offers clients an innovative job analysis method that is reliable, valid, and legally defensible while being – unlike traditional job analysis techniques – flexible, robust to job changes, cost-effective, resource-efficient, less rigorous, and more comprehensive. In fact, conducting job analysis using SkillObject Designer represents the foundation of an efficient and effective end-to-end human resource management architecture offered in SkillsNET's integrated suite of applications. Taken as a whole, these innovative, customizable web-based tools empower organizations to make well-informed employment decisions, increase overall performance, and ensure their future readiness to handle the demands of an ever-changing marketplace.

Glossary

Ability - See Enabling Ability.

Ability Linkage - The process of selecting the primary and/or secondary abilities from O*NET Taxonomy of Enabling Abilities to link to tasks.

Affective Traits - The area of human action which emphasizes the internalized processes such as emotion, feeling, interest, attitude, value, character development, and motivation.

Apprentice - A person working under the supervision of a mentor while learning a trade or skill. Apprentices normally have a basic knowledge of the trade, but lack the practical experience to perform proficiently on an independent basis.

Aptitude - A natural talent or ability. Alternatively, an individual's capacity to learn a particular skill.

Attribute - A characteristic of an individual or a thing.

Basic Skill - A developed capacity that facilitates learning or the more rapid acquisition of new knowledge, or facilitates conveying information to others. Basic Skills can be referred to as Learning Skills.

Behavior - An action or set of actions (often referred to as tasks) performed by a person under specified circumstances that reveal some skill, knowledge or attitude. Organizations seek to increase desirable behaviors or introduce new behaviors and/or eliminate undesirable ones.

Behavioral Anchors - A type of assessment in which scale points or values are descriptions of behavior; the placement of benchmark behaviors next to each point on a graphic rating scale; serve as authentication tools to document either proficiency or performance

Benchmarks - Statement of the minimum expectations of what the incumbent needs to know and do in order to make progress toward proficiency. Proficiency is determined by the setting of benchmark scores (referred to as proficiency benchmark).

Capability - The ability to achieve a desired outcome under specified conditions through the performance of a set of tasks.

Child Task - A task statement that is assigned to a Parent Task in the process of Work Element Editing. The child task is usually redundant to the parent task or has been combined with other child tasks to form the most appropriate parent statement to which it is assigned.

Cluster - A group of like cases or observations. Objects in a cluster are similar to each other. They are also dissimilar to objects outside the cluster, particularly objects in other clusters.

Cluster Analysis - A class of statistical techniques that classifies a set of observations into two or more groups based on combinations of variables.

Cognition - The act, power, or faculty of comprehending, knowing, or perceiving.

Cognitive Ability - An ability that influences the acquisition and application of knowledge in problem solving, reasoning, remembering, and understanding. Cognitive Abilities may sometimes be referred to as Mental Abilities.

Competence - Demonstrated performance and application of knowledge to perform a required skill or activity to a specific, predetermined standard.

Competency – A competency is a range of observable behaviors or outputs/outcomes that demonstrates the necessary skills, knowledge, abilities, and other characteristics needed to perform a work role/occupational function successfully. Competencies can be divided into two categories: enabling/foundational competencies and performance-based competencies.

Competency, Core - Fundamental/enabling skills, knowledge, and personal attributes that contribute to an individual's success in accomplishing the organization's mission.

Competency, Cross-Functional - Applicable to multiple functions. Competencies that are important for many positions/roles, organized into categories and cut across traditional organizational lines.

Competency, Specialty - Important for specific assignments. All areas (operations or support) may identify the skills that are critical for their function. Context related.

Complexity - The level of difficulty in performing a task.

Condition for Performance - Description of the conditions in which performance must take place.

Construct Validity - Involves identifying the psychological trait which underlies successful performance on the job, then devising a selection procedure to measure the presence and degree of the trait.

Content Bias - Disproportionate representation of topics and terms within a test.

Content Validity - The degree to which a selection procedure is tied to the domain it intends to measure.

Core Performance Area - A feature or distinctive part of the duties or activities in a particular job.

Core Work - The unique, essential components of a job needed to complete work.

Criterion-Related Validity - The extent to which scores on a test are related to, or predict, some criterion. Criterion-related validity is used to establish a statistical relationship between selection procedures and measures of job performance.

Criticality - A rating scale that is often used in normative surveys of tasks, tools, unique knowledge or resources. The importance of the performance of a task or other item to a job.

Critical Task - A task requiring human performance which, if not accomplished in accordance with position requirements, will most likely have adverse effects on cost, reliability, efficiency, effectiveness, or safety. A task is also considered critical whenever equipment design characteristics demand human performance which approaches the limits of human capabilities.

Critical Work Function (CWF) - A major responsibility that an individual must fulfill in order to achieve the work required for a job/role. The CWF will directly meet a business need or the mission of the organization.

Cross-Functional Skill - A developed capacity that facilitates performance of activities that occur across jobs. Cross-Functional Skills can be referred to as Performance Skills.

Dendogram - A visual tree diagram of the steps in a hierarchical cluster analysis; often used to represent the results of a cluster analysis. Dendograms can be used to visually assess the cohesiveness of the clusters formed and can provide information about the appropriate number of clusters to keep.

Difficulty - A rating scale that is often used in normative surveys of tasks, tools, unique knowledge or resources. The time, effort and assistance required to achieve proficiency of the task or other item.

Dimension - A mechanism used to group data for ease of understanding or used to cue users to consider varying aspects of their job.

Duration - A rating scale that is often used in normative surveys of tasks, tools, unique knowledge or resources. The length of time it takes to complete a task or other item.

Duty - A set of operationally-related tasks within a given job. It is a logical grouping representing one of the major subdivisions of a job and indicates one of the jobs incumbent's main functions.

Education - Education encompasses teaching and learning general and specific skills and the less tangible, i.e. the imparting of knowledge, good judgment and wisdom.

Enabling Ability - Enduring attribute of the individual that influences performance and enables performance of tasks. Enabling Abilities are drawn from a list of 52 enabling abilities in the O*NET taxonomy.

Enabling Skill - Developed capacity that facilitates learning, more rapid acquisition of knowledge, or that facilitates performance of Skills and Competencies. Enabling Skills are drawn from a list of 46 enabling skills in the O*NET taxonomy

Equal Opportunity Employment (EEO) - EEO is a collection of laws, policies, and programs designed to affirm or provide equal access to initial employment and to occupational, benefits, promotions, and other opportunities during employment.

Factor Analysis - An analytical procedure that can be used for identifying the number and nature of constructs underlying a set of measures.

Frequency - A rating scale that is often used in normative surveys of tasks, tools, unique knowledge or resources. The number of times per work period that a task or other item is performed.

Generalized Work Activity (GWA) - Broad categories of work used as a cueing mechanism to generate task statements and identify Knowledge, Skill, and Ability requirements. GWAs are drawn from a list of 42 Generalized Work Activities in the O*NET taxonomy.

Group Factor - A factor that has high loadings with two or more but not all measures or tests. Alternatively: A tool utilized to review normative survey responses indicating percent performance for a task by pay grade to determine at what pay grade a task should be deemed an Occupational Standard.

Hierarchical Cluster Analysis - A statistical procedure used to analyze groupings within data, simultaneously over a variety of scales, by creating a cluster tree. The tree is not a single set of clusters, but rather a multilevel hierarchy, where clusters at one level are joined as clusters at the next higher level. This allows you to decide what level or scale of clustering is most appropriate in your application.

Human Factors Engineering - The systems engineering discipline that addresses integration of human characteristics, capabilities and limitations into system definition, design, development and evaluation to optimize human-machine performance under operational conditions.

Importance - A rating scale that is often used in normative surveys of tasks, tools, unique knowledge or resources. The criticality of performing a task or other item correctly in terms of safety or mission accomplishment.

Incentive - A plan or program that incites or has a tendency to incite desired behavior or action on the part of individuals or groups of individuals.

Interoperability - A term used to describe the ability of different standard-based systems to work together, facilitating exchange of assets across the organization and improving capability, capacity and agility to meet changing performance requirements.

Inter-rater Reliability -The degree of consistency between two or more raters (individuals) in scoring or responding to an item.

Intervention - An action taken to change a behavior or situation. Interventions may or may not include training as well as other human resource related solutions that impact performance.

Job - The total collection of occupational skills, tasks, duties, and responsibilities assigned to one or more positions which require work of the same nature and level.

Job Analysis - The standardized process that examines a specific job to identify all responsibilities and task requirements of a job in an organization. It is a standardized, systematic procedure used by Industrial-Organizational Psychologists, Human Resource, or Personnel Managers to examine a specific job to identify and describe responsibilities and task requirements of the job, regardless of the person in the job.

Job Context - The environments, attributes and variables that make a job unique at its lower levels.

Job Incumbent - A person holding an indicated job or position.

Journeyman - A person considered experienced and competent who has proven practical proficiency in all areas of a trade or skill and completed all apprenticeship requirements. The individual would be expected to perform work independently and mentor apprentices with limited supervision.

K-Means Analysis - A procedure that attempts to identify relatively homogeneous groups of cases based on selected characteristics, using an algorithm that can handle large numbers of cases. However, the algorithm requires you to specify the number of clusters.

Knowledge - See Unique Knowledge.

Knowledge Library - A collection of Unique Knowledge names utilized in performing a job.

KSAT Relationship - The associated set of knowledge, skills, abilities, and tools required to perform given work tasks or sets of tasks.

Legacy Knowledge - A set of Unique Knowledge that has previously been defined for another job. The legacy knowledge is utilized as a starting point for development of Unique Knowledge for the job being analyzed.

Legacy Resources - A set of resources that has previously been defined for another job. The legacy resources are utilized as a starting point for development of Resources for the job being analyzed.

Legacy Tasks - A set of task statements that has previously been defined for another job. The legacy tasks are utilized as a starting point for development of Tasks for the job being analyzed. Legacy tasks could come from many different sources such as: the Global Skills Content Library, data from previous client job analysis, tasks extracted from existing training or educational curriculum, or other sources.

Legacy Tools - A set of tools that has previously been defined for another job. The legacy tools are utilized as a starting point for development of Tools for the job being analyzed.

Master - A person considered to have mastered a trade or skill who is an overseer, foreman, or employer. A worker qualified to teach apprentices and carry on the craft independently.

Measures - Standard evaluations derived from specific benchmarked requirements (e.g. time, accuracy, precision, etc.)

Modernization - Process in the data life cycle to assure data elements are current, accurate and properly represent the appropriate domain.

O*NET - A common-language taxonomy for identifying and organizing occupational requirements developed by the U.S. Department of Labor to replace the Dictionary of Occupational Titles.

Object Modifier - Words used to clarify, amplify, or further describe the object of a task.

Occupational Data - Data associated with a job.

Outsource - To utilize an external source to execute work associated with all or part of a process. Outsourcing generally indicates that the organization has made a tactical or strategic decision to divest itself of the work being performed by the contractor. The work divestiture also indicates that the corresponding skill requirements no longer fall within the organization's strategic future. Contract providers will have to acquire, grow, and maintain the requisite skills to ensure they are able to perform the functions when measured against a prescribed delivery standard.

Parent Task - Final task statements from the Work Element Editing process that have been edited for clarity, correct grammar and spelling used for SkillObject development. The parent task can be created from one or more Children Tasks from the Work Element Generation process that have a similar intent or wording.

Performance - The act of doing something successfully; using knowledge or ability as distinguished from merely possessing it (proficiency); how well a person, team, unit or organization is meeting the work expectations; experience generally improves performance.

Performance Level - The level of performance achieved by the person performing the item. Performance levels are measured against performance standards and requirements.

Performance Standard - The measurable demonstrated behavior required to complete a task.

Personality - The underlying traits, temperaments, attributes, and disposition of individuals that drive behavior and responses to given situations.

Physical Ability - An ability that influences the strength, endurance, flexibility, balance and coordination. Physical abilities may sometimes be referred to as Physical Movement Abilities.

Primary Ability - The foremost enabling ability needed to perform a task.

Primary Skill - The foremost enabling skill needed to perform a task.

Proficiency - Ability to perform a specific behavior (e.g., task, learning objective) to the established performance standard in order to demonstrate mastery of the behavior. This refers to how much of a particular capability a person must have to be successful in his/her work. It is the degree of mastery of a skill or area of knowledge.

Promotion - The advancement of personnel to a higher position requiring greater technical ability, managerial ability or leadership skills.

Psychomotor Ability - An ability that influences the capacity to manipulate and control objects. Psychomotor abilities may sometimes be referred to as Physical Manipulation Abilities.

Rating Scale - A measure based on descriptive words or phrases that indicate a rater's estimate of the value of the thing being rated. Rating scales are frequently used to indicate information about an item within a job or about required performance levels. The scale may be used with rubrics or descriptions of each response value for the rating scale.

Readiness Analysis - Readiness Analysis is direct comparison of required proficiency levels of the work against the rated proficiency levels of the persons performing the work. The result of the differences can be used as an indicator of readiness. This process can also be used for training needs analysis and person to position matching algorithms that need to be skills based.

Refresh – See Modernization.

Reliability - Reliability refers to the extent to which a process or a result can be replicated. A reliable job analysis procedure is one that provides essentially the same information; 1) when it is applied to the same job by another job specialist; 2) when it relies on a different sample of job experts; or 3) when it is applied at a different time.

Representative Sample - Any subset of persons or items selected to represent a larger group or population that has the same inclinations as the total group or population with reference to some characteristic or characteristics.

Resource - Informational source or reference material used to locate information or that houses information about processes. Resources include items such as manuals, publications, guides, handbooks, instructions, tutorials, documents, reports, forms, blueprints, plans, specifications, codes (e.g. National Electrical Code), regulations, etc. Other examples are case law books, Ships Manning Documents, Engineering Operating Sequencing System.

Resource Library - A collection of resources referred to in order to perform the occupational skills for a job or to create the SkillObjects describing the work performed in the job.

Reviewer - An individual who has breadth of knowledge and experience regarding the job. Must be a recognized leader in their field and have been nominated by career panels, technical training review panels, and/or industry partnership management. Typically, Reviewers are supervisors of those performing the job being analyzed.

Science of Learning (SL) - The theories, technologies, and best practices that contribute to society's understanding of what learning is, how adults learn, and how that learning translates into actual job performance. Data from the fields of educational, organizational, industrial and behavioral psychology are the bases of SL, along with analytical methods covering cognition, sociology, and instructional design, performance and human factors engineering information.

This body of knowledge will be considered during training analyses and will be the basis for making training system recommendations and decisions.

Secondary Skill - A skill that is less important than or subordinate to a primary skill in enabling the performance of a task.

Senior Skills Analyst - An Industrial-Organizational Psychologist, Organizational Development Specialist, or established skills researcher who oversees the work of Skills Analysts and helps define certain project scope, boundaries, and approaches.

Sensory Ability - The ability that influences visual, auditory and speech perception. Sensory abilities may sometimes be referred to as Sight and Sound Abilities.

Skill - See Enabling Skill.

Skill Linkage - The process of selecting the primary and/or secondary skills from O*NET Taxonomy of Enabling Skills to link to tasks.

Skills Management System (SMS) - A data repository of SkillObject data and Level II data, coordinated and grouped to represent the occupational skills data associated with work. The SMS also includes the SkillObject proficiency rating data associated with persons performing the work, and will house Level III data in a future implementation. This environment is the staging area to implement the new Human Capital deployment strategy.

Skills Analyst - An individual with experience, understanding, and certification in aspects of job classification, skill definitions/linkages, skill standards, and job analysis, who performs and manages the primary data collection efforts of the SkillObject development process. A Skills Analyst may be a layperson, and Industrial-Organizational psychologist, an organizational developmental specialist, a researcher, or HRD specialist. Skills Analysts must have completed the Skills Analyst Certification training course and practicum to achieve the status of Skills Analyst.

Skills Compliance Officer - The Skills Compliance Officer (SCO) interfaces with clients and those utilizing the SkillObject data and data elements to audit the manner in which the data are collected and utilized by the client. The SCO audits the integrity of the SkillObject data quarterly to ensure the data are not being used in an inappropriate manner.

SkillObject - A SkillObject is a measurable, detailed description of an occupational skill people perform in accomplishing work. A SkillObject consists of the logically clustered skills, abilities, tools, unique knowledge, resources, tasks (2-10), and performance standards that are performed, trained, or evaluated together in a job and are required to successfully perform the job.

SkillObject Data Element - A SkillObject data element is an element associated with a SkillObject that describes a portion of the work, such as a task, tool, unique knowledge, resource, skill, or ability.

SkillObject Designer (SOD) - An analysis product utilized too quickly and cheaply via a distributed web-based approach, capture work, worker, and workplace specific data that require legal defensibility. The SkillObject data are collected one time and then can be used for many strategic and administrative applications such as recruiting, hiring, retention, training design, training needs analysis, employee development, strategic growth and planning, pay banding, competency-based pay systems, best practices workout, and others.

SkillObject Editor (SOE) - Process used by the Skills Analyst to edit components of the SkillObject following SkillObject Generation.

SkillObject Generation (SOG) - Process used by each STAR to generate SkillObjects for a job, by grouping related task statements, tools, unique knowledge and resources.

SkillObject Mapper - An application used to determine observed proficiency levels for employees on the SkillObjects tools, unique knowledge, and resources of the SkillObjects. The outputs from SkillObject Mapper include a skill and knowledge gap analysis for each employee, aggregated skill and knowledge gaps for groups of employees, and learning target identifiers.

SkillObject Survey Tool - An online survey tool used to validate SkillObject data elements or to perform an organizational culture analysis, etc.

Standard for Performance - The standard to which the condition of performance is applied.

Standardization - Process in the data life cycle to standardize work element characteristics that have the same meaning but may be stated in different terms. Standardization also includes the classification and numbering of work elements.

STAR (Strategic Task Analysis Representative) - An individual chosen to generate tasks they perform in the job/occupation being examined. The individual should be currently working in the job on a daily basis (incumbent worker), and be a top 1/3 performer in their peer group. STARs should provide a good cross representation for all aspects of the job, difficulty levels, and geographic areas.

Statement Modifier - Words used to describe the purpose for the action in a task statement. The statement modifier clarifies and describes why the task is taking place.

Strategic Themes - Strategic Themes (ST) are large clusters/dimensions of work/processes essential to meet mission success

Subject Matter Expert (SME) - See STAR.

Survey - A statistical study that produces descriptive or analytical information for the analysis and interpretation of information about some aspect of study by asking pre-determined questions of members of the survey sample or population. Surveys are utilized in the SkillObject system to determine and validate the most important tasks, tools, unique knowledge, resources, skills and abilities that are required to perform the job.

Task Analysis - The processes by which the human, physical, and cognitive performance required to accomplish a unit of work within a job/position in accordance with performance requirements is recorded and analyzed. It may include, but not be limited to, task time, task accuracy, knowledge required, skill and ability required.

Task Statement - The most specific level of behavior in a job that describes the performance of a meaningful job function in terms of a specific action applied to a particular object. The behavior must be observable, have a definite beginning and end, and result in a completed work action or a measurable work product (either the performance can be observed or the results of the performance can be seen and measured). The task is composed of three basic elements: (1) an action verb which states what is to be accomplished in the task, (2) an object which identifies what is to be acted upon in the task, and (3) any qualifying phrases (in terms of an Object Modifier or a Statement Modifier) needed to distinguish the task from related or similar activities, limit and define the scope of the task, and clearly communicate the nature of the task.

Taxonomy - A set of controlled vocabulary terms, usually hierarchical, used primarily to provide a conceptual framework of the structure and content of a system, for discussion, analysis, or information retrieval. Elements of a group (taxon) within a taxonomy should be separated into

subgroups (taxa) that are mutually exclusive, unambiguous, and taken together, include all possibilities.

Tools/Equipment/Software/Devices - Tangible items such as tools, software, equipment, or devices that are required to perform the SkillObject in the course of their work. Typically, tools should require training to master their use.

Tool Library - A collection of tools referred to in order to perform the occupational skills for a job or to create the SkillObject describing the work performed in the job.

Training - Instruction which provides the learner with knowledge and skills required for immediate application in the accomplishment of a specific task or combination of tasks.

Training Analysis - Training analysis is a process that examines the gap between actual performance and desired performance; that is, the gap between prerequisite knowledge [e.g., enabling learning objectives] and performance standards [e.g., terminal learning objectives]. Training analysis is used to determine the content of training curriculum, when training should occur, and who should attend as learners.

Unique Knowledge - The enduring information, gained through experience or study, including processes, procedures, or intellectual capital that are not transitory or temporary, that are committed to memory and that are required to perform the tasks included in a SkillObject.

Unique Knowledge Library - A collection of unique knowledge referred to in order to perform the occupational skills for a job or to create the SkillObjects describing the work performed in the job.

Validity - Validity is the extent to which the analysis measures what it was designed to measure.

Work - Is an activity of group of activities designed and executed to achieve a given end or objective. Organizational work is executed under two unique workforce categories. The first category is “direct labor”. Direct labor represents the portion of work that is directly related to the actual “hands-on” production of the organizations goods, services, or products. The second category is “indirect labor”. Indirect labor represents the portion of work dedicated to supporting the production of the organizations goods, services, or products. From a Navy perspective, work falls into the Occupational and Organizational dimensions.

Work Context Survey - An optional survey module that identifies information about context in which a job is performed. There are eight dimensions covered in the survey covering areas such as communications, interactions with others, autonomy, work environment, health risks, and physical demands.

Work Element Editing (WEE) - The process utilized by a Skills Analyst to reduce and revise a list of tasks, tools, resources and unique knowledge for a given job to eliminate redundancy, clarify items so that they are understandable to others in the occupation, correct spelling and grammatical errors, and to reduce the size of the task, tool, resource and unique knowledge lists without losing important information.

Work Element Finalization (WEF) - The process utilized by a Skills Analyst in order to review the output from the Work Element Review process, in order to make corrections/additions/deletions, taking into account the Reviewer’s comments and suggestions.

Work Element Generation (WEG) - The process utilized by STARs to review legacy data elements and to generate quality task statements, tools, unique knowledge and resources to describe the job in which the STAR works.

Work Element Review (WER) - The process utilized by Reviewers to review the list of task statements, tools, unique knowledge and resources for a job to suggest clarifications, suggest removal of items, and suggest addition of items.

Workload Analysis - The measurement of the various demands, i.e. physical, mental, mechanical or financial, demands that occur while performing a task or combination of tasks.

Example SkillObject Report

Occupation: Secretary
Job Family: Business Administrative Support Occupations
Economic Sector: Business, Finance, and Management

SkillObject: Administrative Reporting

Tasks & Enabling Skills and Abilities

Communicate work progress and equipment problems to others
Primary Skill: Writing
Secondary Skill: Operation and Control
Primary Ability: Problem Sensitivity

Draft instructions for operation or repair of equipment
Primary Skill: Writing
Secondary Skill: Operation and Control
Primary Ability: Information Ordering

Draft reports on job procedures for future reference
Primary Skill: Writing
Secondary Skill: Information Organization
Primary Ability: Information Ordering

Enter work progress information into project database
Primary Skill: Writing
Secondary Skill: Operation and Control
Primary Ability: Wrist-Finger Speed

Update equipment manuals with any details or new information that is not already included in the manual
Primary Skill: Writing
Secondary Skill: Information Organization
Primary Ability: Information Ordering

Tools/Software/Equipment

Computerized maintenance management system
Microsoft Office Suite

Unique Knowledge

Equipment and maintenance manual layouts
Departmental filing procedures
OSHA safe job guidelines

Resources

Inventory status books
Log books
OSHA safe job procedures manual
Equipment repair manuals

SkillsNET Services & Customer Success Stories

SkillsNET's web-based job analysis methods and SkillObject Designer software have been instrumental in the success and advancement of our industrial, academic, and government and military clients. The examples given below illustrate SkillsNET's proven results stemming from job analysis using SkillObject Designer.

Industry

Mi-SWACO. SkillsNET completed worldwide job analyses to define lists of tasks, tools, resources, unique knowledge, skills and abilities required for successful performance in the Drilling Fluid Engineer position at Mi-SWACO. Survey results illustrated differences in how individuals in various job groups and geographic regions perceived their work, while high agreement was found worldwide among tasks they performed and the importance of those tasks.

ATK. ATK was faced with an aging workforce – half of their engineering staff was ready to retire. SkillsNET customized web-based demographic surveys that were distributed to employees. Survey results were fed into an on-line querying tool, Skills Finder. Skills Finder allowed ATK to search for employees based on specific requirements for a particular job. This allowed ATK to utilize its current workforce in areas that may have otherwise been overlooked.

Cisco Systems. Cisco Systems wanted to ensure that the certification content being taught was required to perform the job. Certifications analyzed included the CCNA, CCNP, CCDA and CCDP programs. Cisco was also interested in discovering new certifications that could be offered to the technical population in charge of servicing their equipment. SkillsNET conducted job analyses on existing certifications and guided Cisco in redesigning their certification content and teaching process. SkillsNET was also able to identify work to support an additional certification.

CitiFinancial. Using SkillObject Designer, CitiFinancial analyzed its Loan Officer position. Job analysis data helped CitiFinancial to identify three levels of Loan Officer positions in the organization. SkillObjects were identified for positions in each tier, and training requirements were linked to these SkillObjects. SkillsNET identified the top ten skills and abilities required for the three positions. This information helped CitiFinancial to focus selection on these skills and abilities.

First Hawaiian Bank. SkillsNET performed job analyses for First Hawaiian Bank's customer service positions and determined that 40% of these employees' time was being spent on administrative activities instead of focusing on customer service. The job analysis allowed First Hawaiian Bank to re-structure the customer service department, resulting in a more efficient workforce.

General Electric. SkillsNET performed a job analysis of General Electric's (GE) sales personnel and determined that 80% of their time was spent on bureaucratic duties, not towards driving sales. This insight allowed GE to reorganize the functions of their sales representatives to ensure that workforce activities were aligned with the mission of the organization.

Stuart C. Irby Company. Stuart C. Irby Company recently merged into Sonepar, the world's largest electrical distributor, a $15 billion international organization based in France. SkillsNET helped optimize workforce operations for Irby's rapidly changing branch operations and sales and management team. Irby used SkillObject Designer to conduct job

analysis for various positions in these departments. This job analysis was a key factor in moving the operations and sales functions to effectively manage organizational changes.

Academia

University of Hawaii. SkillsNET's on-line job profiling system provides an effective conduit between industry and academia. As a registered user, local employees may develop a job profile, job description, and skill gap analysis using SkillsNET's web-based tools. Based on this information, the employer can notify the University of Hawaii for identification of training interventions. Using this system, educators and employers gain insight into the criticality of training for specific jobs and can make educated decisions on how training is implemented.

Military & State Governments

United States Navy. The Navy required a comprehensive system to identify the knowledge, skills and abilities their sailors need to be successful in defending our country. After an extensive analysis of the marketplace, the Navy determined that SkillsNET's SkillObject Technology would drive all job analysis, training, development and proficiency requirements for each community (e.g., Enlisted, Officers, Reservists, Civilians) in the Navy. This ongoing project focuses on five areas of concentration separated into levels of expertise: Professional development, personal development, professional military education and leadership, certifications and qualifications, and performance.

United States Coast Guard. The United States Coast Guard (USCG) faced several challenges on the Chief Warrant Officer (CWO) job. These issues concerned workforce training, details of the current role, and future competencies needed. The USCG used SkillsNET's job analysis methodology to gather data from Coast Guard personnel representing different specialties. The analysis showed significant differences between specialties and illustrated specialties that needed to be added.

National Security Agency. SkillsNET played a significant role in reengineering the Information Technology division with the National Security Agency (NSA). The National Security Agency had a total of 300 unique job titles with less than 40 functionalities. Using innovative web-based solutions, SkillsNET helped the National Security Agency organize jobs by function rather than title.

State of Arkansas. The Arkansas State Legislature created a means by which state employees could receive bonus pay beyond their base salary. The Arkansas Department of Workforce Education (DWE) was tasked with implementing this program in an equitable manner. To determine if a project would be eligible for consideration, the DWE needed to determine the activities performed by their personnel. SkillsNET used SkillObject Designer to capture the work performed by personnel within each job classification. By completing analyses of over 50 jobs in eight weeks, SkillsNET allowed the DWE to successfully implement the competency-based bonus pay system.

State of Oklahoma. The Oklahoma Employment Security Commission (OESC) used SkillsNET's system to provide job analysis services to employers throughout the state of Oklahoma. With the assistance of SkillsNET, local employers were empowered to identify the skills needed to maintain their competitive workforce and training programs to fill those gaps. SkillsNET's process facilitated the creation of appropriate skills development opportunities for emerging, incumbent and transitional workers. The associated labor exchange process fostered the creation of employment opportunities with the ability for prospective employers to create successful job matches.

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About SkillsNET®

SkillsNET provides a revolutionary tool suite and consulting service, which allows enterprises to rapidly capture work, worker, and workplace skill data elements (SkillObjects®) and their relationship to performance. The SkillsNET methodology allows employers to capture their workforce environment through web-based applications with minimal worker and capital investment. Highly trained Skills Analysts and Industrial and Organizational Psychologists, available on-site or via phone, assist the employee and employer through the data collection process. At the end of the process, employers receive a detailed analysis of the skill base required in their workforce, the level of skill in the current workforce, and the performance standards needed to operate in today's dynamic environment. SkillsNET methodology is aligned with the Department of Labor O*NET taxonomy. For additional information please visit www.skillsnet.com

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Impact of Knowledge-Skill-Ability-Centric Capacity Measures on Strategic Planning for Training Intervention Decisions

Impact of Knowledge-Skill-Ability-Centric Capacity Measures on Strategic Planning for Training Intervention Decisions

A White Paper prepared by Michael L. Brown, SkillsNET Corporation, and Darrel L. Sandall, SkillsNET Corporation

Employers are spending more dollars on training today than at any other time in history. This tremendous investment is caused in part by several factors. The pace of change in today's technological information age is driving innovation at previously unseen levels. Increases in communications, shipping, and the Internet have all helped to push us into the global marketplace. Plus, a building economy and the "boomer generation" nearing retirement in the United States are beginning to cause a shortage of skilled workers. This lack of skilled workers is causing critical problems for many industrial sectors such as healthcare.

In the battle to attract and retain workers, companies have discovered that training can be a powerful magnet. Many workers value training above other traditional enticements because they believe that increasing their skills and competence through training is a way of making themselves more valuable. This in turn opens the door for a worker to command a higher salary from both current and potential employers.

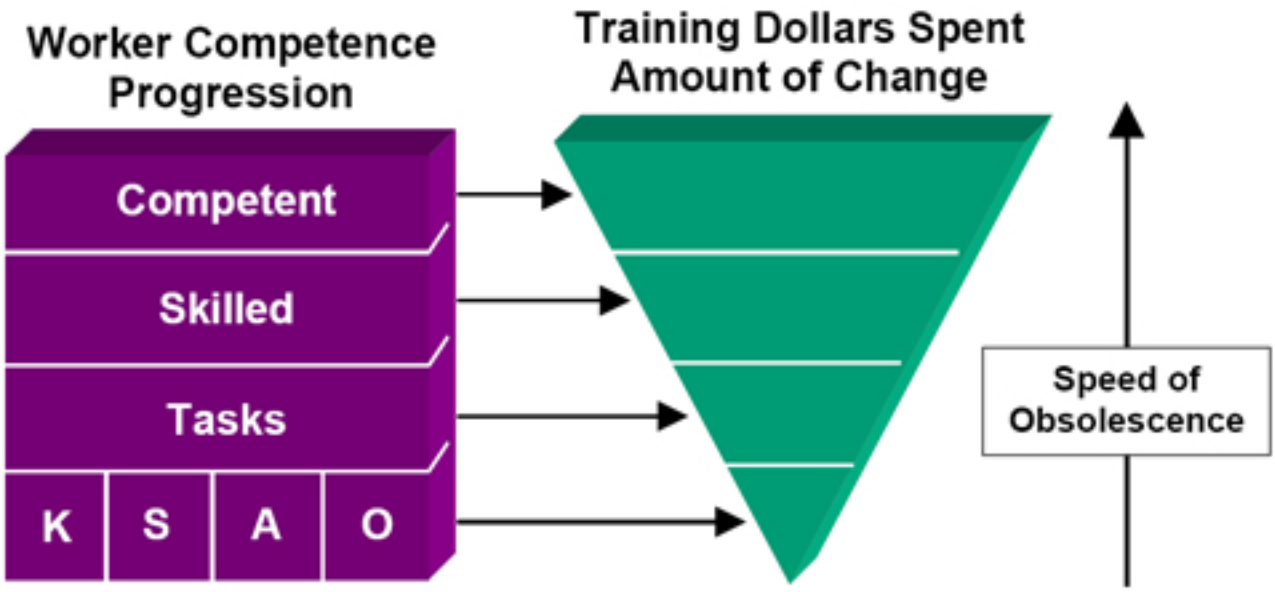
Although most employers believe training to be a key to resolving their skilled worker deficiency, many are recognizing that investing training dollars to directly impact competencies and tasks is not performing as hoped. One possible reason for this is the pace of change. When a company spends $100,000 on impacting competencies or tasks and then technology or business practices change, those competencies and tasks my be entirely obsolete, and the training dollars invested are effectively wasted.

A growing number of employers are realizing now that there is another place to direct their training dollars. Knowledge, Skills, Abilities, and Other Characteristics (KSAO) form the foundation of every behavior performed by a worker. Each competency and task requires a specific set of KSAOs to enable its performance. Different combinations of KSAOs, at different levels combine to enable performance of every task in any work function.

The chart below shows the relationship of KSAO to worker competence. The KSAOs form the foundation that supports proper task performance, functional skill development, and worker competence. The chart also shows that most companies spend their training dollars at the competency level. On the surface, this appears to be logical. Most investments are spent to influence and drive

worker competence. However, as previously noted, as technology changes the way work is done, the tasks change, and suddenly a competent worker is now competent in an archaic method of work. Controlling the obsolescence of worker competence and tasks is critical to developing and maintaining a skilled workforce.

The fallacy of spending the most training dollars on influencing worker competence and tasks is illuminated when the benefits and roles of the KSAOs are examined. KSAOs form the foundation, which supports all worker performance and capacity measures. Also, as technology and work processes change, the tasks and worker competence also change dramatically. However, the KSAOs required for the work function do not change. In fact most of the changes in the KSAOs occurs in the levels of the KSAOs required by the worker for successful job performance. It is much more cost effective, then, to invest in building the capacity of workers through developing their KSAOs and the levels of those same KSAOs.



The relationship of the KSAOs to workers, worker tasks, and worker performance is also shown in the chart below. The chart also shows the critical role that the KSAOs play in influencing not only worker characteristics, but also the worker tasks. Worker performance can be viewed as a combination of several factors. First successful performance on the job is driven by proper performance of the tasks by the worker. However, a worker can be totally competent performing the tasks for their work function, but if the market forces or the organizational climate negatively impacts the situation, the worker's task and overall performance will suffer.

Because the KSAOs are foundational to all worker behaviors and performance, they can actually be viewed as measurements of a worker's capacity. Using KSAOs to determine capacity of your workforce is a powerful tool, but not necessarily a new one. The importance of KSAOs has long been recognized, but until now, there has been no cost effective method to identify the KSAOs and the levels of each required for behaviors. That has changed dramatically over the past few years.

The revolutionary technologies developed and marketed by SkillsNET Corporation enables companies to quickly and cost-effectively migrate to a dynamic, skill-based culture, where employees value learning and worker capacity and performance increase dramatically, enabling both large and

small companies to grow and leverage their intellectual capital. SkillsNET's SkillObject™ solution is developed around the Knowledge, Skill, and Ability taxonomy of the Department of Labor's Occupational Information Network (O*NET) taxonomy of work descriptors. Each work descriptor has an operational definition and behavior anchors that are the result of 25 years of research. A SkillObject™ contains task statements describing the work performed, the Knowledge, Skills and Abilities required for each task, the Unique Tools and Unique Knowledge required to perform the SkillObject™, and Performance requirements for the SkillObject™.

The KSA's form the basis of an entire system of tools designed to increase competitiveness, improve return on investment, improve workforce development decisions, improve the overall quality and capacity of the workforce, and improve the quality of training. This can be accomplished in part by mapping existing training content to SkillObject™ descriptors. This ability to map LearningObjects to SkillObjects™ and to access any distributed training content unleashes the ability to utilize existing training curricula or any other training curricula available, either through private training providers or through Commercial off the Shelf (COTS) training curricula. This maximizes the power of the Human Resource Development professionals in the organization.

If your organization already has developed a skill-based culture, it is easy to link the current skill modules or assessment tools to the SkillObject™ system. Linking the current skills to the SkillObject™ system provides all of the power and flexibility of the SkillObject-centric tools without abandoning the resources already invested in the existing skill-based system.

There are many benefits of implementing an organization-wide SkillObject™ culture. For the employer, the benefits include increased competitiveness through an effective workforce, efficient and predictable workforce output, quantified return on investment for workforce development, increased agility and responsiveness to the market, and improved placement efficiency. For management, the benefits include an enhanced capability to make workforce development decisions; decreased management costs for hiring, training and retention; less time and resources spent on managing change; enhanced capability to leverage core competencies; and the capability to more effectively qualify expansion opportunities. For employees, the benefits of the SkillObject™ system include improved morale; focused and effective professional development; clear skills development and career path; less likelihood of chasing the job market; and a higher tolerance for change.

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MSSC Skill Standards

A Blueprint *for* Workforce Excellence

A Quick Orientation

Published by the Manufacturing Skill Standards Council (MSSC)

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Dear Colleagues,

Welcome to *A Quick Orientation*. In just a few minutes, you will be reviewing the first official release of the manufacturing skill standards developed by the Manufacturing Skill Standards Council (MSSC). These skill standards, developed under the auspices of the National Skill Standards Board, are the result of an unprecedented partnership within the U.S. manufacturing sector and represent the start of a long-term commitment to revitalize manufacturing jobs, skills, and training.

Before you begin your exploration, I wanted to take a moment to explain why we started this project and why we think it is so important. In 1997, leaders in the manufacturing sector met to address a growing challenge: How could we ensure that workers have the skills needed for success in today's manufacturing environment?

We knew we needed to find an answer. If U.S.-based manufacturers are to gain a competitive edge in the global economy and continue to provide good, family-supporting jobs to millions of Americans, a skilled workforce is vital.

But what was it going to take to get there? In the past, most manufacturers operated internal labor markets to recruit and prepare workers. Workers gained their skills on the job or through training provided by their employer or union. We quickly recognized that more was needed.

Today, a higher level of skills is needed to keep pace with rapid technological change, new demands for quality, and growing customer needs. New approaches are needed, both to improve internal training and to ensure our educational system prepares individuals for today's workplace. At the same time, as the workforce has become more mobile, individuals need a way to transport their skills from one job to another. But because most manufacturing skill certifications are specific to a single industry or job function, this can be very difficult.

If we are to raise the skill level of today's workforce and attract a new generation to our industry, we need to create a new "skills pipeline" that will supply manufacturers with skilled workers, while also providing workers with portable certifications and access to good jobs. We believe an industry-wide skill standards system will provide the new approach that is needed.

The MSSC, a unique partnership among business, labor, education, professional and community groups, has stepped up to provide the leadership necessary to build this system. We have already made substantial progress. In the three years since its inception, the MSSC has completed two of the three major steps in building the system: We have created a broad-based coalition and developed skill standards. Our next major goal is to develop an assessment and certification program based on the skill standards.

We invite you to join us in building this new system – helping to ensure the long-term productivity and competitiveness of U.S.-based manufacturing.

Sincerely,

John Rauschenberger, MSSC Chair
Ford Motor Company

Manufacturing Skill Standards Council Steering Committee Members *July 2000 – June 2001*

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I Want to Find Out…

I Want to Find Out…
How to use this publication

A *Quick Orientation* provides important background information about the skill standards and is meant to be read before reviewing the skill standards for each concentration, the Core Knowledge and Skills, and the *Skill Scales Companion Guide*. You may wish to remove this booklet from the binder and use it as a reference when reviewing the skill standards.

I Want to Find Out…
Who is behind this project

The Manufacturing Skill Standards Council (MSSC) was established to develop a national system of skill standards assessment, and certification for the manufacturing and related installation and repair industry sector. The MSSC membership is made up of close to 200 leading organizations with a direct impact on the future of manufacturing, including:

- Companies
- Trade associations
- Industrial unions
- Professional societies
- Large education and training organizations
- Civil rights and community groups
- Public interest and state government representatives

Individuals and smaller organizations affected by the skill standards, such as smaller manufacturers and community colleges, are also part of the MSSC, serving as associate members.

Such a large and diverse membership, representing nearly all elements of manufacturing, has helped the MSSC ensure that its skill standards reflect the needs of manufacturing employers and workers.

The MSSC is co-managed by the industry-led National Coalition for Advanced Manufacturing and the AFL-CIO Working for America Institute.

For more information, please contact us:

On the Web at www.msscusa.org
By phone at (202) 216-2740 or
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By fax at (202) 289-7618 or
(202) 466-4617
By mail at MSSC
C/O National Coalition for Advanced Manufacturing
1201 New York Ave, NW, Suite 725
Washington, DC 20005-3917

Or

MSSC
C/O Working for America Institute, AFL-CIO
888 16th Street, NW
Washington, DC 20006

The National Skill Standards Board

The MSSC's efforts to develop skill standards are part of a larger effort coordinated by the National Skill Standards Board (NSSB). The NSSB, made up of representatives from business, labor, employee, education, and community and civil rights organizations, was established in 1994 by Congress to help create a voluntary national system of skill standards, assessment, and certification. The NSSB has provided funding to the MSSC for the creation of the voluntary partnership and the development of the standards.

The NSSB has established a Common Framework for Skill Standards, which was used to guide the development of the MSSC skill standards. In addition, at key stages of the standards development process, the MSSC submitted its work to the NSSB for review and approval.

The MSSC skill standards were approved by the full board of the NSSB. This approval means that the MSSC skill standards described in this report were judged to have met the NSSB criteria for the development of skill standards.

For more information, please contact the NSSB:

On the Web at www.nssb.org
By email at information@nssb.org
By phone at (202) 254-8628
By fax at (202) 254-8646
By mail at NSSB
1441 L Street N.W., Suite 9000
Washington, DC 20005-3512

I Want to Find Out…
What skill standards are all about

Precision tolerances. Quality controls. Industry-wide product specifications. These are the common measures by which most manufacturers are judged. Without them, manufacturers would have a tough time improving their performance or communicating to customers.

Yet, where are the precision tolerances for today's workforce – the engine of modern manufacturing? What are the industry-wide specifications for training, certifying, and hiring skilled manufacturing workers? With the MSSC skill standards system, we can finally answer these questions.

MSSC skill standards define the knowledge, skills, and performance needed by today's frontline manufacturing workers. They give individuals a standard to work toward and provide a wealth of information that can be used to improve training, education, and hiring practices.

The need for skill standards has never been more pressing. In the 21st century, a skilled and knowledgeable workforce will be the manufacturing industry's principle competitive advantage. High volume has been replaced by "high performance" and "high value added." In this new environment, employers are looking for skilled workers who can work *smarter*, not just *harder*. Today, manufacturers need:

- Employees with problem-solving and customer service skills
- Employees who are creative and analytical
- Employees who can effectively use new technology
- Employees who can lead and adapt to change

Yet, survey after survey shows that manufacturers are finding it difficult to meet these needs. In the search to find a solution, whether through better training programs or a greater emphasis on education, the one thing that has been missing is a clear set of standards. If we do not know what we are working toward, how can we expect to get there?

By defining the knowledge, skills, and performance required for success in today's best practice manufacturing workplaces, the MSSC skill standards provide both a yardstick against which to measure our efforts and a clear set of goals to work toward.

A Focus on the Frontlines and High Performance

The MSSC started its standards development efforts by developing skill standards for the frontlines. By *frontlines,* we mean frontline workers, from entry-level through first-line supervisors working in production and production support and operations.

The reason the MSSC focused first on the frontlines is that this is where some of the most dramatic changes in work have been taking place. And it is an area that is often neglected, in terms of education, training, and certification programs.

Another of the MSSC's key goals was to ensure the standards reflected the needs of high performance and best practice workplaces. To do this, the MSSC developed a definition of these terms that was used to recruit companies to participate in the research. In this way, the MSSC was able to create standards that reflect the needs of today's high performance and best practice organizations.

I Want to Find Out…

Where assessment and certification fit into the picture

This project is about much more than just developing individual skill standards – it is about building a *skill standards system*. Although MSSC skill standards have value as a stand-alone tool, the standards are the foundation of a much larger system of assessment and certification being developed by the MSSC.

This system would assess individuals against the MSSC standards and provide them with feedback to help them improve their performance. Those individuals who achieve a certain level of performance in the assessments would receive a national certification recognized by manufacturing employers.

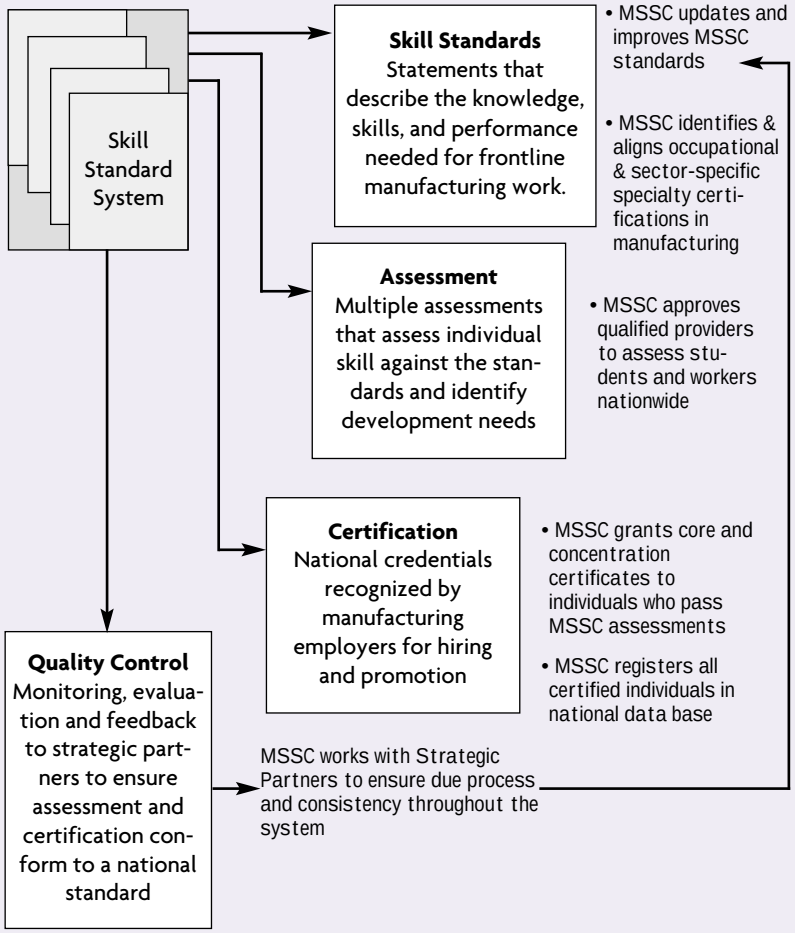
The benefits of such a system to both employers and workers are many. With standards-based assessment and certification:

- Employers would be able to make faster, better hiring decisions.
- Workers would be able to demonstrate to employers that they meet industry standards for excellence, helping them to get jobs and promotions. And because these credentials would be industry wide, they would be highly portable, helping individuals get jobs in many different segments of the manufacturing industry.
- Individuals would be able to measure their skills against the standards and gain valuable information they could use to make better training and education decisions and to improve their performance.

Now that the standards have been established, the MSSC is gearing up to provide assessment and certification based on the standards. We expect several assessments will be available within the next 12 months.

But to ensure the effectiveness of this system, we need to do everything we can to help individuals develop the skills and earn the certifications needed to have rewarding careers in manufacturing. This means making the integration of MSSC standards into industry training and education programs a top priority.

MSSC Skill Standards System



I Want to Find Out…

How the skill standards were developed

One of the real strengths of the MSSC skill standards is how they were developed. To ensure that MSSC skill standards reflect the real-world requirements of today's workplace, the MSSC went directly to frontline workers and first-line supervisors.

From June 1999 to April 2001, the MSSC worked with more than 4,000 frontline workers and first-line supervisors from some 700 companies to develop and validate the skill standards.

The effort began with a series of intensive research sessions, held in manufacturing hubs across the United States, in which hundreds of workers and supervisors were asked to describe the knowledge, skills, and performance needed for success in manufacturing today. The standards that emerged from these panels were reviewed by hundreds of subject matter experts, ranging from manufacturing managers to educators and trainers.

Next, the MSSC conducted a national validation survey of frontline workers and first-line supervisors to verify that the standards identified by the panels reflected a complete and accurate picture of work in their companies.

We believe the number of individuals who participated in the research, their diverse backgrounds, the focus on recruiting research participants from best-practice firms, and the rigorous review and refinement of the skill standards throughout the research process has enabled the MSSC to create world-class skill standards on which the industry can rely.

Ensuring the Quality of the Skill Standards

To develop the highest quality skill standards, the MSSC skill standards were:

- **Based on extensive input from thousands of workers:** More than 4,000 frontline workers and first-line supervisors helped develop and validate the skill standards.
- **Subjected to continuous expert review.** At key steps, the standards were reviewed and refined by subject matter experts, including manufacturing managers, educators, trainers, work analysis experts, and others with the experience and training necessary to ensure the quality of the skill standards.
- **Approved by the National Skill Standards Board (NSSB).** The NSSB, made up of leaders from business, unions, civil rights organizations, and other groups, provided important input and guidance throughout the standards development process. Recently, the NSSB approved the MSSC skill standards, showing its support for the MSSC research.

To ensure the skill standards remain current, the MSSC plans to update the standards regularly.

I Want to Find Out…

How the skill standards are organized

Now it's time to start learning about the skill standards themselves. Let's start by looking at how the MSSC skill standards are organized.

Industry-Wide Skill Standards

The MSSC skill standards were developed for the manufacturing industry sector, which encompasses the following 14 subindustries:

1. Food and Beverage
2. Textile, Textile Products, Apparel, and Leather
3. Furniture
4. Wood and Paper
5. Printing
6. Petroleum and Coal Products
7. Chemicals
8. Plastics and Rubber Production
9. Nonmetallic Minerals
10. Primary and Fabricated Metals
11. Machinery
12. Computers and Electronic Products
13. Electrical Equipment and Appliances
14. Transportation Equipment

What this means is that instead of developing different sets of skill standards for each of these 14 subindustries, the MSSC developed one set of skill standards that apply across all these subindustries. To develop industry-wide skill standards, the MSSC research focused on identifying the knowledge, skills, and performance *common across all the manufacturing subindustries*.

For example, we found that all manufacturing production workers need to know how to identify customer needs, set up equipment for the production process, and inspect the product to make sure it meets specifications - regardless of whether they work in a food and beverage plant, an auto plant, or a computer manufacturing plant. Because these elements of work were *common and critical* across the 14 subindustries, they, along with the knowledge and skills needed to achieve these goals, were included in the skill standards.

Why were skill standards organized this way? Developing skill standards that will prepare people for work across the manufacturing sector will help individuals get as many different jobs across the industry as possible. For example, a laid-off worker certified in the MSSC skill standards will have many of the skills needed to work in an automobile manufacturing plant, a chemical manufacturing plant, and many of the other manufacturing workplaces covered by the 14 subindustries.

In addition to giving individuals portable skills and certifications, the development of standards that apply across the manufacturing sector gives employers a large pool of broadly trained workers from which to choose.

We recognize that many important skills are not common across manufacturing and are unique to a particular company or subindustry. Those skill requirements are being handled by something called specialty skill standards, which are explained later in this publication.

A Focus on Concentrations – Not Individual Job Titles

The MSSC skill standards are organized around six concentrations – major areas of frontline manufacturing work, typically covering families of related jobs and occupations. (These concentrations are described on the next page).

Concentration	Description of Work Covered by Concentration Skill Standards	Sample Job Classifications Covered by Concentration Skill Standards
Production	Set up, operate, monitor, control, and improve manufacturing processes and schedules to meet customer and business requirements.	Operator, production associate, and assembler
Manufacturing Production Process Development	Develop, implement, and improve the manufacturing process through early production and process changes. Assess product and process design for manufacturability	Manufacturing technician, process improvement technician, and jig and fixture designer
Quality Assurance	Ensure the manufacturing system meets quality system requirements as defined by business and its customers.	Lab technician, SPC coordinator, and inspector.
Health, Safety, and Environmental Assurance	Ensure that the manufacturing system meets health, safety, and environmental requirements	Health and safety representative, safety coordinator, and safety team leader.
Maintenance, Installation, and Repair	Ensure that the maintenance of the manufacturing system fulfills customer and business requirements. Install and repair equipment on the manufacturing floor	Industrial maintenance mechanic, industrial maintenance electrician, and millwright.
Logistics and inventory control	Plan and control the movement and storage of materials and products in the manufacturing system	Material handler, material mover, and material associate

What this means is that instead of developing skill standards for every frontline job within manufacturing, the standards have been developed to cover clusters of related jobs covered by the concentrations.

In this way, the standards will prepare individuals for more than one narrow job. This enhances an individual's ability to get different jobs by providing him or her with a broader range of skills and ensures that individuals have the flexibility needed to handle different kinds of work. It also helps the project avoid the pitfall of building standards around job titles and occupational definitions, which vary widely from company to company. Concentrations focus on the functions of work and, in this way, are much more stable than job titles. Organizations will combine the functions covered by the different concentrations into their own job titles.

So, the key things to keep in mind about the organization of the skill standards is that they apply across the manufacturing industry sector and are organized around clusters of jobs called concentrations.

I Want to Find Out…

Exactly what makes up a skill standard

Skill standards include lots of different types of information. That's because we wanted to create standards that are comprehensive enough to be useful in developing curricula, making important career decisions, and creating assessments. All this information is divided into two categories:

- Information *About the Work*
- Information *About the Worker*

About the Work

This describes what needs to be done at work and how well. It includes:

- *Critical Work Functions*: Major responsibilities of work within a concentration.
- *Key Activities*: Major tasks involved in carrying out a critical work function.
- *Performance Indicators*: Indicators of how to determine when someone is performing each key activity competently.

In the example to the right, taken from the Production concentration, the critical work function is "Maintain a safe and productive work area." Four key activities are associated with it:

- "Perform environmental and safety inspections,"
- "Perform emergency drills and participate in emergency response teams,"
- "Identify unsafe conditions and take corrective action," and
- "Provide safety orientation to other employees."

Each key activity has approximately half a dozen performance indicators.

What can we learn from this example?

We can see that one of the major responsibilities of production work in manufacturing is to "Maintain a safe and productive work area." We know this because this responsibility has been identified as a *critical work function*.

We know that one of the key tasks someone needs to do to fulfill this responsibility is to "Perform environmental and safety inspections." We know this because this task has been identified as a *key activity*.

From looking at the performance indicators for the skill standards, we can also find out what it looks like when someone is performing this task well.

For example, in the case of the key activity we just mentioned ("Perform environmental and safety inspections"), we know that when…

- "Potential hazards in the work are identified, reported, and monitored;"
- "Corrective action is taken to correct potential hazards;"
- "Health, safety, and environmental documentation and policies are thoroughly and regularly reviewed;"
- "Inspections meet all relevant health, safety, and environmental laws and regulations;"
- "Inspections are done according to company schedule and procedures;"
- "Inspections are documented;" and
- "Inspection records are stored correctly"

…this key activity has been performed competently. That's because all of these elements have been identified as *performance indicators*.

P3

Critical Work Function: Maintain a safe and productive work area.

Critical work functions *describe the major responsibilities involved in carrying out a concentration*

Concentrations *are the major areas of front-line work covering families of related jobs. Separate standards were identified for each concentration.*

Key Activities **Key activities** *are the duties and tasks involved in carrying out a critical work function*	Performance Indicators **Performance indicators** *correlate to the key activities. The performance indicators provide information on how to determine when someone is performing each key activity competently*
Perform environmental and safety inspections	Potential hazards in the work are identified, reported and monitored. Corrective action is taken to correct potential hazards. Health, safety and environmental documentation and policies are thoroughly and regularly reviewed. Inspections meet all relevant health, safety, and environmental laws and regulations. Inspections are done according to company schedule and procedures. Inspections are documented. Inspection records are stored correctly.
Perform emergency drills and participate in emergency response teams	Training and certification on relevant emergency and first aid procedures is complete and up to date. Emergency response complies with company and regulatory policies and procedures. Emergency drills and incidents are documented promptly according to company and regulatory procedures.
Identify unsafe conditions and take corrective action	Conditions that present a threat to health, safety and the environment are identified, reported, and documented promptly. Corrective actions are identified. Appropriate parties are consulted about corrective actions. Corrective actions are taken promptly according to company procedures. Ongoing safety concerns are tracked and reported until corrective action is taken.
Provide safety orientation to other employees	Orientation covers all topics and procedures needed to facilitate employee safety. Orientation makes clear the need and processes for employees to raise safety concerns, ask questions, and receive additional training. Orientation is documented according to company requirements. Orientation meets all relevant laws, policies, and regulations. Safety training is delivered regularly.

About the Worker

This aspect of the skill standards describes the knowledge and skills an individual needs to perform the work described by each critical work function, along with its key activities and performance indicators.

There are three types of knowledge and skills described in the skill standards:

- *Academic Knowledge and Skills* – Academic skills, such as mathematics, writing, etc.
- *Employability Knowledge and Skills* – Broadly applicable skills, such as working in teams, analyzing and solving problems, etc.
- *Occupational and Technical Knowledge and Skills* – Occupational and technical skills that tend to be specific to an industry or concentration, such as skill using inspection tools, knowledge of manufacturing processes, etc.

So, for example, on a previous page, you reviewed the critical work function of "Maintain a safe and productive work area." The "About the Worker" aspect of the skill standards would tell us the specific academic, employability and occupational and technical knowledge and skills needed to maintain a safe and productive work area (see example to the right). The following information provides a more in-depth explanation of the "About the Worker" aspect of the skill standards.

Academic and Employability Knowledge and Skills

The MSSC skill standards incorporate 17 categories of academic and employability knowledge and skills.[1] They are:

Academic Knowledge and Skills Categories

- *Mathematics*
- *Science*
- *Reading*
- *Writing*

Employability Knowledge and Skills Categories

- *Listening*
- *Speaking*
- *Using information and communications technology*
- *Gathering and analyzing information*
- *Analyzing and solving problems*
- *Making decisions and judgments*
- *Organizing and planning*
- *Using social skills*
- *Adaptability*
- *Working in teams*

[1] An expert panel convened by the NSSB identified these academic and employability knowledge and skills based on more than a year of research.

P3 Critical Work Function: **Maintain a safe and productive work area.**

Knowledge and Skills

Describes what a worker needs to know or be able to do to perform the critical work function

ACADEMIC AND EMPLOYABILITY SKILLS

Skill	Overall Complexity Rating for Workers	Overall Complexity Rating for Supervisors	Complexity Dimension	Complexity Subdimension	Complexity Subdimension Rating for Workers
Math	**NA**	**L**	Complexity of mathematics content	Number sense and computation	**NA**
				Geometry, measurement, and spatial sense	**NA**
				Complexity of data analysis, statistics, and probability	**NA**
				Functions and algebraic thinking	**NA**
				Complexity of representation and communication	**NA**
			Complexity of problem solving	Mathematical methods	**NA**
				Mathematical reasoning	**NA**
				Mathematical tools	**NA**
Science	**L**	**L**	Complexity of scientific inquiry	Design	**L**
				Use of evidence	**L**
			Complexity of understanding the nature of science	Unifying concepts and processes	**L**
			Complexity of core scientific content	Physical science	**M**
				Life science	**NA**
				Earth and space science	**NA**
			Complexity of applied science	Science and technology	**L**
				Science in personal and social perspective	**NA**
Reading	**M**	**M**	Complexity of text		**M**
			Complexity of reading skills		**M**
			Complexity of reading purpose		**M**
Writing	**L**	**M**	Complexity of text	Complexity of text	**M**
			Complexity of writing product	Type of product	**M**
				Organization	**M**
				Elaboration	**M**
			Complexity of writing process	Writing development	**L**
				To inform	**M**
				To persuade	**M**
Listening	**M**	**M**	Complexity of communication	Content complexity	**M**
				Demands on attention	**M**
				Communication indirectness	**L**
			Barriers to communication	Limitations on interaction	**M**
				Distractions	**M**
Speaking	**M**	**M**	Complexity of communication	Content complexity	**M**
				Tact and sensitivity required	**M**
				Communication indirectness	**L**
			Context demands	Diversity of audience	**M**
				Constraints on preparation	**M**
				Distractions	**M**
				Listener resistance	**M**
Using Information and Communications Technology	**L**	**L**	Complexity of technology application	Complexity of equipment or technology	**L**
				Complexity of applications	**L**
				Training time constraints	**M**
			Frequency of technology change	New learning required	**M**
Gathering and Analyzing Information	**M**	**M**	Difficulty of information gathering	Amount of information	**M**
				Number and variety of sources	**M**
				Resourcefulness needed	**M**
			Complexity of analysis	Complexity of information and analysis	**M**
				Need to evaluate source information	**M**
				Lack of analysis guidelines	**M**

About the Worker

- *Leading others*
- *Building consensus*
- *Self and career development*

For each of these academic and employability knowledge and skills, the MSSC skill standards provide:

Complexity Ratings: The complexity level rating tells us, for a given critical work function, the level of complexity required in a particular academic and employability knowledge and skill. For example, if writing is required to perform a given critical work function, the complexity rating would tell us whether individuals need to possess complex writing skills enabling them to write technical manuals, reports, or proposals, or whether they need lower-level writing skills to write labels and telephone messages.

To develop complexity level ratings, the MSSC used the NSSB Academic and Employability Skill Scales, which enable experts to rate the level of complexity required in a given knowledge and skill. The scales include various dimensions and subdimensions, which look at different aspects of a skill. On the next page is an example of part of the skill scale for writing, showing one subdimension for "complexity of text."

The standards provide us with two different types of complexity ratings, both based on scales like this.

Overall Complexity Rating: As the name implies, the overall complexity rating gives a rough estimate of the overall level of complexity required for a given knowledge and skill. This rating was developed by looking across the complexity subdimensions in a given skill scale and determining the overall level of complexity required to perform a particular critical work function, along with its key activities and performance indicators. This overall rating is expressed as:

L= low complexity
M= moderate complexity
H= high complexity

In some cases, the overall complexity rating was **NA (Non-Applicable)**. This means that this skill was deemed not to be needed to perform this given critical work function, so no complexity rating was assigned.

In the example on page 15, writing received an overall complexity rating of "L" (for workers). This means that a low level of complexity in writing is required for workers to perform the critical work function of "Maintain a safe and productive work area."

The overall complexity ratings were developed for "Workers" and for "Supervisors." As mentioned earlier, the standards were developed for frontline manufacturing workers. This includes entry-level workers *through* first-line supervisors. The critical work functions, key activities and performance indicators apply to this entire group. However, separate overall complexity ratings were developed for "workers," whom the project defines as entry-level manufacturing workers *up* to first-line supervisors, and for "supervisors," whom the project defines as first-line supervisors.

Subdimension Complexity Rating: To provide users with more detailed information, the MSSC skill standards also provide

Skill Scale Example

WRITING

Express ideas and information in written form clearly, succinctly, accurately, and in an organized manner; use English language conventions of spelling, punctuation, grammar, and sentence and paragraph structure; tailor written communication to the intended purpose and audience.

COMPLEXITY DIMENSION / COMPLEXITY SUBDIMENSION		COMPLEXITY LEVEL SCALE		
		HIGH	MODERATE	LOW
COMPLEXITY OF TEXT	**COMPLEXITY OF TEXT** *How complex is the type of material to be written in performing this critical work function?*	• Highly complex or technical materials are written (e.g., technical manuals, reports, proposals, procedures, written commentaries, formal email, substantially visual material such as flowcharts); material contains high density of information and a substantial proportion of highly technical terms or unfamiliar vocabulary.	• Moderately complex or technical materials are written (e.g., letters, memos, email, multistep directions and instructions, reference materials, books on particular topics, visuals that support meaning such as charts, graphs, figures, diagrams, and maps).	• Simple, familiar, or nontechnical materials are written (e.g., labels, telephone messages, routine forms, lists, simple notes, signs, informal email).

Please Note: This is just an excerpt of a much larger scale for writing, which can be found in the *Skill Scales Companion Guide*, enclosed with this publication.

individual ratings for each subdimension on the skill scales. This rating is expressed as:

L = low complexity
M = moderate complexity
H = high complexity

In some cases, the subdimension complexity rating was **NA (Non-Applicable)**. This means that this *particular dimension* of the skill was deemed not to be needed to perform this given critical work function, so no complexity rating was assigned.

In the example on page 15, the writing subdimension of "complexity of text" received a rating of "M," which means that a moderate level of complexity in the area of "complexity of text" is required for workers to perform the critical work function of "Maintain a safe and productive work area."

The subdimension complexity ratings were only identified for workers, which includes entry-level manufacturing workers up to first-line supervisors. No subdimension complexity ratings have been developed at this time for first-line supervisors.

Skill Scales Companion Guide

To review a full copy of the skill scales, see the *Skill Scales Companion Guide*, a separate publication that is part of this binder. As you review the skill standards, use the guide to understand each table and exactly what each complexity rating means.

How Can All This Information Be Used?

Education and training developers can use complexity level ratings to find out what level of skill they should be focusing on (e.g., basic mathematics vs. high-level mathematics).

Employers can use complexity ratings to help focus training. For example, a team leader may notice that her co-workers are having trouble performing the work described by a particular critical work function. She can then look at the complexity ratings for the knowledge and skills needed to perform that critical work function and zero in on the right training program, saving time and money.

The MSSC will use complexity ratings information as the basis for developing assessments and certifications based on the skill standards.

Occupational and Technical Knowledge and Skills

Occupational and technical knowledge and skills are those knowledge and skills that are unique to a given industry sector or concentration. In manufacturing, they include knowledge and skills in areas such as inspection tools and equipment, production tools and equipment, and manufacturing processes.

For each critical work function, the MSSC identified the occupational and technical knowledge and skills needed to perform the function, along with its key activities and performance indicators.

In the example to the right, we see that for the critical work function of "Maintain a safe and productive work area," the following major categories of occupational and technical knowledge and skills are needed:

- Safety procedures
- Personal safety
- Safety policies and regulations
- Corrective action
- Safety training

For each of these categories, the standards include specific examples illustrating what types of knowledge and skill are needed.

Like the information on the academic and employability knowledge and skills, the occupational and technical knowledge and skills can be used to help workers identify what they need to know and be able to do to perform the work described by the skill standards. This information can also be used by training developers, providing them with more detail about how to prepare individuals to perform the work described by each critical work function.

Please note that the MSSC did not develop complexity ratings for the occupational and technical knowledge and skills. This may be a part of future research.

About the Work and About the Worker: A Powerful Combination

One of the real strengths of the MSSC skill standards is that they provide information about what needs to be done on the job (i.e., critical work functions, key activities, and performance indicators) and the knowledge and skills needed to achieve this performance. It may be tempting to use just one aspect of the skill standards in your efforts to improve the workforce, but the real power of

P3 Critical Work Function: **Maintain a safe and productive work area.**

Knowledge and Skills

Describes what a worker needs to know or be able to do to perform the critical work function

OCCUPATIONAL AND TECHNICAL KNOWLEDGE AND SKILLS

These are the technical knowledge and skills needed to perform the critical work function.

Skill Category	Specific Knowledge and Skills	Specific Knowledge and Skills
Safety Procedures	A. Knowledge of how to locate and use Material Safety Data Sheets (MSDS). B. Knowledge of company first aid or first response procedures. C. Knowledge of material handling techniques to safely move materials. D. Knowledge of how to be proactive in responding to a safety concern and document occurrences. E. Knowledge of emergency exits. F. Knowledge of various emergency alarms and procedures.	G. Knowledge of clean-up procedures for spills. H. Knowledge of Lock Out/Tag Out requirements. I. Knowledge of how to inspect work area and report possible safety risks. J. Knowledge of machine functions to determine if all safeguards are operational. K. Knowledge of safety procedures in case of smoke or chemical inhalation. L. Knowledge of procedures for handling hazardous materials.
Personal Safety	A. Skill in identifying and reporting unsafe conditions. B. Knowledge of safety issues related to hazardous materials. C. Knowledge of housekeeping needed to maintain a safe work environment.	D. Skill in determining if all safety guards are in place prior to machine operation. E. Knowledge of clothing and personal protective equipment (PPE) that should be worn to ensure safety.
Safety Policies and Regulations	A. Knowledge of basic filing procedures to properly store inspection records. B. Knowledge of safety requirements and environmental regulations related to performing inspections. C. Knowledge of policies and procedures needed to perform audits and train employees about hazardous conditions.	D. Knowledge of company safety standards for handling potential hazards. E. Knowledge of how to safely store, identify, and use hazardous materials and pressurized vessels. F. Knowledge of OSHA and other health and safety requirements as applied to the workplace.
Corrective Action	A. Knowledge of what constitutes an unsafe condition to be able to take corrective actions. B. Knowledge of required corrective action procedures.	C. Knowledge of accident documentation procedures.
Safety Training	A. Skill in developing and/or delivering safety training per guidelines.	B. Knowledge of health and safety education requirements.

About the Worker

the MSSC skill standards is that they cover both elements.

For example, if you are an educator developing curricula, you may be tempted to focus only on the knowledge and skills, but teaching the knowledge and skills in the context of the real demands of the workplace (as expressed by the critical work functions, key activities, and performance indicators) can often achieve the best results. Or, if you are an employer wishing to communicate your business goals to your workforce, you can use the critical work functions, key activities, and performance indicators to explain the kind of performance you need on the job, while communicating the knowledge and skills required to help individuals achieve that level of performance.

I Want to Find Out…

What is meant by "core knowledge and skills" and "specialty skill standards"

You just finished reviewing what the MSSC calls the Concentration Skill Standards. In addition the MSSC skill standards system includes Core Knowledge and Skills and Specialty Skill Standards:

Core Knowledge and Skills– Once the MSSC developed skill standards for all six concentrations, it looked across those concentrations to identify the knowledge and skills that are common and important across the six concentrations. These common skills form the MSSC Core Knowledge and Skills. Core Knowledge and Skills identify the knowledge and skills that will give individuals a broad-based introduction to many kinds of work across the manufacturing industry sector, cutting across the concentrations. To obtain MSSC certification, individuals will need to demonstrate mastery of the core knowledge and skills plus standards for at least one concentration.

Specialty Skill Standards – We have spoken a lot about portability of skills and certifications and how important it is to develop standards that apply across the entire manufacturing industry sector in order to achieve that goal. That's precisely what core and concentration skill standards enable us to do.

Although core knowledge and skills and concentration skill standards will cover a large part of what an individual needs to know and be able to do to succeed at work, they will not cover everything. The skills, knowledge, and performance unique to a specific job or occupation, a manufacturing subindustry, a specific technology, or a specific apprenticeship program will be covered by specialty skill standards. The MSSC is working to align these specialty skill standards and certifications with the MSSC skill standards system.

I Want to Find Out…

How to use the skill standards now and in the future

The MSSC is working to build a national assessment and certification system for the manufacturing sector, but there are many things you can begin doing now to make use of the skill standards. Here are some ideas.

I am:	Value of stand-alone MSSC Standards	Value of MSSC Assessments and Certifications
An Employer	• Help establish high-skilled jobs and career paths • Benchmark manufacturing processes to best practices • Plan organizational re-design and develop job descriptions • Work with line mangers, unions and employees to conduct training needs analyses • Develop or improve training programs • Work with local schools to develop curriculum and programs to prepare students for good manufacturing jobs	• Recruit or hire staff • Help your employees assess their skills and develop an individual training plan • Compare job profiles and interviewees
An Employee	• Plan your career path • Upgrade your existing skills and learn high-performance skills • Learn about the skills employers need and describe your skills to an employer • Support and promote best practices in your workplace	• Assess skills against MSSC standards • Obtain portable credentials for new and existing skills • Demonstrate qualifications to employers
An Educator/ Trainer	• Work with local manufacturers and unions to develop curriculum that meets skill needs • Identify teacher/trainer qualifications • Advise students on career opportunities in manufacturing	• Assess proficiency • Recommend certification
A Union Representative	• Encourage employers to develop or improve training programs • Bargain training dollars and programs for your members • Develop or improve union training programs • Negotiate new career paths for members • Help leverage public training dollars for manufacturing training	• Get recognition for members' existing knowledge and skills • Assess members skills and provide assistance in education/career planning • Credential members and workers in MSSC skill standards • Work with employers and public agencies to place union-credentialed workers in good manufacturing jobs
A Workforce Development Professional	• Work with employers and unions to incorporate standards into local labor market information and economic development systems • Build capacity of training providers to help workers attain standards • Build the use of standards into criteria for funding public job training programs	•Assess and credential participants in MSSC skill standards •Use MSSC credentials in job placement

MSSC skill standards were developed using rigorous research methods, including industry-wide validation. To ensure the use of the standards and their related assessments and certifications comply with U.S. employment law and civil rights law, employers are legally required to conduct an internal validation of the standards before using them to make hiring and promotion decisions, just as they do today for any new standards or tests they use.

I Want to Find Out…
What's next for the project

Work is under way within the MSSC to develop assessment tools and certification programs based on the skill standards. These tools and programs are part of the total MSSC system, and our mission will not be realized until these are complete.[2]

As the MSSC and its partners work to build the national assessment and certification system, we encourage you to begin using the skill standards. As a stand-alone tool, the standards allow employers and unions to do a better job of communicating skill needs to workers, educators, and trainers. Employees can use the standards to seek out training for career advancement. Educators and trainers can start to plan curricula based on the standards and communicate to students about the skills that employers expect.

In the long term, we need the leadership of company executives, employees, union leaders, educators, and economic development directors in using the standards in their workplaces and training programs. Other businesses, vendors, and suppliers will follow the innovators who begin to use the skill standards.

Most of all, we encourage you to get involved with the work of the MSSC. Start by giving us your feedback on the skill standards, either by completing the feedback form in the binder and faxing it to (202) 289-7618 or by completing a feedback form online at www.msscusa.org .

[2] The skill standards in this publication should not be viewed as potential substitutes for existing certification and apprenticeship programs. Although some aspects of the MSSC skill standards may overlap with existing certification and apprenticeship programs, the MSSC's mission is to provide assessments and certifications for manufacturing work where none currently exists. To do this, the MSSC plans to work with existing certification and Registered Apprenticeship programs to ensure our assessments and certifications complement and support, rather than duplicate, existing programs.

Special Thanks and Acknowledgement

For the past three years, the MSSC has been fortunate to have the dedication of several leading organizations and individuals who are committed to making workforce excellence an attainable goal for all American manufacturers. Although the list is too large to print in this document, the MSSC would like to extend a very special thank you to the following individuals for their leadership, expertise and exceptional work over the past few years:

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Mr. Skip Tenczar, Springfield Technical Community College, MA

MANUFACTURING SKILL STANDARDS COUNCIL

MSSC

Tools for Workforce Excellence

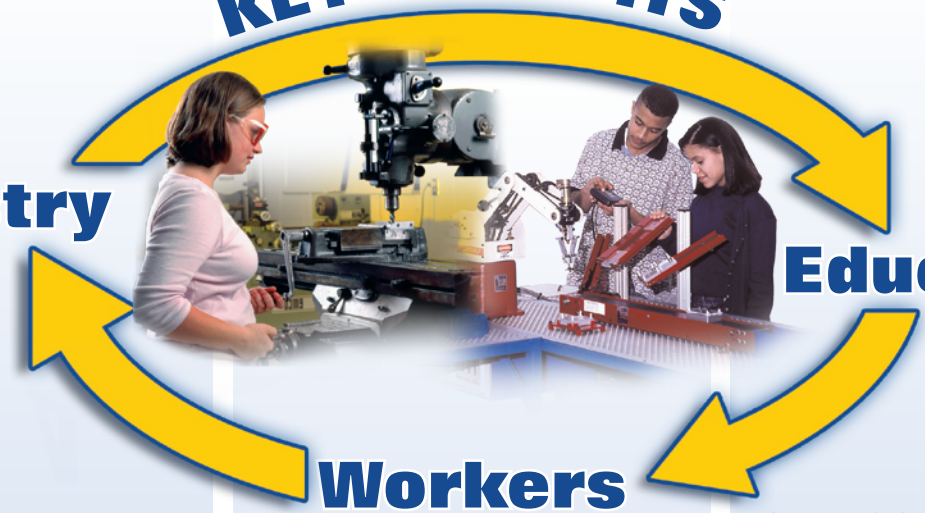
"Training the Industrial Athlete of the Future"

MSSC (Manufacturing Skill Standards Council) is a nationwide, industry-based skill standards, assessment and certification system for all sectors of manufacturing.

- U.S. Secretary of Labor Elaine Chao, November 2004

Modern manufacturing requires 21st century skills. The MSSC's vision is to equip America's workforce with the high-performance knowledge and skills necessary to boost the productivity, innovation, and competitiveness of U.S. manufacturers. Our goal is to train, assess, & credential forty percent of the nation's production workforce over the next ten years.

KEY BENEFITS



- Meet company needs for agile workers with the core knowledge skills to keep pace with technological change
- Decrease recruitment costs by providing job candidates with industry recognized credentials
- Increase worker productivity and innovation through multi-disciplinary skill-sets
- Provide diagnostic tool to benchmark workers against a high-performance national standard and identify skill gaps. Increase ROI for training by targeting those skill gaps
- Attract, motivate, and retain qualified employees

- Offer the only national, industry-recognized core skill certifications for production workers
- Improve career advancement opportunities and earnings by obtaining high-performance skills through MSSC training
- Improve job security through certification of proven skill sets
- Provide nationally portable credentials offering flexibility to work successfully in all manufacturing sectors and all production occupations

- Increase industry client base and student enrollment through MSSC network and nationally recognized certification-based training.
- Increase student enrollment through on demand e-learning solutions
- Provide fully developed courses for immediate implementation
- Offer high-quality courses with proven results
- Provide teacher certification to increase skills and opportunities for instruction

www.msscusa.org

The MSSC System

Standards

Industry-led, federally recognized, nationally validated standards explicable to all industry sectors.

TRAINING	**MSSC Courses**	• **Integrated Course** (140 hours) for all 4 MSSC Modules • **Modular Courses** (48 hours) for each Module • **"Fast Track"** Modular Courses (15-18 hours each) for experienced production workers
	MSSC Certified Instructors	3-day course
	Glencoe/McGraw-Hill MSSC Textbooks:	High-Performance Manufacturing: Portable Production Skills and Manufacturing Applications Booklet
ASSESSMENT	**Assessment**	Assessments in four, three-hour modules: Manufacturing Processes and Production, Safety, Quality Practices and Continuous Improvement, and Maintenance Awareness
	MSSC Certified Assessment Centers	Certified assessment centers across the US
CERTIFICATION	**Documentation & Certification of Individuals**	The fully designed MSSC documentation system consists of the following: 1. **"MSSC Production Technician"** Certificate for passing all four modules. 2. **"Recognition Award"** for passing each module. 3. A **score report** detailing areas for improvement. 4. A detailed **"Employer Diagnostic Tool"** benchmarking results for 10 or more workers against national scores.

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MANUFACTURING SKILL STANDARDS COUNCIL

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MSSC Assessment

MSSC certification is designed to validate that any individual with the certification has both the technical as well as employability and academic skills needed to work in modern manufacturing. Rigorous assessment is part of the fabric of MSSC to ensure the integrity of the certification. Certification covers MSSC's four core competency areas: Manufacturing Processes and Production, Maintenance Awareness, Quality and Continuous Improvement, and Safety. Each area is addressed with a separate assessment.

MSSC training and assessment address the need for employability and academic skills as well as technical skills. The assessments require mastery of core knowledge and skills that are essential to high performance manufacturing:

Employability Skills

- **Problem Solving**
- **Decision Making**
- **Teamwork**
- **Organization and Planning**
- **Social Interaction**
- **Adaptability**
- **Leadership**
- **Consensus Building**
- **Career Awareness and Self-Development**

Academic Skills

- **Math**
- **Science**
- **Reading**
- **Writing**
- **Listening**
- **Speaking**
- **Computer**
- **Gathering and Analyzing Information**

Once training is completed, participants may take the assessment for that topic. Following each assessment, a Certificate of Recognition is provided. All four key assessments must be passed in order to achieve the Production Technician certification. Should a participant not pass one of the assessments, they may re-take the assessment.

MANUFACTURING SKILL STANDARDS COUNCIL
MSSC
Tools for Workforce Excellence

MSSC Assessments

Manufacturing Processes and Production

- Awareness of customer needs
- Resources for production processes
- Equipment modes & set up
- Equipment monitoring
- Inspection to meet specs
- Product / process documentation
- Product preparation for shipping
- Machine automation
- Electrical principles
- Mechanical principles
- Pneumatic pressure and flow
- Bearings & couplings
- Belt and chain drives

Maintenance Awareness

- Preventive maintenance
- Routine repair
- Indicator monitoring
- Equipment maintenance training
- Maintenance of production schedule
- Analysis of breakdowns
- Alignment checks
- Lubrications and coolants
- Blueprint reading
- Circuit analysis
- Tool maintenance
- Preventive actions
- Corrective actions
- Verification and documentations

Quality and Continuous Improvement

- Internal quality audits
- Calibration of data collection equipment
- Continuous improvement
- Quality test documentation
- Quality maintenance adjustments
- Communication of quality problems
- Corrective actions
- Recording of process outcomes
- Quality training
- Closed-loop correction action
- Introduction to SPC

Safety

- Creation of a safe workplace
- Environmental safety inspections
- Emergency drills
- Correction of unsafe conditions
- Safety orientation training
- Safety equipment use
- Work environment safety
- Safety-related maintenance
- Equipment monitoring for safety
- Operator safety
- Communication of safety problems

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MSSC Training

MSSC offers complete training to enable workers to build the core knowledge and skills needed in modern manufacturing. Comprehensive courses, certified instructors, and excellent text reference material combine to create a valuable training experience. Qualified instructors implement courses to help workers and students develop or enhance their skills. Successfully passing four modular assessments leads to industry-recognized, nationally portable credentials.

Four key skill areas have emerged from the extensive work done across all manufacturing sectors: Manufacturing Process and Production, Safety, Quality and Continuous Improvement, and Maintenance Awareness. MSSC offers three flexible paths to achieve certification, depending on both the current level of worker / student knowledge as well as employer needs.

Integrated Course	Modular Course	Fast Track Courses
• 140 hours, full-time, intensive • Covers all 4 MSSC modules • All 4 assessments given at end of course • Best for dislocated workers, summer semester students	• 48 hours each, three-credit equivalent • One course for each of 4 MSSC modules • Assessments given at end of each course • Best for students in academic semesters	• 15-18 hours each • One course for each of 4 MSSC modules • Assessments given at end of each course • Best for experienced incumbent workers

"The MSSC System provides industry with a new set of tools to ensure that both entering and incumbent workers are flexible, easily trainable, and highly motivated 'knowledge workers' in the high-performance work organizations of the 21st Century."

- James McCaslin, President and COO, Harley-Davidson Motor Company

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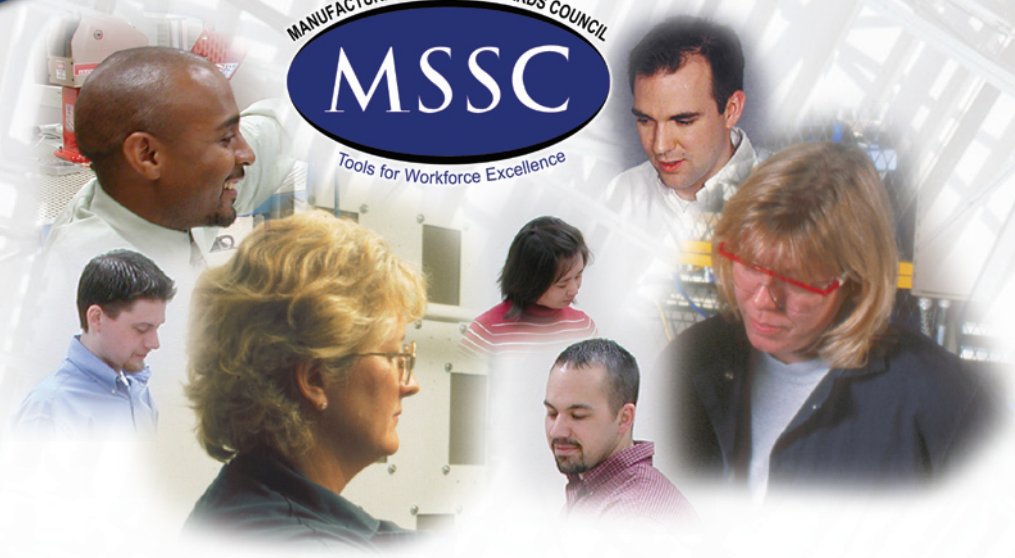


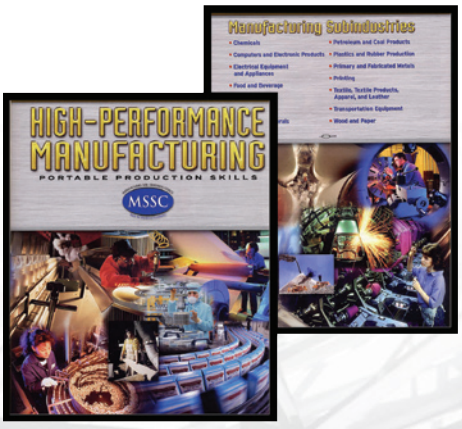
Course Overview

Courses are delivered through educational institutions such as community colleges and high schools throughout the United States. A blended learning approach is used where both instructor-led and e-learning instruction are leveraged to expand knowledge and develop industry critical skills. MSSC has partnered with Amatrol, Inc. to develop a rich array of virtual technical material. Participants develop high performance manufacturing skills through lectures, self-paced studies, on-line labs, "homework", presentations, and individual / group activities.

This set of classes provides opportunities for workers and students to build core skills and knowledge needed for high performance manufacturing. The courses examine fundamentals and interrelationships in areas for production (manufacturing processes, maintenance awareness, quality, and safety). "Stepping back" and understanding manufacturing as a system helps participants become flexible, learn to evaluate the impact of decisions, solve problems, be innovative, and contribute more fully to advanced manufacturing firms.

Instructor Certification

MSSC offers a 3-day training course to certify instructors in ways to teach MSSC courses in different learning environments. An instructor's package is provided that includes all materials needed by the instructor: power point presentations, facilitator notes, visuals, play maps, unit completion times, optional delivery methods, math problems and answers, and facilitator notes.



Text Reference

MSSC training uses McGraw Hill / Glencoe's superb High-Performance Manufacturing text as part of the learning experience.

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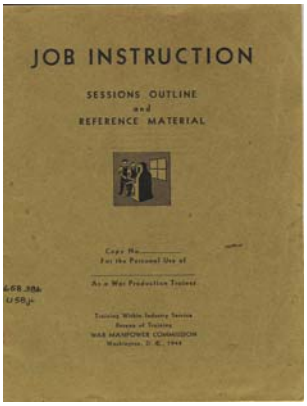
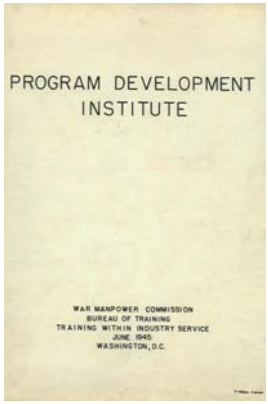
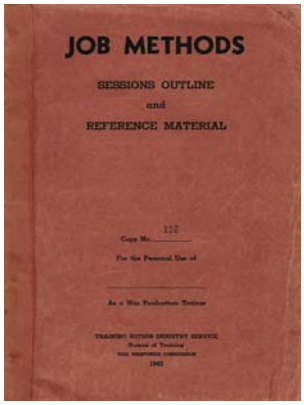
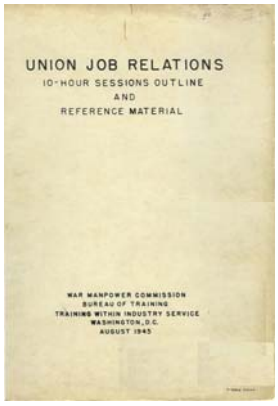
The Roots of Lean

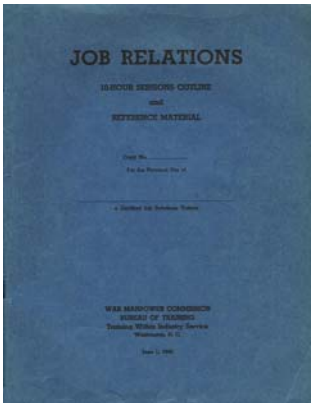
Training Within Industry: The Origin of Japanese Management and Kaizen











Jim Huntzinger

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ABSTRACT

The Training Within Industry Service (TWI) was established in 1940 during World War II to increase production output to support the Allied Forces war effort. The TWI Service was lead by the Four Horsemen, as they became known during WWII: Channing Rice Dooley, director of the TWI Service; Walter Dietz, associate director; Mike Kane, assistant director; and William Conover, assistant director. Three of the four men had met while serving in a training capacity during World War I using methods developed by Charles Allen. Charles Allen's training methodology, developed prior to World War I for shipbuilding, would become the key to the methods developed by the Four Horsemen during their TWI Service.

From Allen's four-step training method the "J" programs would evolve and have a major impact on manufacturing in the United States during the war. The "J" programs were:

- Job Instruction
- Job Methods
- Job Relations
- Program Development

These programs were incorporated into industry by a large network of trainers set-up throughout the country by the TWI Service. They focused on the interface between supervisors and employees and proved invaluable to the United States' industrial support of the war effort.

After the defeat of Japan the occupational forces realized that in order for Japan to rise from the destruction they had received as a result of the war and to prevent chaos in the defeated country, Japan needed support in rebuilding their industrial infrastructure. The programs developed by the TWI Service were just what were needed to help the new Japanese management accomplish this goal.

A former TWI trainer and his group were contracted to come to Japan and begin the training process. They used the multiplier effect (training trainers who would be the core to train more trainers) to get the program started. Several Japanese agencies picked-up the training and promoted it at a national level. The massive training of the TWI's programs over the following decades in all facets of Japanese industry pushed the principles taught to become an integral part of what is known today as *Japanese Management*. A major key of these methods is *kaizen*, which has its source from the TWI and Charles Allen.

A review of some basic philosophies of Japanese management and kaizen proves that they are actually an evolution of a training technique developed nearly ninety years earlier in the United States. The techniques have evolved through the TWI programs of WWII and their infiltration into Japanese industry by the Allied occupational forces. They continued to evolve in post-war-Japan through today to become some of the most successful management techniques in use today in industry. The table below compares the basic four-steps of this training through this century.

Steps	Charles Allen	TWI			Kaizen
		Job Instruction	Job Methods	Job Relations	
1	Preparation	Prepare	Breakdown	Get the Facts	Observe and Time Current Process
2	Presentation	Present	Question	Weigh and Decide	Analyze Current Process
3	Application	Try Out	Develop	Take Action	Implement and Test New Process
4	Testing	Follow Up	Apply	Check Results	Document New Standard

Table 1: Comparison of Steps

SOURCE: Created by the author.

The ironic twist of these management principles is that even though they have their roots in the United States, today American companies struggle to use them to the successful level that some of their Japanese competitors do.

What Was TWI and Why Was It Formed

What was the Training Within Industry Service, TWI? What does it have to do with modern manufacturing techniques? The answer is everything. For those who have heard of lean manufacturing, Japanese management methods, and kaizen, TWI may well be the ground zero of these modern manufacturing philosophies that have developed into the most promising methods in industry today.

The TWI Service was started and developed to support industry for the United States war effort during World War II. It was established in August of 1940 by the National Defense Advisory Commission and eventually was moved under the Federal Security Agency to function as a part of the new War Manpower Commission on April 18, 1942.[1] It would remain under the War Manpower Commission throughout the rest of its existence, which ceased operation in September of 1945.

TWI was one of the first emergency services to be organized after the Fall of France on June 20, 1940[2]. As the war escalated, the Allied Forces (even prior to the United States' entry into the war) needed significant war supplies. This need greatly increased the production levels in all types of industry. The United States government realized this situation and began steps to help cover the demand of war products. Many companies were receiving increasing orders for existing and new products, which exceeded their ability to respond. It also became apparent that if the United States would enter the war, the situation would become even more critical. The TWI service was started to increase production in order to meet the serious demand that has risen upon industry. It focused on war contractors and other necessary war supply manufacturers, which continued to grow in numbers as companies transitioned to war production.

TWI established a nation-wide network of industrial professionals to teach valuable techniques to the manufacturers of war products. The network would be made up of a volunteer staff of people, some full-time and some part-time, from private industry on

[1] Labor Division, War Production Board, Training Within Industry Service, January 1943, *The Training Within Industry Program, Bulletin No. 1* (Washington D.C.: U.S. Government Printing Office), p. 3.
[2] War Production Board, Bureau of Training, Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, (Washington D.C.: U.S. Government Printing Office), p. 3.

loan from their companies. *The real job had to be done by industry, within industry*.[3] This emphasis was critical to create a legitimate organization that would be accepted by manufacturers. Also, for the same reason, TWI was never forced into any plant, but served only by invitation and acceptance of the plant's own management.

The Four Horsemen

The Four Horsemen, as they would become known for their leadership and service, were Channing Rice Dooley, Director of the TWI Service; Walter Dietz, Associate Director; Mike Kane, Assistant Director; and William Conover, Assistant Director. Dooley and Dietz were both graduates of Purdue University and had extensive industrial experience as well as previous government service in training issues during World War I. They both generously accepted the assignment to be on loan from their companies to coordinate and develop the TWI program. During their WWI assignment they had worked together and were both familiar with Charles Allen's four-step method of training. (As will be explained later, this method of training became the backbone of the TWI's programs.) Kane had been involved with industrial training most of his career and had worked directly with Charles Allen during the training of shipyard employees during WWI. He had known Dooley and Dietz from the experience with WWI. Conover had also been involved with industrial relations and training during his professional career.

The Four Horsemen were the leadership and drive of the TWI Service and it was their vision and experience that would help the TWI programs become a major success. Although it was the combined contribution of a huge number of people from industry to develop and deploy the objectives of the TWI Service, the Four Horsemen understood the magnitude of the task and what would be needed from industry and the government to evolve and guide the process.

The Results of TWI

The effectiveness of the TWI Service was very dramatic during the course of the war. *The Training Within Industry Report: 1940-1945* gives many details of the results of the programs and how TWI tracked the impact of their service throughout its existence. Given below is the tabulation of results collected by TWI at seven different intervals during its service.

	Percentage of Plants Reporting Results of 25 Percent and Over						
	May 1943	Sept. 1943	Feb. 1944	Nov. 1944	April 1945	July 1945	Sept. 1945
Production increased	37	30	62	76	64	63	86
Training time reduced	48	69	79	92	96	95	100
Manpower saved	11	39	47	73	84	74	88
Scrap loss reduced	11	11	53	20	61	66	55
Grievances reduced	(Not reported)		55	65	96	100	100

Table 2: TWI Plant Results

SOURCE: War Production Board, Bureau of Training, Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, (Washington D.C.: U.S. Government Printing Office), page 92.

[3] Ibid., p. 6.

The number of industry people to go through the five, two-hour sessions for each training program was quite large. Even though the number of those who attended the sessions does not necessarily directly translate to results, it does give an idea of the magnitude of coverage the TWI Service achieved during its short five-year existence. Considering that all of the programs had to be developed and that the Service actually started down the consulting path during its first year, the number of people trained is quite impressive.

> *When TWI operating service ended September 30, 1945, the following certification totals appeared:*
>
> *Job Instruction……..1,005,170*
> *Job Methods……...244,773*
> *Job Relations……490,022*
> *Union Job Relations……..8,856*
> *Program Development……..1,829*
>
> *Total……1,750,650*
>
> *These people have been trained in 16,511 plants and unions, in every kind and size of war industry and essential service…*[4]

How TWI Evolved During WWII

The purpose of the TWI program was directly stated in its overview bulletin,

> *To assist war production industries to meet their manpower needs by training within industry each worker to make the fullest use of his best skill up to the maximum of his individual ability, thereby enabling production to keep pace with war demands.*[5]

This objective would guide the leaders of TWI as they continued to develop the best means to apply the service during it five-year existence. The development process was very laborious, but resulted in excellent field-tested methods and procedures.

The First Effort

The initial effort was to use the TWI network of people for consulting plants on how to solve many of their production issues. The leaders of the TWI quickly learned that this method would not be adequate to help the ever-increasing number of plants requiring assistance. Despite the fact that a large portion of TWI's initial effort was promoting their services, the drain on their resources steadily increased. TWI had developed bulletins, surveys, and speaking engagements in order to "sell" their program. This process was not easy because many plants had not yet felt the pressure of training issues or thought that they did not have the time available.

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[4] Ibid., p. 126.
[5] Labor Division, War Production Board, Training Within Industry Service, January 1943, *The Training Within Industry Program, Bulletin No. 1* (Washington D.C.: U.S. Government Printing Office), p. 3.

Despite the need to sell TWI services, the strains of spreading themselves too thin continued. As the TWI leaders soon discovered, problems developed because the TWI personnel were needed as consultants and manufacturing plants were continually asking for TWI assistance with their various in-house problems. As a result, these two issues quickly overloaded the limited resources of TWI's network. Trying to tackle problems in the role of a consultant consumed a large amount of time, which was not possible if TWI members were to help the war supply industry as a whole. The in-house problems companies desired help with included machinery, material, and manpower – from labor disputes to safety problems. Beyond this, the number of defense plants continued to mushroom. Although this period during TWI service grew to be chaotic, it gave them a great lesson about what TWI should focus on to truly help industry in the war effort.

The Second Effort

The initial chaotic period of trying to organize the TWI Service redirected it toward a new plan and focus. A paragraph out of Walter Dietz's book explains what they did.

> *The district heads met in Washington where experiences were exchanged and ideas discussed. It was decided to make a major shift in the whole approach to the task and some of the original plans, such as giving contractors a consulting service on a broad range of in-plant training problems, were abandoned. Instead, the needs of the supervisors were to be the area of concentration because the serious shortage of experienced men had forced numerous plants to appoint many who were not qualified to do the job.*[6]

The new objective gave TWI the direction it would need to be successful throughout the rest of its tenure. The focus on supervisors and their interface with employees would be the critical factor needed to support the war effort. This factor is also one of the key foundations from which Japanese management methods evolved. This correlation will be illustrated below.

TWI leadership realized that the methods developed would need to be taught successfully by a wide range of trainers with differing amounts of experience and skill in a large variety of industries. In addition, this information would be delivered to an enormous number of plant supervisors possessing various levels of knowledge and experience. It was quite a daunting task and the training methods would have to be absolutely bulletproof. This issue is where Charles Allen's four-step method would play a significant role.

The Origin Of The TWI Methodology

What would be the cornerstone of TWI Service's training program was developed from methodology introduced by Dooley, Dietz, and Kane. All three gentlemen had been involved in training assignments during World War I. They used this experience to develop the TWI training programs used during World War II.

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[6] Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry* (Summit, NJ: Walter Dietz), p. 13.

Charles R. Allen

During World War I, the Emergency Fleet Corporation of the United States Shipping Board implemented an urgent training program to support the training of shipyard workers due to a ten-fold increase in demand of the number of workers required. Due to this demand, only non-experienced workers were available and they needed to be trained.

Charles Allen had been a vocational instructor who had developed and presented his views on industrial training prior to WWI and later in his book published in 1919. Therefore, Allen was asked to head the training program set-up by the Emergency Fleet Corporation to address the vast training need of the shipyard workers. Allen used his four-step method, as described below, to train the shipyard workers:

> *…each complete teaching lesson calls for four steps, or teaching operations known as step 1, Preparation, step 2, Presentation, step 3, Application and step 4, Testing (or Inspection). These steps, are always carried out in the order given – The purpose of step 1 is to get the learner ready to be instructed, of step 2 to instruct him, of step 3 to check up errors, and of step 4 to give a final inspection of the instruction job.*[7]

Charles Allen's methods and philosophies also describe how to choose the best trainers, what an industrial trainer is, what he needs to know and do, and details the essence of what is and is not effective instruction. These and many other of Allen's lessons are completely interwoven in the methods and practices of the TWI program. In fact, within the first few pages of his book, Allen states its purpose:

> *This book is intended, therefore, to serve two purposes – to serve as a handbook to instructors in industrial plants, and also to serve as "instruction notes" in instructor training courses.*[8]

Allen's four-step method was the basis for all of the training programs developed and dispersed by the TWI during WWII. It was a known and proven method that had been around for thirty years. Barring a few dated phrases, the methods presented in Allen's book are just as valid and applicable today as they were in the early part of the century (WWI) as well as the middle of the century (WWII).

The Importance of Training

Allen recognized and stressed the importance of proper training in industry. He discussed how improperly trained employees create excess cost and that the cheapest method to use only well-trained people from the start.

> *…three factors in efficient production…The instructor, because it is through effective instruction that we can secure efficiency in training. The man, because when properly trained he does the best work. The job, because production efficiency comes from well instructed men doing good jobs.*[9]

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[7] Charles R. Allen, 1919, *The Instructor The Man and The Job*, J.B. (Lippincott Company; Philadelphia and London), p. 129.
[8] Ibid., p. iv.
[9] Ibid., p. 3.

To achieve the best training four principles must be applied; standards must be set, good instruction must be established, continued training must be maintained, and training must not end too soon. These principles must become an integral part of a company's process of business. These items seem to be common sense, but how many companies have this type of program in place and have mastered it even if they do?

Allen devotes much of the book to not only his four-step method of training, but to methods of instruction and effective conditions of instruction. He illustrates much of his work with shop examples and emphasizes the importance of getting the "interest" of the learner, or making the learner want to learn. He also covers in great detail the importance of selecting the correct people to be trainers, how the trainer should and should not instruct, and how the trainer should develop, organize, and deploy the training. Even though Allen's training methods are straightforward and seem like common sense, they are not very common in today's manufacturing companies.

The Four-Step Process

Charles Allen's 4-Step process was the basis for TWI's training program. The first step, preparation, focuses on, creating in the learner's mind, a connection between their past experience and the lesson to be taught. Although the learner may have no industrial experience, a good instructor will find an analogy or story, which will lead the learner to relate the present teaching objective to something he knows. Allen emphasizes that even when teaching the simplest skills or jobs, preparation is key to increasing the effectiveness of instruction. It may be stated that tying in a past experience, even though simple or only indirectly related, directs the learner's thoughts to the task at hand and establishes an "interest" for the learner. It is most likely for this reason that Allen dedicates several chapters in his book to the methods of gaining the interest of the learner.

The second step, presentation, is in Allen's words; "to lead him to 'get' the new idea which the instructor desires to 'tack on' to what he (learner) already knows". Presentation imparts a piece of knowledge to the person being trained, and each piece is only a small part of a larger lesson. An effort must be made by the instructor not to give too much information at one time. This will result in focusing on the individual point to be taught. The format of the presentation step is a well-organized process established prior to the lesson with methods chosen to allow the best direction and theme of the lesson. The presentation process developed is selected from a variety of methods, as detailed throughout the book, based on both the type of job and the characteristics and level of the learner. The effectiveness of developing the best method of presentation is completely dependent on the skill of the instructor in the following areas: selection of the proper method, organization of the lesson points, and emphasis of the most important points.

Application, the third step, establishes if the learner can "do it." Even though the learner may be in the right frame of mind (step 1) and the instructor did an excellent job of presenting the lesson (step 2), the question remains if the new knowledge can be applied. Allen stresses in step 3 that the learning contains no value unless the person can actually do it and do it correctly. The application step has two purposes:

1) *…since power to apply a thing is different from simply knowing it, he must be trained in actually applying, or putting into practice what was presented*
2) *…to check up the degree to which the learner has grasped all the points in the lesson*[10]

Another important point Allen discusses is that no matter how well the lesson has been taught, mistakes will be made and must be corrected in this step.

The final step, testing, is simply allowing the learner to do the job unaided, but viewed by the instructor. If the learner fails to do the work independently, it is a result of the instructor not implementing the proper teaching method. The instruction must be improved and repeated. He emphasizes that if each of the lesson steps had been carefully and properly developed and taught, the learner would not have failed during the test step. The fault lies completely with the instructor. Allen does explain how this situation is common and that true instruction is not an easy skill to learn. Much practice and experience are part of developing a good instructor. The person who can successfully achieve the fourth step with a learner is a rare and valuable asset. The final step is as much of a test for the instructor as it is for the learner.

Allen's 4 Step method of instruction is a series of building blocks with each one completely dependent on the previous step to be successful. Allen's explanation of his four-step method indicates that it is a method of correctly stringing together a series of *One-Point* lessons, which is common today in many companies that use lean principles or Japanese Management methods. Each individual lesson within the overall lesson must have a stand-alone point that must be understood by the learner while connected to the entire lesson. Although the explanation of the 4 steps are only four chapters of Allen's book, nearly all of the other chapters present ideas, philosophies, examples, procedures, and methods on how to understand, prepare, develop, and deliver the 4 steps successfully, or simply how to be an effective instructor.

The Courses

The connection between Charles Allen's methods and TWI's Service training program came directly from the leaders of TWI. Kane had been a member of the Emergency Fleet Corporation group under Charles Allen during the First World War. Dooley and Dietz had been on assignment for the War Department during WWI and knew Allen and Kane, as well as Allen's training methods. In fact, in *The Training Within Industry Report 1940-1945*, significant discussion is given to the work of Allen and his emphasis on stressing the difference between "teaching and telling" and "instructing and showing." The importance of teaching and instructing instead of telling and showing became the main foundation of the TWI programs, ***learning by doing***, which translates to solving problems on the job with the guidance of a properly trained instructor.[11] The *learn-by-doing* approach would become an integral part of TWI's philosophy of training.

[10] Ibid., p. 139.
[11] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, pp. 185-190.

The Five Needs of a Supervisor

TWI continued to "sell" its service to production facilities. In order to explain to manufacturing plants why the TWI programs were beneficial, TWI developed a philosophy, which was delivered continually and became a standard part of the TWI Service. This philosophy was known as:

Every Supervisor has Five Needs:
1. Knowledge of the Work
2. Knowledge of Responsibility
3. Skill in Instructing
4. Skill in Improving Methods
5. Skill in Leading[12]

The first two needs were the responsibility of the plant or company to establish for the supervisor. This information covered equipment, products, and the skills required to manufacture them, as well as company policies, agreements, and schedules. TWI assisted companies in giving their supervisors the training to attain the last three needs. As will be discussed below, each of the three "J" programs targeted one of the three supervisor skills. These skills must be learned and practiced in order for production levels to be met and increased, especially with industry circumstances in the United States at the time.

The J-Programs

The "J" programs, as they became know as, were modeled from Allen's four-step method for training. Kane used the four-step method during one of TWI's initial program requests. A shortage of trained lens-grinders and polishers resulted in a severe lens shortage and thus, a call to the TWI Service. Kane used the four-step method to develop a 7-Step method combined with a "key points" concept to decrease the time required to train lens-grinders and polishers from years down to months. The key points concept was developed during the lens crisis. Kane discovered that, although there were a large number of operations to learn to manufacturer lenses, only a small number of the operations were difficult to master. Also, only a few steps within the vital operations were critical to understand how to successfully master the technique. As Dietz would later state, "In essence, "Key Points" means simply this: much of the supposedly difficult work in any industrial operation is relatively simple".[13] Combining his modified "Steps" with the newly developed "Key Points," Kane had not only significantly improved training for the lens crisis, but also established what would become the cornerstone of TWI's training program.

Job Instruction

Charles Allen's four-step method of industrial instruct would be used to develop the five session (two hours each) training program for Job Instruction. The first two sessions would cover the presentation and discussion of the instruction method developed and the last three sessions were used for actual practice of the method. All of the participants were to use an instruction method being taught to members of their department for actual application of the methods presented and then report back to the group during the sessions. This actual application was based on the slogan adapted by TWI, "*If the*

[12] Ibid., pp. 48-49.
[13] Dietz, p. 4.

learner hasn't learned, the teacher hasn't taught"[14]. This approach was yet another philosophy that the TWI Service borrowed from Charles Allen. Allen had repeatedly reinforced this statement, or better yet attitude, in his book and in his own instruction. TWI's mission would incorporate this approach during development and implementation of their training programs.

Job Instruction would not be officially released until it had been used, evaluated, and revised multiple times. In fact, all of the training programs would be developed in the same manner. TWI would develop the instruction method by using it in many plants and then use the feedback from the plants along with their own assessment of how effectively it accomplished its task. This approach was used to develop a sure-fire method to be successfully used in all industries, and also so that it was a method developed for industry by industry. The leaders of the TWI Service, even though they were from industry, believed that "for industry by industry" was critical for the program's acceptance and success.

Job Instruction focused on *instructing employees rather than "letting them learn*"[15]. This focus was present even prior to development of the training program and continued throughput the existence of the TWI Service. A training manual developed by the Western Electric Company during the war was published by TWI and re-emphasized this focus. It also relied on Charles Allen's four-step method and job analysis technique for developing good training methods. The manual developed, *Job Instruction: A Manual for Shop Supervisors and Instructors*, reads like a summary of Allen's book and references two of Allen's training books in its bibliography. The manual states:

> *Good teaching is helping people to learn without getting in their way of learning. Poor teaching may actually hinder their learning.*[16]

The Job Instruction training manual was developed to tackle one of the first issues realized after TWI refocused their efforts. With the steady increase in production demand combined with the decrease of experienced employees, training new personnel became a critical factor. TWI introduced Job Instruction training to help alleviate the problem. With Allen's four-step method as the backbone of the training, significant improvements were made in a large number of war production facilities.

The Job Instruction training manual referenced Job Instruction cards and their use during the training sessions. All persons attending were issued a card. The front of the card outlines the instructor or supervisor's procedure for "getting ready" to instruct. This procedure is similar to Allen's technique proposed in his book. The back of the card outlines the four-step method of *How to Instruct*. The small pocket-sized card was an important training tool. The card was to be carried by the supervisors at all times as a reminder of and reference to the methods they had been trained to use on their jobs. Pictures of the original Job Instruction cards are shown below.

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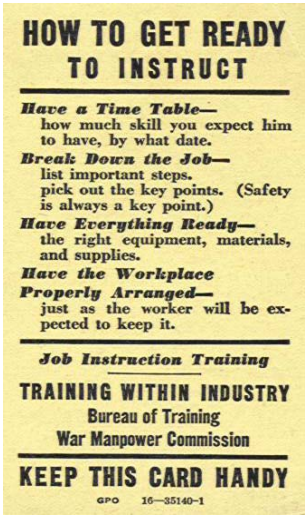
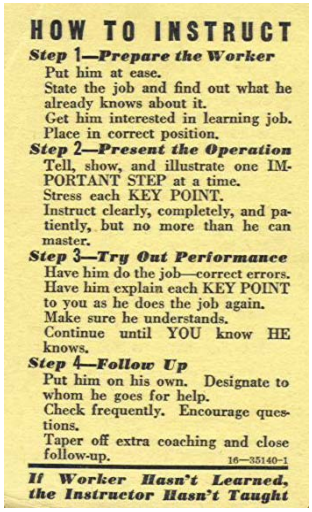
[14] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 193.

[15] Labor Division, Office of Production Management, Training Within Industry Service, August 1941, *How To Train Production Operators* (Washington D.C.: U.S. Government Printing Office), p. 1.

[16] Labor Division, War Production Board, Training Within Industry Service, date not given, *Job Instruction: A Manual for Shop Supervisors and Instructors* (Washington D.C.: U.S. Government Printing Office), p. 1.



Front of the Job Instruction Card



Back of the Job Instruction Card

Figure 3: TWI Job Instruction Card

SOURCE: War Production Board, Bureau of Training, Training Within Industry Service, 1944, *Job Instruction: Sessions Outline and Reference Material* (Washington D.C.: U.S. Government Printing Office), Inside back cover.

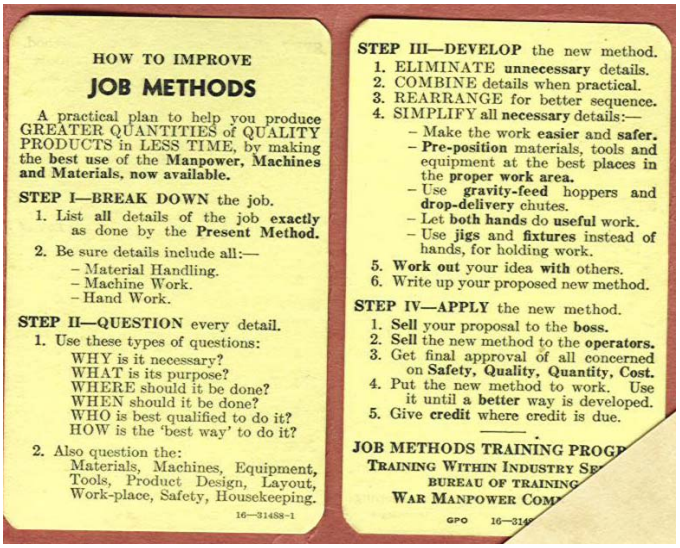
Job Methods

The objective of Job Methods training was to give supervisors a technique to achieve obvious improvements in the work area using a practical approach instead of a technical approach. Use of this philosophy provides a universal procedure that would be successful in all types of war production plants.

> *…the objective of helping the supervisors to produce greater quantities of quality products in less time, by making the best use of the manpower, machines, and material now available.*[17]

The four-step method was again used to develop the training procedure. Within the method, a procedure for breaking down jobs was critical for developing a new and improved way to do the job. A simple demonstration of assembling a radio shield was used during the training session to illustrate how to breakdown the "present" method and implement a new way for the "proposed" or improved method. The aim of the Job Methods program was to prevent supervisors from presenting ideas that were incomplete or flawed. By following the four-step Job Methods procedure, the supervisors would discover improvements during this process and create a feasible solution before presenting it to management. An outline of the procedure, like Job Instruction, was printed and given to the trainees on a small pocketsize card for continued reference. An illustration of the Job Methods card is shown below. A similarity to the method used for implementing KAIZEN can be seen in the steps detailed on the card. The reason for this will be discussed later. Job Methods proved to be another very successful program for the TWI Service.

[17] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 230.



HOW TO IMPROVE

JOB METHODS

A practical plan to help you produce GREATER QUANTITIES of QUALITY PRODUCTS in LESS TIME, by making the **best use** of the **Manpower, Machines and Materials, now available.**

STEP I—BREAK DOWN the job.

1. List **all** details of the job **exactly** as done by the **Present Method.**
2. Be sure details include all:—
   - Material Handling.
   - Machine Work.
   - Hand Work.

STEP II—QUESTION every detail.

1. Use these types of questions:
   WHY is it necessary?
   WHAT is its purpose?
   WHERE should it be done?
   WHEN should it be done?
   WHO is best qualified to do it?
   HOW is the 'best way' to do it?
2. Also question the:
   Materials, Machines, Equipment, Tools, Product Design, Layout, Work-place, Safety, Housekeeping.

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STEP III—DEVELOP the new method.

1. ELIMINATE **unnecessary** details.
2. COMBINE details when practical.
3. REARRANGE for better sequence.
4. SIMPLIFY all **necessary** details:—
   - Make the work **easier** and **safer.**
   - **Pre-position** materials, tools and equipment at the best places in the **proper work area.**
   - Use **gravity-feed** hoppers and **drop-delivery** chutes.
   - Let **both hands** do **useful** work.
   - Use **jigs** and **fixtures** instead of hands, for holding work.
5. **Work out** your idea **with** others.
6. Write up your proposed new method.

STEP IV—APPLY the new method.

1. **Sell** your proposal to the **boss.**
2. **Sell** the new method to the **operators.**
3. Get final approval of all concerned on **Safety, Quality, Quantity, Cost.**
4. Put the new method to work. Use it until a **better** way is developed.
5. Give **credit** where credit is due.

JOB METHODS TRAINING PROGR
TRAINING WITHIN INDUSTRY SE
BUREAU OF TRAINING
WAR MANPOWER COM
GPO 16—314

Front and Back of the Job Methods Card

Figure 4: TWI Job Methods Card

SOURCE: War Production Board, Bureau of Training, Training Within Industry Service, 1943, *Job Methods: Sessions Outline and Reference Material* (Washington D.C.: U.S. Government Printing Office), Inside back cover.

Job Relations

The Job Relations program was implemented mainly due to need:

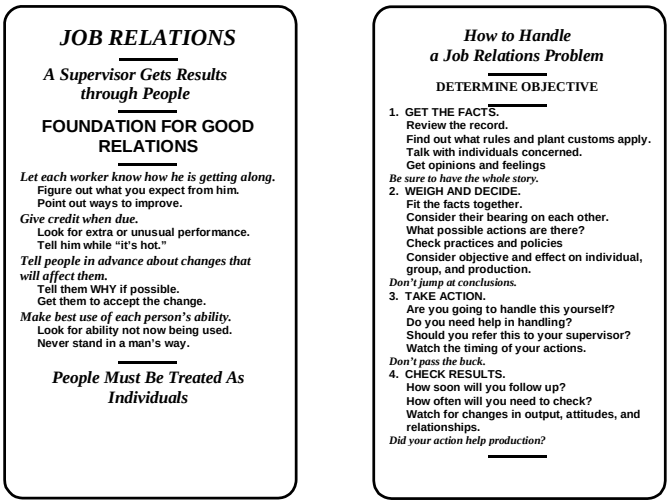
> *…that supervisors needed a great deal of help in human relations – the art of handling men.*[18]

Although the need was that of human relations between supervisors and their subordinates, it was titled with the term "job" in order to relate the program to the job, as were all of the "J" programs. With this emphasis in mind, a theme of *poor relationships causes poor results* in production and *good relations lead to good results* on the job would be the underlying objective of the Job Relations procedures developed.[19] Much of the program's emphasis was placed on teaching the importance of understanding and resolving small issues before they became large, widespread issues. During development of Job Relations training, some universal and fundamental elements were discovered. These elements became the foundation of the Job Relations program with the most vital skill for any supervisor to achieve being: *People Must be treated as individuals*[20].

As with the other two "J" programs, the four-step method was used to develop the Job Relations procedures, thus securing the underlying principles. The training sessions consisted of explaining the principles using everyday case studies involving a fictitious supervisor and his employee. Each of the four steps would be presented in a case study showing and how the supervisor handled the situation. This method was used to present

[18] Dietz, p. 19.
[19] Bird McCord, "Job Instruction," Robert L. Craig (ed.), 1976, *The Training and Development Handbook – A Guide to Human Resource Development*, 2nd ed. (New York: McGraw-Hill), p. 32-17.
[20] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 40.

the lesson to the group. Each attendee was then required to use the process in their area of responsibility and report the results back to the class. Again, a Job Relations card was made and given to each training attendee for reference. The outline for the Job Relations process is listed on the Job Relations card illustrated below.



JOB RELATIONS

A Supervisor Gets Results through People

FOUNDATION FOR GOOD RELATIONS

Let each worker know how he is getting along.
Figure out what you expect from him.
Point out ways to improve.

Give credit when due.
Look for extra or unusual performance.
Tell him while "it's hot."

Tell people in advance about changes that will affect them.
Tell them WHY if possible.
Get them to accept the change.

Make best use of each person's ability.
Look for ability not now being used.
Never stand in a man's way.

People Must Be Treated As Individuals

How to Handle a Job Relations Problem

DETERMINE OBJECTIVE

1. **GET THE FACTS.**
   Review the record.
   Find out what rules and plant customs apply.
   Talk with individuals concerned.
   Get opinions and feelings

Be sure to have the whole story.

2. **WEIGH AND DECIDE.**
   Fit the facts together.
   Consider their bearing on each other.
   What possible actions are there?
   Check practices and policies
   Consider objective and effect on individual, group, and production.

Don't jump at conclusions.

3. **TAKE ACTION.**
   Are you going to handle this yourself?
   Do you need help in handling?
   Should you refer this to your supervisor?
   Watch the timing of your actions.

Don't pass the buck.

4. **CHECK RESULTS.**
   How soon will you follow up?
   How often will you need to check?
   Watch for changes in output, attitudes, and relationships.

Did your action help production?

Front and Back of the Job Relations Card

Figure 5: TWI Job Relations Card

SOURCE: Adapted from Bird McCord, "Job Instruction," Robert L. Craig (ed.), 1976, *The Training and Development Handbook – A Guide to Human Resource Development*, 2nd ed. (New York: McGraw-Hill), p. 32-22.

Union Job Relations

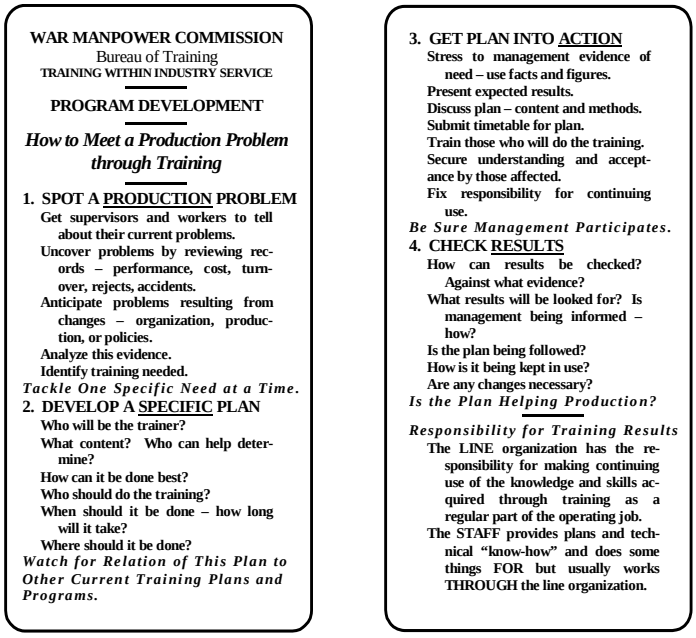
In February of 1945, the TWI Service released a Union Job Relations training manual. Development and issue of this manual resulted from many plants with unions using marked-up copies of the Job Relations manual in training of their union stewards. The Union Job Relations manual was a modified version of the Job Relation manual with the focus on union stewards instead of supervisors. It also used union problems in the four case studies to be taught.[21] The basic format was the same as the Job Relations manual. Union leadership throughout the country was very supportive of the "J" programs and found them helpful to their membership.

Program Development

Program Development was organized as a means to show plants how to set-up and administer training within their own facility using their own people. As was now standard for TWI, it utilized the four-step method and Key Points to present procedures for plant personnel to solve their company's own production problems through a training program using the "J" programs as a base. Program Development was developed using input from many experts within industry to maintain TWI's premise of "for industry by industry." A series of conferences was used to gather information, put together an outline, and develop the procedure into an accepted and usable form. Several iterations of Program Development resulted during its evolution including different names for the

[21] Ibid., pp. 220-221.

program and changing outlines. Upon its final release, a Program Development card was available and listed the four-step method as it appears in the illustration below.



WAR MANPOWER COMMISSION
Bureau of Training
TRAINING WITHIN INDUSTRY SERVICE

PROGRAM DEVELOPMENT

How to Meet a Production Problem through Training

1. SPOT A PRODUCTION PROBLEM
- Get supervisors and workers to tell about their current problems.
- Uncover problems by reviewing records – performance, cost, turnover, rejects, accidents.
- Anticipate problems resulting from changes – organization, production, or policies.
- Analyze this evidence.
- Identify training needed.

Tackle One Specific Need at a Time.

2. DEVELOP A SPECIFIC PLAN
- Who will be the trainer?
- What content? Who can help determine?
- How can it be done best?
- Who should do the training?
- When should it be done – how long will it take?
- Where should it be done?

Watch for Relation of This Plan to Other Current Training Plans and Programs.

3. GET PLAN INTO ACTION
- Stress to management evidence of need – use facts and figures.
- Present expected results.
- Discuss plan – content and methods.
- Submit timetable for plan.
- Train those who will do the training.
- Secure understanding and acceptance by those affected.
- Fix responsibility for continuing use.

Be Sure Management Participates.

4. CHECK RESULTS
- How can results be checked? Against what evidence?
- What results will be looked for? Is management being informed – how?
- Is the plan being followed?
- How is it being kept in use?
- Are any changes necessary?

Is the Plan Helping Production?

Responsibility for Training Results
- The LINE organization has the responsibility for making continuing use of the knowledge and skills acquired through training as a regular part of the operating job.
- The STAFF provides plans and technical "know-how" and does some things FOR but usually works THROUGH the line organization.

Front and Back of the Program Development Card

Figure 6: TWI Program Development Card

SOURCE: Adapted from Walter Dietz with Betty W. Bevens, 1970, *Learn by Doing: The Story of Training Within Industry* (Summit, NJ: Walter Dietz), p. 26.

The introduction of Program Development followed a familiar path for those plants that had already received the three supervisory programs.

> *The P.D. Institute Conductor followed standard TWI practice and described a production problem, then demonstrated how a training director solved it through use of a four-step method.*[22]

Program Development would be the last service that TWI would develop and deploy. By the time the last revision of it had been put into use, the end of the war was in sight and this meant the end of TWI was also on the horizon.

The Multiplier Principle

One critical technique used by the TWI Service was key to disperse the training programs on a broad scale throughout all of the country's war production facilities. It was known as the "Multiplier Principle." The multiplier principle was simple in concept, but powerful in its application. Simply put, it stated:

> *Develop a standard method, then train the people who will train other people who will train repeated groups of people to use the method.*[23]

[22] Ibid., p. 46.
[23] Ibid., p. 6.

The use of the multiplier principle allowed TWI to certify over 1.7 million supervisors and trainers throughout the United States in its brief five-year existence.

Coupled with the multiplier principle was TWI's requirement for strict adherence to follow the training programs exactly as intended. Trainers were expected to follow the manuals exactly or they would lose their license. The manuals were designed to be read from up to five feet away so that trainers could easily reference and read from them during training sessions. Each manual had reference sections explaining detailed information, font changes and symbols to denote exactly what trainers should do, emphasize, and even write on the blackboards. The Job Instruction manual had the phrase, WORK FROM THIS OUTLINE – DON'T TRUST TO MEMORY, on every page as a reminder to strictly follow the format of the booklet. Each of the three "J" program manuals had a letter to the War Production Trainers from Dooley, which contained a similar statement:

> *To assure a uniformly high standard, you should ALWAYS work from this outline. Never deviate from it. Don't trust to your memory, regardless of how many times you may present the plan. It is not difficult and if you follow instructions you can't fail.*[24]

All of these methods, along with the multiplier principle, allowed TWI to present a very standardized curriculum to a large number of plants using many individual trainers with a wide range of experience and ability. This technique was their method of maintaining quality control of their service. TWI felt that once they had developed the Job Instruction training program, as well as the other programs, that trainers must follow the sessions exactly as intended for success to occur.

The Kaizen Technique

The most interesting aspect of what TWI accomplished, aside from the huge success industry in the United States had during its war production effort, is KAIZEN. Kaizen has become one of the most recognized and emulated techniques of Japanese management methods or of the Toyota Production System, TPS. Although kaizen is just one of the many tools and/or philosophies of lean manufacturing, its origin can be traced back to the early part of the Twentieth century. In essence, Charles Allen's four-steps may be the grandfather of kaizen.

Job Methods – The Original Kaizen

In review, the objective of Job Methods was to give supervisors a method for improving production using a practical approach instead of a technical approach. TWI desired and succeeded in giving supervisors a simple yet effective method for making improvements in their work area on a continual basis. The purpose of the pocket cards was to keep this idea along with the procedures with the supervisor at all times. The term *kaizen* is usually translated as *continuous improvement for the better* or simply *continuous improvement*. A point that TWI stressed about Job Methods could literally be a definition for kaizen today.

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[24] War Production Board, Bureau of Training, Training Within Industry Service, 1943, *Job Methods: Sessions Outline and Reference Material* (Washington D.C.: U.S. Government Printing Office), p. 1.

> *Management must be shown that Job Methods was not an attempt to make professional engineers out of their supervisors. Job Methods will help supervisors to make many small improvements on the job they are closest to. TWI needed to stress this point to management, and trainers needed to steer supervisors toward the improvements that were closest to them, those which could be made without wholesale re-design of machines or tools or department layouts.*[25]

This statement is not only an important account about the purpose of Job Methods during WWII, but also is what kaizen is targeting in industry today. Masaaki Imai who has written about Japanese management methods and worked to bring these methods to the West states that, "*KAIZEN is the basic philosophical underpinning for the best in Japanese management*"[26]. Research and writing by Alan Robinson of the University of Massachusetts also confirmed that Job Methods is the pre-cursor to kaizen in Japanese management methods. In referencing the Job Methods training, Robinson states:

> *The aim of this program was to teach supervisors the importance and techniques of continuous improvement.*[27]

More detail of how the TWI programs disseminated into the Japanese industry will be explained in the next section. As will be seen, it is evident that Job Methods is the foundation of today's kaizen methods.

The Shingijitsu and the Kaizen Workshop

Masaaki Imai's book, *Gemba Kaizen*, and Jeff Liker's book, *Becoming Lean*, made reference to Training Within Industry material. Research of these documents led to *The Training Within Industry Report: 1940-1945*. As detailed previously, the report defined the program, how it developed, what it developed, and those involved throughout its five-year existence. It also references the work of Charles Allen several times throughout the report, thus acknowledging his influence on the TWI leadership. The most significant correlation between kaizen and the TWI programs was the outline for the Job Methods four-steps, which read like the kaizen training materials offered by the Shingijitsu consulting group in their *5 Days and 1 Night* seminar from the early 90's.

For those not familiar with the Shingijitsu Consulting Group, they are a Japanese consulting group specializing in helping companies implement lean manufacturing techniques. They were introduced to the West by Masaaki Imai in the late 1980's and continue their consulting service today. Several pupils of Taiichi Ohno from Toyota and its group companies founded the Shingijitsu group. Their specialty has been kaizen workshops, which have grown throughout North American and European industry since their inception.

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[25] Ibid., pp. 38-39.
[26] Masaaki Imai, 1986, *Kaizen: The Key to Japan's Competitive Success* (New York: Random House), p. xxxi.
[27] Alan Robinson, 1991, *Continuous Improvement in Operations: A Systematic Approach to Waste Reduction* (Cambridge, MA: Productivity Press), p. 18.

Listed below are phrases commonly heard and listed for anyone participating in a kaizen workshop. They highlight eliminating waste, making work task improvements, and a perpetual drive to maintain improvement activities.

- *"The answers to Why? And What? identify unnecessary details to be eliminated."*
- *"The answers to Where?, When?, and Who? Give leads for combining and rearranging."*
- *"The answers to How? Supply leads for developing 'the one best way' today by simplifying."*
- *"Work out your ideas with others"*
- *"Operators have good ideas too; often just as many as we have – sometimes more!"*
- *"Improvements are of no value unless put to work."*
- *"Put the new method to work – use it until a better way is developed"*
- *"Remember there will always be a better way. Keep searching for further improvements."*
- *"We can't afford to be 'too busy' to find time to continually search for improvements."*
- *"Improvements must be made now!"*[28]

The interesting thing about these common kaizen workshop phrases is that they are actually taken from the 1943 Job Methods training manual used by the TWI service. Therefore, it would seem that the kaizen workshop is just an extension of the former TWI training session. They both use the same methodology for implementing improvements and both emphasize the *learn-by-doing* approach. Anyone who has attended the Shingijitsu's workshop can attest to the hours, even into the night, spent on making changes out in the shop; or *learning by doing*.

As with most good and usable ideas, they are not generally new. It can be stated that kaizen is not new. In fact, kaizen is fifty years old when going back to Job Methods. Industry could be celebrating the Golden Anniversary of kaizen, but, again, that may not be true:

> *The principles of the Job Methods plan are not new. They were developed thirty years ago.*[29]

This statement is from the Job Methods training manual (1943) and is in reference to Charles Allen's development of his four-step method for instructing techniques. So now, we may well be closing in on the 90-year anniversary of the original kaizen principles. It is surprising that an industrial philosophy considered to be a modern and foreign method is actually a very old hometown practice that has just been forgotten.

[28] Training Within Industry Service, 1943, *Job Methods: Sessions Outline and Reference Material*, pp. 29 - 34.
[29] Ibid., p. 37.

TWI MAY BE LEAN'S (NOT-SO-DISTANT) GREAT UNCLE

Upon review of the information detailed above, the impact the TWI Service had on today's Japanese management methods becomes clear. How did this program disseminate into Japanese industry? What other areas in modern management may have been effected?

John Shook, who went to work for Toyota in 1983, may give the answers. He was directly involved with their transfer of management methods and production system (TPS) to North America. He sheds light into TWI's influence on one of Japan's (and the World's) most effective manufacturers.

> *I discovered them in a roundabout way in the process of "adapting" some of Toyota training materials to make them appropriate for NUMMI. When I found myself struggling with some of the concepts of a certain training program, my Japanese colleague fetched from a back-room file a yellowed, dog-eared, coffee-stained copy of the English-language original training manual, just as they had received it (minus the coffee stains I trust) some 30 years before. To my amazement, the program Toyota was going to great expense to "transfer" to NUMMI was exactly that which the Americans had taught the Japanese decades before.*[30]

TWI's Dissemination into Japanese Industry

TWI's introduction to Japan's industry began with the end of World War II.[31] During the Allied Occupation of Japan after the war ended, General Douglas MacArthur was in command. His Occupation authorities quickly realized that due to the near complete destruction of the Japanese industrial base, civil unrest was feared to be a high potential. Instead of severe punishment, as many people in the West desired, they recognized that rebuilding Japanese industry was critical. A major objective of the rebuilding was to eliminate the intense militarism that existed before and during the war and to instill a democratic attitude within industry. Some of the members of MacArthur's Occupation leadership were aware of the TWI Service and its success in the United States. They felt that the TWI programs were exactly the type of initiative that would help support the rebuilding and infuse democratic principles in Japan on a national level. In Alan Robinson's book *Corporate Creativity*, he discloses a memo from 1949, which describes the situation in Japan at the time:

> *Supervision is ordinarily a "haphazard" rule-of-thumb process, and…in-plant training is characteristically done by putting a new man under an experienced worker to pick up his skills as well as he can. Such practices are incompatible with modern industrial methods and with the achievement of high output per worker.*[32]

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[30] John Shook, "Bringing the Toyota Production System to the United States: A Personal Perspective," Jeffrey Liker (ed.), 1997, *Becoming Lean* (Portland, OR: Productivity Press), p. 69.

[31] This section is based on the research and writing of Dr. Alan Robinson of the University of Massachusetts. He has done excellent research in discovering the story behind the impact of TWI in Japanese management practices. For further details, reference his work given in the bibliography.

[32] Alan Robinson and Sam Stern, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen* (San Francisco, CA: Berrett-Koehler Publishers), p. 74.

Perhaps that most disturbing point of this statement is not related to the situation in Japan in 1949, but in fact, that it describes many of our manufacturing plants today. This method is common practice for today's supervisors in our "modern" industry!

The Occupation authorities did move forward and brought the TWI programs to Japan. The job was awarded to TWI Inc., from Cleveland, Ohio. The company was lead by Lowell Mellon who had been a TWI instructor in the United States during the war. His job was to teach the courses in Japan while implementing the Multiplier Principle. Mellon along with three instructors spent six months training thirty-five "master instructors" and set the foundation for the Multiplier Principle to take effect. Upon Mellon's departure, several government agencies continued to spread the TWI training throughout Japan's industry. By 1995, almost 100,000 TWI instructors have been certified. The official number does not reflect the actual total because many instructors received their certified training and went back to their own companies to set up internal TWI programs. As an example Toyota implemented TTWI, Toyota Training Within Industry. Takahiro Fujimoto, provides a detailed analysis of how the Toyota Production System evolved at Toyota, and noted TWI's influence into Toyota's management system:

> *As for management techniques, the Japanese automakers continued to learn the U.S. techniques related to scientific management, including training within industry (TWI)…education of first-line supervisors for quality control and continuous improvement (kaizen) started also in the 1950s, following TWI.*[33]

Another interesting fact that Robinson relates is that although the Job Methods training was translated into Japanese in 1950, it remained unmodified for nearly twenty years.[34] Many of the elder executives of Japanese companies today were the young professionals at the end of the war who became responsible for rebuilding their industry. They were trained and influenced by the TWI programs (and several others) and carried these methods with them throughout their careers. As we will see below, TWI's infiltration in Japan's industrial management continues to have an impact today.

Learn By Doing

As we have seen, the principle *learn-by-doing* was the foundation upon which TWI was built. All of the training programs were developed based on the learner using the procedure on an actual shop issue and presenting it to the group – *learning by doing*. Throughout *The Training Within Industry Report: 1940-1945*, the phrase is used and its emphasis stressed. In fact, one of the "four essentials" upon which the training programs were built was:

> *It must be built on the principle of demonstration and practice of "learning by doing," rather than on theory*.[35]

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[33] Takahiro Fujimoto, 1999, *The Evolution of a Manufacturing System at Toyota* (Oxford University Press: New York, New York), p. 40.
[34] Robinson, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen*, pp. 77 - 79.
[35] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 32.

This was the influence of Charles Allen; his four-step method was built upon creating the best possible environment to enable a perfect *learn-by-doing* situation for the learner. This feature is what the TWI Service successfully developed and promoted in the United States during the war and what the Allied Occupation brought and implemented in Japan after the war. It was such a fundamental aspect of the TWI programs that Walter Dietz's self-published book about TWI is titled, *Learn By Doing*. Its practice is still prevalent today.

The author's experience with *learn by doing* comes from his first employer after graduating from college, Aisin Seiki. Aisin is a Toyota Group company and one of Toyota's biggest suppliers. As Aisin was transplanted in North America to supply the Toyota plants, the author was a manufacturing engineer who was constantly told that he must "go do by yourself", or go out in the shop to the manufacturing line and try it by his self. This situation may not have been Charles Allen's or the TWI's best-organized manner of learning by doing, but it was a derivative of that process. The Japanese engineers who the author worked beside not only stressed "go do by yourself", but related how they had been told this same directive as "freshman" (new, fresh from school) engineers. After struggling through some CNC machine tool manuals completely in Japanese and accidentally machining a couple of fixtures, the author eventually *learned by doing*. The author also spent quite a bit of time running the assembly and machining lines as an operator. As will been seen, this is another technique used to train under the *learn-by-doing* philosophy.

Another example of the *learn-by-doing* approach is related by John Shook in his article in the book, *Becoming Lean*. John's section *Lessons in the Toyota Production System* describes his first lesson:

> *Learn by doing translates as: build some cars. After a couple of weeks of orientation, I was put to building Corollas at the Takaoka plant, which was a great experience, though I didn't appreciate every aspect at the time.*[36]

John's experience with the method was spent working on the lines in Toyota's automotive plants including stamping, body weld, paint, and final assembly. This practice is used to give engineers and managers an intimate understanding of the processes for which they will be responsible. There is no better way to understand something, than by actually doing it – *learn by doing*.

As shown above, *learn by doing*, thought to be a Japanese style of training has it roots in the TWI program brought to Japan after World War II.

Supervisor Development

TWI also introduced the use of supervisors to Japanese industry. Although supervisors have always played and continue to play a critical role in manufacturing, the growing use and role of team and group leaders can be traced to TWI's focus on the supervisor role or interface between the supervisor and operator. For those familiar with the strong support role team leaders play at Toyota, the tie into TWI training is prevalent. The team leader

[36] John Shook, "Bringing the Toyota Production System to the United States: A Personal Perspective," Jeffrey Liker (ed.), 1997, *Becoming Lean*, p. 47.

plays the role of instructor, leader, advisor, fill-in, and improvement solicitor and implementer. These functions correlate to the three "J" programs and what they taught the supervisors.

1. *Job Instruction Training (JIT) taught supervisors the importance of proper training for their workforce and how to provide this training.*
2. *Job Method Training (JMT) taught how to generate and implement ideas for continuous improvement.*
3. *Job Relations Training (JRT) taught leadership and human relations.*[37]

As both TWI and Charles Allen emphasize, the supervisor (instructor) has to have much more than knowledge of the job. They must also have the ability to develop a procedure and instruct the learner to receive, understand, and apply the function of the job. TWI also, with Job Methods and Job Relations, required supervisors to lead people and use their ideas to improve and increase production. Today, the role of the team leader or supervisor in Japanese management philosophy reflects the role the TWI Service was presenting to industry for supervisors.

Top Management Support

Anyone who has either read about or worked to implement lean manufacturing understands the absolute support management must give for lean to be successful. This requirement is a mainstay for any type of change. Another interesting aspect of the TWI program is its staunch requirement for management support in the manufacturing plants where the training took place. Upper management support for TWI training had to be forthright before any training would happen. TWI developed directives for their and the hosting company's responsibilities. The model TWI developed for this plan is illustrated below.

[37] Robinson, 1997, *Corporate Creativity: How Innovation and Improvement Actually Happen*, p. 75.

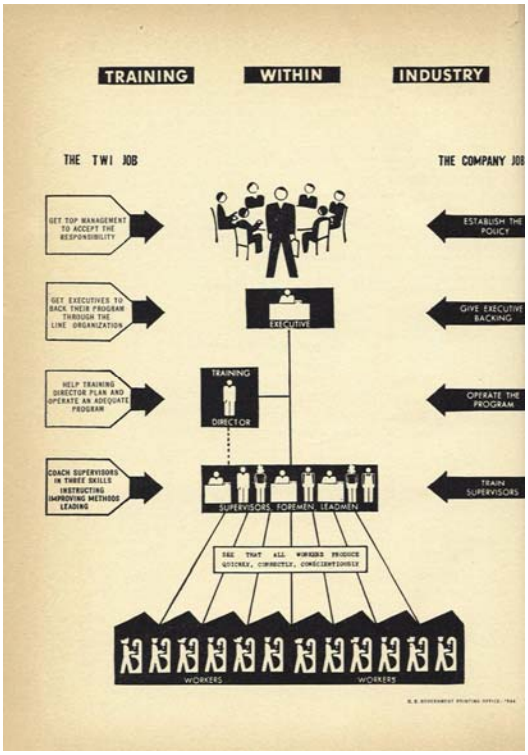

Figure 7: TWI and Host Company Responsibility Requirements

SOURCE: War Production Board, Bureau of Training, Training Within Industry Service, June 1944, *Management and Skilled Supervision* (Washington D.C.: U.S. Government Printing Office), Back cover.

This requirement was also a part of the "for industry by industry" attitude held by TWI leadership. In fact, Chapter 5 in *The Training Within Industry Report* is about the need of management support and it is titled, *Working With Management*.

> *In 1943 TWI established the policy of starting a program in a plant only after the executive group and the supervisory organization had been thoroughly informed about the TWI programs. This executive group, also, had to be thoroughly aware of its responsibility for making these programs work. It can readily be appreciated that a busy president can approve a program enthusiastically, but the plant superintendent, if ignorant of it or unsold as to its possibilities, can be a barrier.*[38]

TWI leadership had an excellent understanding of the need for top management support. They also realized that in order to get this support, they would have to "sell" the program to management. TWI developed a method to do just this. They presented training as a management tool and focused their promotion on selling results, not techniques. They understood that ultimately, most management personnel were interested in bottom line

[38] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 61.

results. This focus helped TWI achieve the initial buy-in and continued support by the large number of executives needed to make the service a success at a nation-wide level.[39]

Coaching

Another idea of the Japanese management philosophy is the use of "coaching" to lead and guide employees. This term is discussed and taught to all levels of management as a great and improved, modern method of managing people. This is considered as changing from the "old" management style of being authoritarian to the "new" style of coaching. Yet the use of coaching as a management method was repeated throughout the TWI Report. In fact, it has a section in the report dedicated to coaching and its continued use. TWI gave five points to guide plant trainers in the coaching process while instructing the "J" programs; Walter Dietz reiterates them in his book as well.

1. *Give reasons and advantages.*
2. *Get understanding of the principles.*
3. *Select a problem and work on it together.*
4. *Ask him to work another problem alone.*
5. *Give credit for good results and good effort.*[40]

The TWI report continues with a brief definition and an explanation of what it means to coach someone in a plant environment. It also ties coaching to the programs themselves and stresses how it supports the Multiplier Principle.

> *Coaching only means helping someone to do a better job of what he's trying to do.*[41]

> *The objective of a TWI program, and the objective of coaching, is not to solve a problem, but to develop ability to solve any problems when they come up.*
> *All of this means a personal working relationship – you can't coach on the phone, or in a letter, or by a lecture. You have to work with a man. His boss is the best one to work with him, out on the job. He can show him how to do a better job – not just criticize, explain why his good work succeeded so he'll do the same thing again…*[42]

Today, companies desire to promote this "new" technique to give their managers an improved manner in which to lead their people. Coaching is not new in industry as the TWI report reveals, maybe just forgotten for a time. Along with the four-steps, the four horsemen learned the value of coaching in the shop from Charles Allen.

> *The men will eventually think of the instructor as a "coach" rather than as a production foremen…Under good management…the men will not be afraid to ask questions and the questions will be to the point; there will be much discussion but there will be little argument; the men will be on the*

[39] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*. The details of TWI process are discussed fully in Chapter 5, Working With Management, pp. 60 - 75.
[40] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p.172.
[41] Ibid., p.173.
[42] Ibid., pp.172 - 173.

job whether they are under the eye of the instructor or whether they are not; all conditions will be business-like and "natural".[43]

Allen describes what sounds like an ideal situation between players and a coach, or what many companies are trying to achieve with their own management and workforce today. It appears that Allen and TWI were aware of and promoting what we refer to as a "team" environment within an organization.

Job Elimination Due to Kaizen

Although the TWI Service remained focused on the training it developed and its deployment at the national level, several questions were frequently asked during the Job Methods training. In fact, three questions were so frequently asked that TWI developed standard answers for them. One of the questions is also one of the most common questions raised today when kaizen is implemented in a plant. "*What should be done if employees are eliminated as a result of methods change?*"[44] TWI emphasized that this issue was to remain the responsibility of the company. Although TWI stood by this policy, they did issue a standard "suggestion" to companies in this situation.

In dealing with a specific instance during this war period, it is recommended: that no one ever be laid off as a result of a methods change but that an employee thus affected be transferred…[45]

Their suggestion is in parallel with the standard response recommended by those leading kaizen workshops today.

The 5W 1H and the 5 Whys

Job Methods discloses the source of the 5W 1H, which stands for Why, What, Where, When, Who, and How. This technique is used to breakdown a job and develop a new and improved method by questioning everything involved in an operation. Use of these questions was Step 2 of the Job Methods four-step procedure and was the transition between the old and new methods. This technique of questioning used for Job Methods was targeted to help breakdown present procedures in order to help discover better methods for doing work.

The first Job Methods sessions were frankly designed to develop a questioning attitude among supervisors with the result of getting from them ideas which already were close to the surface. The detailed questioning of the breakdown has meant that it is possible to go far below the surface and really evolve ideas which never could have appeared on the basis of suggestions.

In making a Job Methods breakdown, it has been learned that, in order to really analyze the details, it is very helpful to look first at the verb (which normally is the first word in the detail). For example, take an assembly job breakdown which has these two details; "Reach down to box on floor" and "Pick up bolt." The first step in the questioning process is

[43] Allen, 1919, p. 281.
[44] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 231.
[45] Ibid.

> *to ask "Why is it necessary?" If you ask "Why it is necessary to reach down to box?" the answer probably would be "in order to pick up the bolt." If you confine yourself to the verb, and say "Why is it necessary to reach down?" you are immediately led into considering the possibility that the box of bolts should have been up on the whole work bench.*[46]

The 5W 1H are still used today in kaizen for discovering improvements. Use of these questions has virtually remained unchanged since the TWI service included them as part of Job Methods. Although Toyota uses the 5W 1H today, they also use a modified version as a direct problem solving technique; the 5W 1H or the 5 Whys and 1 How. Most often this method is referred to as the 5 Whys.

> *When a problem occurs, if the manner of probing into the cause is insufficient, measures taken can become blurry. At Toyota, we have the so-called five W's and one H. The five W's are not the conventional "who, when, where, what and why," but every word is replaced by a "why," and we say "how?" In this way, we delve into the true cause that is hidden behind the various causes. It is essential that we come face to face with the true cause.*[47]

For anyone who has been trained to use the 5 Whys, the sequence listed above from the 1945 Job Methods procedure is the basic process. It also makes sense that the 5 Whys are used to solve problems or supplement kaizen. Kaizen is, in a sense, the resolving of work problems – or improvements.

Waste Elimination

As an extension of the 5 Whys, Job Methods is about job improvement or in today's terms, waste elimination. Further discussion is given about the job breakdown technique in the TWI report and how it supports the four-step method of Job Methods. As we recall, the outline of the four-step method very closely resembles the methodology used in kaizen workshops. Listing the details of an operation, questioning all steps presently involved in a job, developing new methods (combining, rearranging, simplifying), and applying the new methods are all part of both Job Methods and kaizen workshops. Basically it is setting the original standard and then asking why, then improving it – the essence of kaizen. The focus of both of these methods, kaizen and Job Methods, is about waste elimination (removing unnecessary or non-value added activity from the current process).

> *This improvement was not accomplished through speed-up, but through elimination of unnecessary details.*[48]

> *Use it until a **better** way is developed.*[49]

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[46] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 234.
[47] Japan Management Association, 1986, *Kanban: Just-In-Time at Toyota* (Cambridge, MA; Productivity Press), p. 27.
[48] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 224.
[49] Ibid., p. 227.

Maybe that is why Masaaki Imai states in his 1986 book, Kaizen:

> *I would like here to propose KAIZEN as the overriding concept behind good management. It is the unifying thread running through the philosophy, the systems, and the problem-solving tools developed in Japan over the last 30 years. Its message is one of improvement and trying to do better.*[50]

The TWI Service was doing nothing more than promoting good management practices as a means to improve production.

Why U.S. Industry Lost TWI

So the questions arise; why did the United Stated, the developers, implementers, and teachers of such a simple and successful program, lose it, only to be throttled by it in manufacturing markets decades later, and have no idea what was behind the Japanese management miracle? Both of these are good questions. No simple and straightforward solution will totally answer them. But there are certain factors, which played a significant role in why it happened.

Top of the Industrial World

At the end of World War II the United States was at the top of the industrial world. Not only had it led in the victory of the war in both the Pacific and in Europe, but also the U.S. had been supplying products to America and its allies before and during the war. An incredible build-up of industrial strength had occurred. The United States due to its determination as a country, large amount of resources, and natural barriers (the Atlantic and Pacific Oceans) had become a major Superpower and with no damage to its infrastructure. In fact, the U.S. was in quite good shape with high morale and a stronger than ever industrial base. It had achieved this stature with many of the "boys" overseas fighting the war as well.

The "Boys" Return

With the end of the war, the men fighting overseas would return home and back to the plants in which they had worked prior to the war. The TWI Service was no longer in existence; it was no longer needed with the victory of the war and was shutdown. The leaders of TWI understood the situation and realized well in advance that the end was inevitable. In fact, they relate in the report how they always felt that the end of their service was just a few days away. This "feeling" lasted about five years, much longer than they had anticipated.

The adjustment of returning to civilian production was also quite a task. The men returning from the war effort had not been trained in TWI methods and the TWI's national support network no longer existed. With the United States on top of the world industrially and men untrained in TWI methods returning to fill their prior roles, the critical emphasis needed for the TWI effort was gone. Once settled in, it would be natural for the returning men to get back to their pre-war routine. This situation may be the biggest contributor to the loss of the accomplishments of the TWI Service. In fact,

[50] Imai, 1986, *Kaizen: The Key to Japan's Competitive Success*, p. xxxii.

the leadership of TWI understood this concern and in the report relates information on how things may change once the war effort is finished.

> *In looking at the simplicity of TWI programs it would seem that, since they only represent common sense, their development should have been possible without too much trouble. But it must be remembered that a lot of non-essentials had to be eliminated.*
>
> *The TWI programs have been developed under opportunities never before available – the nation's war plants have been the laboratory, the experimental shop, and the proving ground. Development work would have continued as long as TWI existed – no program is ever perfect, and no program is any good unless it meets needs. Since needs change, any program must be kept growing.*[51]

It would appear that Dooley, Dietz, Kane, and Conover could sense the pending peril for the TWI programs after the conclusion of the war, which would terminate the need. As may be recalled, a good portion of TWI's effort was spent selling the need and services to the management of companies even with the critical demand war production. The TWI leadership even suggests that perhaps as much time was spent on selling the training as was spent conducting the training. With this combination, the loss of the "need" and the untrained "boys" returning it seemed destined for TWI principles to fade from the industrial landscape, and time has proved this to be so.

Resistance to Change

One final factor should also be considered as a contributor to TWI's disappearance, the resistance to change. People's resistance to change seems to be a natural occurrence. Most individuals will work to remain in a comfort zone, even if receiving pressure to change. This opposition has been the norm in industry as well.

One technical reporter from the *American Machinist* magazine tells a story of when a friend of his was trying to show a head toolmaker a new type of tool system; he is accused of peddling some useless "newfangled" method. He was not selling anything, just trying to show what was going on in industry.[52] The interesting point of this story is that it dates from around the year 1904.

Industry has always resisted change. This is illustrated in the books, *Lean Thinking* and *Becoming Lean*. Both books have information and stories about the difficulty of introducing change into a plant. In the case of these books, it is the implementation of lean that leads to resistance by industrial people. So in a broad sense, today's difficulty implementing Japanese management methods and lean philosophies may be a repeat of the difficulty the TWI Service faced when working with companies sixty years ago to implement some of the same philosophies. Granted, Japanese management and lean philosophies are much more encompassing than the TWI programs were, but they do come from the same roots.

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[51] Training Within Industry Service, September 1945, *The Training Within Industry Report: 1940-1945*, p. 261.

[52] Fred H. Colvin, 1988 (originally published in 1947), *Sixty Years with Men and Machines* (Bradley, IL: Reprint by Linday Publications), pp. 42 - 43.

CONCLUSION

The arguments detailed above are probably not the only reasons that TWI methods and philosophies mirror Japanese management practices or lean philosophies; many things contributed to their development. But one thing is sure; TWI did play a significant role in the evolution of Japanese management practices and lean philosophies, some directly such as Job Methods, and some not so directly. In the end, most have survived in Japan because they were superior techniques used in a comprehensive manner to help companies achieve a competitive advantage. The need for change in Japan began after the war, and the need continues even today.

Although U.S. companies failed to continue using the methods developed and deployed by the Training Within Industry Service after the war, today's companies often resist change not wanting to emulate the Japanese kaizen techniques. But in fact, kaizen or Japanese management methods are not specifically Japanese or American techniques; they are the result of an evolutionary process with significant contributions from both. Based on direct intentions and unforeseen circumstances in industry, the practices advanced forward to what they are today. It may be that the ideas started with a man by the name of Charles Allen and continued with the contribution of thousands of people from both sides of the ocean and will continue to evolve as many more learn how to apply it – *learn by doing*.

Even today the question remains, "Can these techniques be successfully implemented?" Many manufacturers incorrectly assume that Japanese management methods and kaizen are effective in Japanese companies because of their unique culture, but this is not true.

> *Frustrated by their inability to replicate Toyota's performance, many visitors assume that the secret of Toyota's success must lie in its cultural roots. But that's just not the case.*[53]

We have shown that these modern manufacturing techniques are, in fact, nearly one hundred year old methods that have evolved over the years with their underlying themes unchanged. It is ironic that although U.S. industry developed the methods that form much of the basis of Japanese management and lean philosophies, the United States has struggled over the last twenty years to fully implement these philosophies in our present-day systems. Success in the future of U. S. manufacturing may depend on, *if we can do what we have already done*.

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[53] Steven Spear and H. Kent Brown, September-October 1999, "Decoding the DNA of the Toyota Production System", *Harvard Business Review*, Reprint 99509, p. 97.

depth research into the evolution of manufacturing in the U.S. with an emphasis on lean. Reach him at jim.huntzinger@flexwareinnovation.com or 317-813-5415.

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TWI
The TDO Training Within Industry Program

TRAINING TO PAVE THE PATHWAY TO LEAN

Phase I	Introduction to Lean concepts
Phase II	Start the Journey with a High Visibility and High Impact Project
Phase III	Create Initial Process Stability and Connected Process Flow
Phase IV	Establish Standardized Processes and Procedures
Phase V	Build and Sustain Continuous Improvement Culture

PHASE I

Introduction to Lean

Lean 101 - Classroom Training that includes "learn-by-doing" Simulation Exercises.
An eight-hour workshop for decision makers, key personnel, union leaders, formal and/or cultural leaders who have peer influence within the organization. This training combines comprehensive classroom teaching with hands-on interactive simulation exercises for participants to put what is learned in class to use in a simulated factory environment. Participants learn the basic concepts and tools of Lean and a reliable methodology to train employees on how to implement these tools in the workplace. Depending on the size of an organization and the number of people involved, this training may have to be repeated as new teams are formed.

- Time: 8 hours in 1 day for a group of 16-22 individuals.

PHASE II

Start with a Project that has High Visibility with potential for High Impact

(Target to Completion 2-4 months)

1. ***Establish a Value Stream Strategy*** (product families).

The initial Value Stream Mapping is for the decision makers in your company to identify product families and the value streams they flow through. The end result will be a Family Breakdown of your products and process that may require some rethinking of the current structure that supports the existing value streams. This Team will make a consensus selection of a High Impact Family to be used through the remainder of Phase II activities.

2. ***Value Stream Mapping*** (high impact with high probability of success).

This is a continuation of the first step, but will involve creating a team to include individuals who participated in the lean 101 overview. This team will be empowered to create a Current State Map of each product family and brainstorm ideas to eliminate reduce and combine activities to combat the 8 wastes identified in the lean overview. The final result will be a Future State Map and a set of tasks to help move the company toward the future state. Prioritization of the tasks will help with making the changes high impact.

3. ***5S*** (high visibility)
This process can include members beyond the original team who also attended the lean overview but it will be difficult for them to see this process as being more than just basic housekeeping. The team will be focused on preparing the area designated for the future state using the 5S methodology of Sort, Set in Order, Shine, Standardize and Sustain. This will be the first 'learn-by-doing' activity that, by its nature will make a large impression with people on the floor as well as with the primary team participating in these activities.

4. ***Cellular Design and Workflow***
This can be done as classroom training in preparation for using the tools and techniques on a Kaizen Blitz. This training should be delivered to the core team who will be involved in the Future State map implementation.

5. ***Kaizen Blitz***
The workshop will be handled in the Shingijutsu Method of Documenting Reality, Identifying Wastes, Planning Countermeasures, Implementing Changes, Verify Changes, Quantify Results and Make Standard. This cycle will be taught and facilitated on product family as defined with the Value Stream Mapping. The Lean tools of 5S, Kanban, Flow, Error proofing, and Standardized Work will be used in hands on activities to reinforce using the lean tools.

6. ***Visual Controls***
This workshop will focus on the extension of 5S and how to make visual controls manage the work. Basic techniques will be described and examples shown. The program will be delivered in a hands-on approach where teams will implement different types of visual controls in designated areas during the training.

7. ***Lean Material Handling***
This workshop will focus on how to maintain pull, replenish single piece flow lines and schedule production. Concepts of heijunka, kanban, milk runs, 2 bin systems, 3 bin systems and water spiders will be developed.

8. ***TWI Job Relations Training (JR)***
Even in the closest knit and smallest companies it has become apparent that a consistent means of handling interpersonal issues is highly effective in building cohesiveness and consensus. JR training will also give management, supervisors/team leaders and lead operator levels a problem solving methodology to prevent problems from happening. This methodology is also a highly effective consensus decision making tool for teams when roadblocks occur. TWI training need not be delivered to the shop floor workers who are not participating in team activities.

PHASE III

Create Connected Process Flow and Initial Process Stability

(Target to Completion 4-9 Months)

It is most likely individual processes will be unstable at companies that have not been using lean methods and improving processes. Stability is defined as the capability to produce consistent results over time that results from having removed variability from the process. For example:

- equipment that is not well maintained will break down regularly,
- for any number of reasons defects are regularly produced, or,
- the amount of time it takes to perform a given task varies from person to person or across shifts indicating a lack of standard work.

The first step then is to achieve a basic level of process stability.

TWI Job Instruction Training (JI)

Only for those people who will be breaking down and documenting how jobs are performed. JI will teach these people a consistent and reliable method to breakdown jobs into teachable elements that, when taught to existing workers, will enable them to perform jobs the same way to minimize variability. This training should be delivered to managers, team leaders and first line supervision that will then be responsible to spread the training to the people who do the work. A matrix is to be developed and maintained to track the retraining process.

Continue Lean Implementation to extend lean tools to the remaining value streams.

This will be based on a team by team approach. Each Value Stream should be assigned a team of 8-10 individuals who will be trained in Lean tools as was the first Value Stream Team. This would again follow the following format:

1. ***Value Stream Mapping*** (core team of 4-6 individuals) a team will map the current state and develop a future state for the value stream. Tasks will be defined and prioritized for execution of the future state.
2. ***5S and Visual Control*** Workshop
3. ***Cellular Design and Workflow*** Training
4. ***Kaizen Blitz*** – Team of individual stake holders will make the initial transformation of the value stream to flow.
5. ***Additional lean tool*** training as desired and required by each independent team.

PHASE IV

Establish Standardized Processes and Procedures
(Target to Completion 9-18 Months)

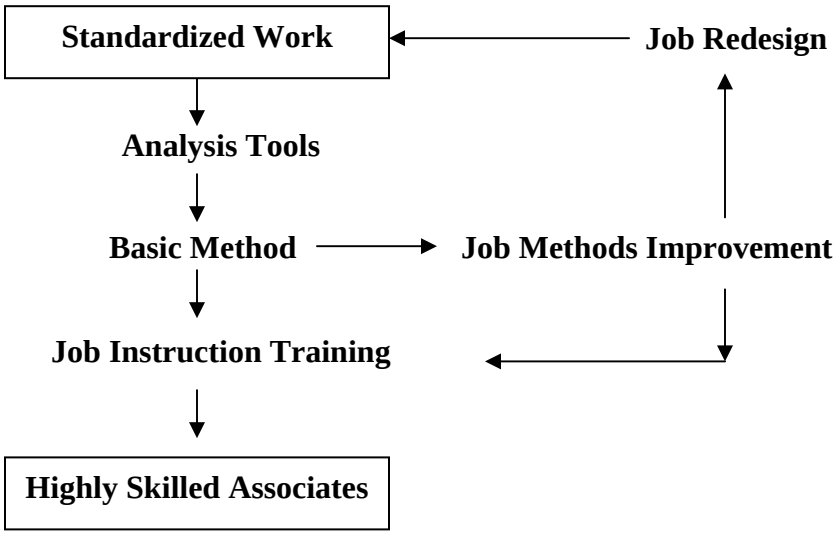
Masaaki Imai's influence on Jeffrey K. Liker can be seen in Chapter 6 of his book the *Toyota Way Fieldbook* where he states that "The establishment of standardized processes and procedures is the greatest key to creating consistent performance." Liker tells us that "the creation of standardized processes is based on defining, clarifying (making visual), and consistently utilizing the methods that will ensure the best possible results……As such, standardization is not applied as a stand-alone element at specific intervals. Rather it is part of the ongoing activity of identifying problems, establishing effective methods, and defining the way those methods are to be performed. And it is driven by people, not done to people. People doing the work understand it in sufficient detail to make the biggest contributions to standardization."

TWI Job Methods Training (JM)
After the lean concepts have been used and demonstrated with kaizen event activities, it becomes increasingly difficult to justify and support a 4 day event activity that is not delivering high returns. Job Methods training is recommended for all individuals at PCI. The outcome of the program will be a framework for a suggestion system and a drive to use ingenuity before investment. These suggestions may be large enough to warrant a kaizen event approach or small enough that the worker only needs notify everyone that the standard is changing for a better way.

Introduction of Six Sigma Tools and Applications
To achieve a world class level of performance with Six Sigma, each and every person in an organization must learn to identify the key metrics for each process and find a way to measure, analyze, improve, and control these metrics.

PHASE V

Build and Sustain Continuous Improvement Culture *(Target 24 months - Never Ending)*



Laurence P. Gebhardt, Ph.D , Chair
Crosscut Initiatives Panel, NSRP
c/o SENESCO Marine
1200 Aspen Drive
Pocatello, ID 83204

RE: SkillsNET in Kind Contribution to Shipfitter Project

Dear Dr. Gebhardt,

SkillsNET Commercial, Ltd is very pleased to be selected to provide the reference service to the NSRP Crosscut Initiative. In addition to the agreed upon labor and effort fee SkillsNET will be making the following in-kind contributions:

1	Job Analysis Software fee	$ 10,000.00
2	Network and Database support	$ 4,000 00
3	Business Consulting	$ 12,000 00
4	Team Project support	$ 8,000 00
5	Skills Analysts Support	$ 15,000 00
	Total	$ 49,000.00

We are committed to providing this in-kind products and services because we share the vision to align the shipyard workforces and provide education the necessary skills and competency data to maintain training and education course materials that support the work being performed

Please do not hesitate to contact me or Mr Tim Ferron if you have any questions

Very Truly

Michael Brown
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