
Competency Models in Action:

Welding Occupations for the 21st Century

February 2010

Introduction

Industry Competency Models graphically display the knowledge, skills and abilities required to perform successfully in the workplace. They can be used to help frame the competency requirements of broad industry groups, or they can be used to frame what's needed in a particular industry sub-sector or a specific occupation. The National Center for Welding Education and Training (Weld-Ed) was awarded a grant from the National Science Foundation to advance the welding industry by improving the quality of education and training. Weld-Ed partnered with the American Welding Society (AWS) and industry experts creating a National Skills Panel to review available training and education programs to ensure that the curricula are preparing workers with the skills needed by employers in the 21st century. The Weld-Ed Skills Panel identified the Advanced Manufacturing Competency Model as a resource to support the effort.

The Workforce Need

While welding is not a new or emerging industry, the following definition of welding by AWS underscores how technology and the introduction of new alloys and materials has changed the knowledge and skill requirements needed by workers in the 21st century.

WELDING is defined as: *the fusing of the surfaces of two work pieces to form one; is a precise, reliable, cost-effective and high tech method for joining materials.*

*No other technique is as widely used by manufacturers to join metals and alloys efficiently and to add value to their products. Most of the familiar objects in modern society, from buildings and bridges, to vehicles, computers and medical devices could not be produced without the use of welding.**

*Source: American Welding Society, *Vision for the Welding Industry*.

The Skills Panel began the work of meeting its challenge by requesting sample welding curricula from secondary and post-secondary schools across the country. Their charge included reviewing the programs of high schools, community and technical colleges and four year institutions. An analysis of the materials collected showed great variation in what was offered in welding programs: welding, welding technology, and welding engineering. The panel decided that a core set of knowledge and skills should be developed for use throughout the U.S. to ensure the quality and consistency of welding programs. By articulating the core requirements of a program of study, employers could then be confident that program completers would have the skills needed to qualify them as entry level workers. Using this

skills-based approach would also provide a resource for documenting skill attainment required for welding certifications. The panel was aware of the complexity of the task ahead – to develop and validate the core skills required for welders, welding technicians, and welding engineers. Another issue was that there was little consensus around exactly what is a ‘welding technician’.

Solution: Develop Three Competency Models for Welding Occupations

Several Weld-Ed panel members had participated in the development and validation of a competency model for advanced manufacturing developed through a collaboration of the U.S. Department of Labor, Employment and Training Administration, the National Association of Manufacturers (NAM), the National Council for Advanced Manufacturing (NACFAM), and other industry experts. Based on that experience, those panel members thought of using the Advanced Manufacturing Competency Model as a foundation for developing their own Welding Competency Model. The [Advanced Manufacturing](#) model identified the worker traits, knowledge and skills needed by workers across the entire advanced manufacturing industry which would include welding; therefore this validated model would provide a resource or foundation for the work ahead.

AWS, one of the partners in Weld-Ed and an industry association with 60,000 members, already had both industry boards and curriculum committees that were ongoing and that could help with the competency model development and validation processes. The membership, composed of employers, educators, manufacturing suppliers, equipment sales people and others, provided the subject matter experts needed to identify and validate core skills. A team headed by Dr. David Dickinson, former professor of engineering at the Ohio State University undertook the effort to develop three occupational competency models:

- **Welder** focuses on the psychomotor skills with very basic cognitive information. He/she can get the welding job done quickly.
- **Welder Technician** strives to balance skills and knowledge-based learning. The technician can develop welding procedures and supervise welders while interpreting the directions from the engineer.
- **Welding Engineer** has some skill training in supervised labs, but the bulk of his/her learning has been in the cognitive area. He/she develops new products and processes by applying his/her knowledge to invent, design and improve.

The team agreed that all of the traits, knowledge areas, and skills identified on Tiers 1-4 of the Advanced Manufacturing industry model should be included as the base for each of the occupational models. They identified the knowledge and skills specific to the welding industry creating an industry sector Tier 5. Subjects such as graphics, computer applications, advanced chemistry and physics were included on Tier 5. On Tier 6 – Occupation-specific Knowledge they included topics such as: the strength of materials, heat transfer, fluid mechanics, metallurgy, electricity and non-destructive evaluation. The team decided that Tiers 7 and 8 – Occupation-specific Technical Competencies and Requirements – should reflect the knowledge, skills and abilities (KSA’s) required of each occupation; therefore they drafted a separate model for: welding engineers, welding technicians or general welders. The competencies on Tier 9 –

Management Competencies were not addressed in this project, but may be in the future. Visit the Competency Model Clearinghouse to learn more about content and structure of the nine tiers of the [Building Blocks for Competency Models](#).

The proposed or draft content for Tiers 6, 7, and 8 were derived from the educational curricula collected and from AWS certification standards. The team constructed a series of competency statements as well as a process to review and validate the contents. They sent the proposed content for the occupational models on spreadsheets to 30-40 volunteer subject matter experts selected from the membership and requested each to 'Accept', 'Modify', or 'Reject' the inclusion of each statement. The feedback was tabulated and discussed, and general consensus approval for the content was obtained through Web-meetings.

The three occupational models depicted increasing levels of skills and knowledge making them useful for several purposes. Students and adult learners could see "what specifically is needed" to advance from an entry-level welder up a career ladder. The model also provided a resource to conduct a gap analysis of existing curriculum. Program developers can use the model when working with employers to develop education and training that meets an employer's need to upgrade the skills of the existing workforce.

A Model for other Industry Groups

The most exciting part of the project for the educators on the Skills Panel was to see that competency models, developed in partnership with industry and professional technical associations, provide a solid map for instructional outcomes and learning objectives. Dr. David Dickinson emphasized that the use of the Advanced Manufacturing Competency Model saved the welding group "incredible amounts of time." At first, he and his colleagues believed that fitting the knowledge and skill specifications into the competency model structures would be time-consuming. However, once they began the process, they realized how smoothly the specifications fit into the Building Blocks Tier structure. Dr. Dickinson believes that the process used by the welding industry "could be accomplished by any number of industry groups."

Ms. Monica Pfarr, the Principal Investigator for the Weld Ed project, noted that her group was eager to develop competency models once they understood the many benefits, including how the models can be used for curriculum development, assessment, course learning objectives, employer job descriptions, career ladders and documenting skills attainment through certification. Look for additional information about the Weld-Ed experience in [The Welding Journal](#), a monthly publication of AWS.

For more information you can contact: Monica Pfarr mpfarr@aws.org or David Dickinson Dickinson.1@osu.edu

To view the welding occupation competency models and the Advanced Manufacturing Competency Model, visit the Related Links below.

Related Links

Welding Occupational Competency Models

<http://www.weld-ed.org/Educator+Resources/Competency+Models.htm>

Weld-Ed: The National Center for Welding Education and Training

<http://www.weld-ed.org/>

American Welding Society

<http://www.aws.org/w/a/>

Advanced Manufacturing Competency Model

<http://www.careeronestop.org/competencymodel/pyramid.aspx?HG=Y>