**Summary of Changes**

**Advanced Manufacturing Competency Model**

**February 2022 Update**

The Advanced Manufacturing Competency Model was updated in February 2022. The updates reflect input from practitioners and many serve to remove or add detail to reflect user’s requirements.

**Tier 1: Personal Effectiveness Competencies**

* Edited key behavior description in *1.1 Interpersonal Skills* block.

1.1 Interpersonal Sills

* 1.1.3 Demonstrating emotional intelligence
  + Edited key behavior description: 1.1.3.2 Accurately interpret ~~and respond~~ to the verbal and nonverbal behavior of others.

**Tier 2: Academic Competencies**

* No changes were made to the Tier 2 Competencies.

**Tier 3: Workplace Competencies**

* Edited and added key behavior descriptions in *3.8 Personal Health and Safety* block.

3.8 Personal Health and Safety

* 3.8.3 Preventive health, safety, or environmental inspections.
  + Edited key behavior description: 3.8.3.1 Identify the elements and procedures related to inspections ~~such as the audit of records and documentation, documentation of inspection findings, inspection of emergency response protocols, and inspection of fire protection and control~~.
  + Added key behavior descriptions:
    - 3.8.3.2 Audit of records and documentation
    - 3.8.3.3 Documentation of inspection findings
    - 3.8.3.4 Inspection of emergency response protocols
    - 3.8.3.5 Inspection of fire protection and control

**Tier 4: Industry-Wide Technical Competencies**

* Moved Technical Content Item from *4.1.7 Testing/Troubleshooting* to *4.5.3 Quality Improvement*.
* Edited Technical Content Area and added Technical Content Items in 4.2 Operations Management block.
* Edited Technical Content Area, renumbered Technical Content Areas, and added Technical Content Items in *4.3 Maintenance, Installation, and Repair* block
* Added and edited Technical Content Items in *4.5 Quality Assurance and Continuous Improvement* block.

4.1 Manufacturing Process Design/Development

* 4.1.7 Testing/Troubleshooting
  + Moved 4.1.7.4 Statistical process control to 4.5.3 Quality Improvement.

4.2 Operations Management

* Edited Technical Content Area: 4.2.5 Manufacturing ~~Manual~~ tool and equipment operations.
* 4.2.4 Precision measurement
  + Added:
    - 4.2.4.1 Physical dimension measurement instruments and techniques (e.g., micrometers, calipers)
    - 4.2.4.2 Volume measurement instruments and techniques (volumetric glassware)
    - 4.2.4.3 Microscope instruments and techniques (e.g., optical, charged particle, scanning probe)
    - 4.2.4.4 Pressure and flow measurement instrument and techniques (e.g., Digital manometer, vacuum gauge)
    - 4.2.4.5 Detection instrument and techniques (e.g., Gas detection, Leak detection, etc.)
    - 4.2.4.6 Electrical measurement instruments and techniques (i.e., digital multimeter, voltmeter)
    - 4.2.4.7 Mass measurement instruments and techniques (e.g., analytical balance, trip balance, torsion balance)
* 4.2.5 Manufacturing tool and equipment operations
  + Added:
    - 4.2.5.1 Manual tool and equipment setup and operation
    - 4.2.5.2 Manufacturing equipment monitoring including performance and in/out of spec conditions
    - 4.2.5.3 Manufacturing equipment set up and operation including product and process setup, power up/down procedures
    - 4.2.5.4 Manufacturing equipment and system analysis
    - 4.2.5.5 Manufacturing equipment qualification including adjustment, calibration, and testing
* 4.2.10 Manufacturing types
  + Edited: 4.2.10.1 Process batch and continuous manufacturing (e.g., chemicals, refining, brewing, smelting, utilities, pharmaceutical manufacturing)
  + Deleted: 4.2.10.4 Electrical/electronics manufacturing processes
  + Added:
    - 4.2.10.4 Repetitive manufacturing - the quantity-based, constant-flow production of same or similar goods in rapid succession over a long period of time, often involving automated assembly processes. Often used for mass production for both discrete and process manufacturers. (e.g. electronic goods, automobiles, durable consumer goods)
    - 4.2.10.5 Job Shop Manufacturing - the manufacturing of small batches of a variety of custom products requiring unique set-up and sequencing of process steps. (e.g., machine too shop, machining center, paint shop, commercial printing shop)

4.3 Maintenance, Installation, and Repair

* Added Technical Content Area: 4.3.32 Chemical and gas delivery and disposal system maintenance, installation, and repair
* Renumbered Technical Content Areas 4.3.32 – 4.3.33 to 4.3.33 – 4.3.34.
* 4.3.2 General skills
  + Added 4.3.2.10 Information communication skills (e.g., manufacturing shift pass-down practices, on the job task-oriented instruction, and machine performance parameters)
* 4.3.34 Clean room protocol for maintenance
  + Edited: 4.3.34.1 ~~Hand tools clean~~ Clean room protocol for hand tools

4.5 Quality Assurance and Continuous Improvement

* 4.5.3 Quality improvement
  + Added:
    - 4.5.3.3 Statistical process control (SPC) analysis techniques and assessment for out-of-control situation
    - 4.5.3.4 Statistical process control (SPC) and reports generation from automated SPC software
    - 4.5.3.5 Statistical process control (SPC) and responding to out-of-control situations according to defined escalation procedure
    - 4.5.3.6 Statistical process control (SPC) and critical parameter data for specific equipment sets
* 4.5.9 Corrective and preventive actions
  + Edited:
    - 4.5.9.1 ~~Documentation~~ Document creation
    - 4.5.9.2 ~~Eliminating non-conformities~~ Verification and documentation
    - 4.5.9.3 ~~Verification and documentation~~ Non-conformities elimination
* 4.5.12 Data analysis and presentation
  + Added: 4.5.12.3 Multiple source data targeting, retrieval, and validation

**January 2020 Update**

The Advanced Manufacturing Competency Model was updated in January 2020. The updated model is a comprehensive industrywide model providing a dynamic repository for skills and competency profiles in the Advanced Manufacturing industry.

The revisions also incorporate foundational health and safety skills from the National Institute for Occupations Safety and Health’s (NIOSH) [Safe • Skilled • Ready Workforce Program](https://www.cdc.gov/niosh/programs/ssrw/default.html), an initiative designed to help protect America's workforce and create safe, healthy, and productive workplaces.

**Tier 1: Personal Effectiveness Competencies**

* Added Adaptability and Flexibility block [moved from Tier 3 – Workplace Competencies]

1.1 Interpersonal Skills

* Created key behavior titles: *Interacting and working with others/Respecting diversity, Demonstrating sensitivity/empathy, Demonstrating emotional intelligence, Maintaining open relationships*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

1.2 Integrity

* Created key behavior titles: *Behaving ethically, Acting fairly, Taking responsibility*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

1.3 Professionalism

* Modified block definition:
  + Maintaining a socially acceptable demeanor professional presence.
* Created key behavior titles: *Demonstrating self-control, Professional appearance, Social responsibility, Maintaining a positive attitude*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

1.4 Initiative

* Modified block definition:
  + Demonstrating a commitment to effective job performance by acting on one’s own and following through to get the job done.
* Created key behavior titles: *Taking initiative, Persisting, Setting challenging goals, Working independently, Achievement motivation*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

1.5 Dependability and Reliability

* Created key behavior titles: *Fulfilling obligations, Attendance and punctuality, Attending to details, Following directions*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

1.6 Adaptability and Flexibility [previously 3.3]

* Changed block definition:
  + Displaying the capability to adapt to new, different or changing requirements.
* Modified key behavior title from *Deal with ambiguity* to *Dealing with change*
  + Edited key behavior descriptions:
    - Take effective action when necessary without having to have all the necessary facts in hand.
    - Adapt plans, goals, actions, or priorities in response Respond effectively to unpredictable or unexpected events, pressures, situations, and job demands.
  + Added key behavior description:
    - Change tasks quickly and effectively when working on multiple projects or issues.
  + Deleted key behavior description:
    - Effectively change plans, goals, actions, or priorities to deal with changing situations.

1.7 Lifelong Learning

* Created key behavior titles: *Demonstrate an interest in learning, Participating in learning activities, Using change as a learning opportunity, Identifying career interests, Integrating and applying learning*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

**Tier 2: Academic Competencies**

* Deleted Information Literacy block and incorporated key behavior descriptions into block 2.1 Reading

2.1 Reading

* Modified block definition:
  + Understanding written sentences, paragraphs, and figures in work-related documents on paper, on computers, or adaptive devices.
* Created key behavior titles: *Comprehension, Attention to detail, Information integration, Information analysis*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

2.2 Writing

* Modified block definition:
  + Using standard business English to compile information and prepare written documents on paper, on computers, or adaptive devices.
  + Created new key behavior 2.2.3 Tone and incorporated previous key behavior descriptions into it.
* 2.2.1 Organization and development
  + Edited key behavior description:
    - 2.2.1.3 Present well-developed Develop ideas with supporting supported by information and examples.
  + Added key behavior descriptions:
    - 2.2.1.4 Proofread finished documents for errors.
    - 2.2.1.5 Tailor content to appropriate audience and purpose.
    - 2.2.1.6 Distribute written materials appropriately for intended audiences and purposes.
* 2.2.2 Mechanics
  + Edited key behavior description:
    - Write in a manner appropriate for business, using language appropriate for the target audience, a professional tone, and appropriate word choice.
  + Added key behavior description:
    - Write legibly when using handwriting to communicate.

2.3 Mathematics

* Modified block definition:
  + Using principles of mathematics such as algebra, geometry, and trigonometry to solve problems.
* Created new key behaviors *Computation, Measurement and estimation, Application* with relevant subject matter.
* 2.3.1 Demonstrate mastery of mathematical principles [modified from: Know and apply mathematical principles]
  + Added key behavior descriptions:
    - Elementary trigonometry – triangles and trigonometric functions
    - Elementary calculus – exponential, logarithmic and trigonometric functions, vectors, complex numbers, conic sections, and analytic geometry

2.4 Science

* Modified block definition:
  + Knowing and applying Using scientific principles rules and methods to solve problems.
* Created key behavior titles: *Know and apply scientific principles, Comprehension, Application*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

2.5 Communication – Listening and Speaking

* Created new key behavior 2.5.3 Persuasion/Influence with relevant subject matter
* 2.5.1 Communicating [previously Speaking and Presenting]
  + Edited key behavior descriptions:
    - 2.5.1.1 Express relevant information appropriately to individuals or groups taking into account considering the audience and the nature of the information (e.g., explain technical concepts to non-technical audiences).
    - 2.5.1.3 Speak clearly and confidently using Use common English conventions including proper grammar, tone, and pace.
  + Added key behavior descriptions:
    - 2.5.1.2 Convey information clearly, correctly, and succinctly.
    - 2.5.1.4 Effectively establish interpersonal contact with one or more individuals using eye contact, body language, and non-verbal expression as appropriate to the person’s culture.
    - 2.5.1.5 Ask questions or report problems or concerns to people in authority when information or procedures are unclear or need improvement, or when feeling unsafe or threatened in the workplace.
* 2.5.2 Receiving information [previously titled Listening]
  + Edited key behavior descriptions:
    - 2.5.2.1 Receive Attend to, understand, interpret, and respond to verbal messages and other cues received in a variety of ways, including hearing, American sign Language, instant messaging, text-to-speech devices, and other methods.
    - 2.5.2.2 Apply active listening interpersonal communication skills using reflection, restatement, questioning, and clarification.
    - 2.5.2.4 Understand Interpret complex instructions.
  + Added key behavior descriptions:
    - 2.5.2.3 Identify feelings and concerns communicated in various formats, such as writing, speech, American Sign Language, computers, etc., and respond appropriately.
    - 2.5.2.5 Consider other viewpoints and alter opinion when it is appropriate to do so.
    - 2.5.2.6 Effectively answer questions of others or communicate an inability to do so and suggest other sources of answers.

2.6 Critical and Analytical Thinking

* Created key behavior titles: *Reasoning, Mental agility*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

2.7 Basic Computer Skills

* Updated entire block and created new key behavior titles: *Computer basics, Using software, Using the Internet and email, Ensuring computer security*
* Organized new key behavior descriptions within each key behavior to reflect the updated information.

**Tier 3: Workplace Competencies**

* Moved Adaptability and Flexibility block to Tier 1: Personal Effectiveness Competencies.
* Added new block: 3.8 Personal Health and Safety with key behavior titles (and relevant key behavior descriptions):
  + 3.8.1 Maintaining a healthy and safe environment
  + 3.8.2 Safeguarding one’s person
  + 3.8.3 Preventive health, safety, or environmental inspections

3.1 Business Fundamentals

* Updated entire block with new key behavior titles: *Situational awareness, Business ethics, Market knowledge*
* Organized new key behavior descriptions within each key behavior to reflect the update information.

3.2 Teamwork

* Updated entire block with new key behavior titles: *Identifying team membership and role, Establishing productive relationships, Meeting team objectives, Resolving conflicts*
* Organized existing and new key behavior descriptions within each key behavior title.

3.3 Customer Focus [previously Marketing and Customer Focus]

* Modified block definition:
  + Efficiently and effectively addressing the needs of clients/customers.
* 3.3.1 Understanding customer needs
  + Edited key behavior description:
    - 3.3.1.4 Demonstrate awareness of client goals the impact of the project’s carbon footprint.
  + Added key behavior descriptions:
    - 3.3.1.2 Attend to what customers are saying and ask questions to identify customer needs, interests, and goals.
    - 3.3.1.3 Anticipate the future needs of the customer.
* 3.3.2 Providing personalized service
  + Edited key behavior descriptions:
    - 3.3.2.1 Provide prompt and, efficient responses, and personalized assistance to meet the requirements, requests, and concerns of customers.
    - 3.3.2.2 Provide thorough, accurate information to answer customers’ questions and to meet inform them of commitment times or performance guarantees.
    - 3.3.2.4 Actively look for ways to help customers by identifying and proposing Identify and propose appropriate solutions and/or services.
  + Added key behavior description:
    - 3.3.2.3 Address customer comments, questions, concerns, and objections with direct, accurate, and timely responses.
* 3.3.3 Acting professionally
  + Edited key behavior description:
    - 3.3.3.3 Display and good-natured, cooperative attitude; be Remain calm and empathetic when dealing with hostile customers.

3.4 Scheduling and Coordinating [previously Planning and Organizing]

* Modified block definition:
  + Planning and prioritizing work to manage time effectively and accomplish assigned tasks as efficiently as possible.
* Added new key behavior titles with relevant new key behavior descriptions: *Arranging and informing, Coordinating in distributed environments, Shiftwork*
* 3.4.4 Anticipating obstacles
  + Edited key behavior description:
    - Develop contingency plans to address them identified obstacles.

3.5 Creative Thinking and Problem Solving

* Updated entire block with new key behavior titles: *Identifying the problem, Seeing the big picture, Generating innovative solutions, Choosing a solution, Implementing the solution*
* Organized new key behavior descriptions within each key behavior to reflect the update information.

3.6 Checking, Examining, and Recording

* Modified block definition:
  + Entering, transcribing, recording, storing, or maintaining information in written or electronic/digital format, including adaptive devices and software.
* Created new key behavior titles: *Obtaining data and information, Detecting errors, Completing forms/documentation, Maintaining logs, records, and files*
* Organized existing and new key behavior descriptions within each key behavior title.

3.7 Working with Tools and Technology

* Modified block definition:
  + Selecting, using, and maintaining tools and technology, including adaptive tools and technology, to facilitate work activity (with accommodation when necessary).
* 3.7.1 Using tools
  + Edited key behavior definition:
    - 3.7.1.1 Operate tools, technology, and equipment in accordance with established operating procedures and safety standards.
  + Added key behavior definition:
    - Demonstrate appropriate use of tools and technology to complete work functions.
* 3.7.2 Selecting tools
  + Edited key behavior definitions:
    - 3.7.2.1 Identify Select and apply appropriate and cost-effective tools or technological solutions to the problem at hand.
    - 3.7.2.3 Use information technology and computer applications to support as it supports the gathering, storage, manipulation, and transfer of data and information.
* 3.7.3 Keeping current on tools and technology [previously Keeping current]
  + Added key behavior definition:
    - 3.7.3.2 Adapt quickly to changes in process or technology.
* 3.7.4 Troubleshooting and maintenance [previously Maintenance and troubleshooting]
  + Edited key behavior definition:
    - 3.7.4.3 Determine causes of operating errors and take the appropriate corrective action.
  + Added key behavior definitions:
    - 3.7.4.1 Develop alternatives to complete a task if desired tool or technology is not available.
    - 3.7.4.4 Learn how to maintain and troubleshoot tools and technologies.
    - 3.7.4.5 Record down events using appropriate methods.
    - 3.7.4.6 Communicate down events in a timely manner to needed audiences.

3.9 Sustainable Practices

* Created key behavior titles: *Minimizing environmental impact, Complying with standards, laws, and regulations*
* Organized previous key behavior descriptions into the key behaviors and added more key behavior descriptions within each key behavior.

**Tier 4: Industry-Wide Technical Competencies**

* Eliminated Entry- and Technician-level designations

4.1 Manufacturing Process Design/Development

* 4.1.1 Critical Work Functions
  + Added
    - 4.1.1.4 Develop functional specifications for the design and development of control systems.
* Technical Content Areas
  + Added new Technical Content Areas with relevant subject matter:
    - 4.1.3 Engineering concepts
    - 4.1.5 Design lifecycle and concepts
    - 4.1.6 Development lifecycle – Commissioning
    - 4.1.9 Workflow assessment

4.2 Operations Management [previously titled Production]

* 4.2.1 Critical Work Functions
  + Edited:
    - 4.2.1.1 Understand Name the various manufacturing types, processes, and products.
    - 4.2.1.2 Understand Describe the manufacturing business as a system that integrates multiple disciplines, processes, and stakeholders.
    - 4.2.1.3 Manage raw materials/consumables/outputs.
    - 4.2.1.6 Develop manufacturing industrial production/process plans and documentation.
    - 4.2.1.8 Monitor manufacturing industrial process and systems.
  + Added:
    - 4.2.1.7 Support the operation and control of production/process equipment.
* Technical Content Areas
  + Added new Technical Content Areas with relevant subject matter:
    - 4.2.8 Industrial process
    - 4.2.9 Industrial productions
    - 4.2.12 Industry-wide standards
    - 4.2.14 Organizational design and management
    - 4.2.15 Human behavior/motivation/leadership
  + 4.2.6 Automated systems and control operations
    - Added:
      * 4.2.6.9 Vacuum systems
  + 4.2.10 Manufacturing types
    - Added:
      * 4.2.10.4 Electrical/electronics manufacturing processes
  + 4.2.11 Production/process monitoring
    - Added:
      * 4.2.11.6 Instrumentation
  + 4.2.13 Project management and execution [previously titled Manufacturing management]
    - Edited
      * 4.2.13.6 Project management tools and techniques
    - Added
      * 4.2.13.1 Contracts
      * 4.2.13.3 Operation training
      * 4.2.13.5 Project lifecycle

4.3 Maintenance, Installation, and Repair

* 4.3.1 Critical Work Functions
  + Edited:
    - 4.3.1.2 Coordinate preventive maintenance to ensure production process runs smoothly support production or industrial process.
  + Added:
    - 4.3.1.7 Utilize predictive maintenance techniques.
    - 4.3.1.8 Explain maintenance impact on critical operations.
    - 4.3.1.9 Read, interpret, communicate and document action, information and instruction from technical documents.
* Technical Content Areas
  + Added new Technical Content Areas with relevant subject matter:
    - 4.3.3 Machining skills
    - 4.3.11 Networking and communication systems maintenance, installation, and repair
    - 4.3.12 Programmable/configurable systems maintenance, installation and repair
    - 4.3.19 Computer systems maintenance, installation and repair
    - 4.3.28 Optics
    - 4.3.29 Electromechanical systems maintenance, installation and repair
    - 4.3.30 X-ray maintenance, installation and repair
    - 4.3.31 Chemical processing systems maintenance, installation and repair
    - 4.3.32 Reliability and maintainability
    - 4.3.33 Clean room protocol for maintenance

4.4 Production in the Supply Chain/Supply Chain Logistics

* 4.4.1 Critical Work Functions
  + Added:
    - 4.4.1.1 Express promotion and selling strategies.
    - 4.4.1.2 Identify and pursue prospective customers and appropriate customer groups.
    - 4.4.1.3 Monitor customer preferences to determine focus of sales efforts and services that satisfy customer needs.
    - 4.4.1.4 Emphasize and promote features in marketing or sales.
    - 4.4.1.5 Assist in the selection of services based on the match between customer needs and product or service specifications.
    - 4.4.1.6 Inform customers regarding service contracts, offered services, estimated cost, delivery of services, and any other information regarding the purchase of services.
    - 4.4.1.7 Resolve customer complaints regarding sales or services promptly and to the satisfaction of the customer.
* 4.4.10 Supply-chain management
  + Added:
    - 4.4.10.8 Cost of goods sold (COGS) real time
    - 4.4.10.9 Value cost analysis
* 4.4.11 Workflow
  + Added:
    - 4.4.11.4 Lot control
    - 4.4.11.5 QA release

4.5 Quality Assurance and Continuous Improvement

* 4.5.1 Critical Work Functions
  + Added:
    - 4.5.1.7 Apply and analyze concepts associated with measuring quality.
    - 4.5.1.8 Implement controls to support quality management.
    - 4.5.1.9 Use quality management to ensure quality levels.
    - 4.5.1.10 Seek new approaches and techniques to improve quality levels.
* Technical Content Areas
  + Added new Technical Content Area with relevant subject matter:
    - 4.5.4 Problem solving tools
* 4.5.2 Quality Assurance
  + Added:
    - 4.5.2.4 Corporate and site standards
* 4.5.8 Continuous improvement
  + Added:
    - 4.5.8.4 Performance improvement strategies
* 4.5.11 Probability and statistics/Statistical process control methods
  + Added:
    - 4.5.11.6 Measurement uncertainty and dead time

4.6 Process and Equipment Health, Safety, and Environment

* 4.6.5 Preventive health, safety, or environmental inspections
  + Added:
    - Emergency response team and responsibilities
* 4.6.7 Standards
  + Added:
    - 4.6.7.2 International Information Security Management Guidance (ISO27001)
* 4.6.8 Safety procedures
  + Added:
    - 4.6.8.2 Open space – raised tile floor
    - 4.6.8.3 Ladder safety – working with heights