



TECHNICAL CERTIFICATION COMPETENCY MODEL

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TECHNICAL CERTIFICATION COMPETENCY MODEL

Competency Model

This Competency Model identifies the knowledge, skills, and abilities one should possess to achieve a **Certified Manufacturing Technologist** (CMfgT) and **Certified Manufacturing Engineer** (CMfgE) credential. The model is also helpful in understanding each certification and evaluating which certification complements your professional development goals.

To create this Competency Model a committee of content experts in engineering and manufacturing roles, whom are also certified as a CMfgT and/or CMfgE, used the **Body of Knowledge** to analyze and identify specific roles for each certification.

1. Manufacturing Foundations
2. Manufacturing Process Application
3. Design & Development
4. Digital Enterprise
5. Automated Systems & Control
6. Quality
7. Continuous Improvement
8. Business Acumen

TECHNICAL CERTIFICATION COMPETENCY MODEL

TECHNOLOGIST	ENGINEER
1 - Manufacturing Foundations - 20%	1 - Manufacturing Foundations - 15%
1.1 Mathematics	1.1 - Mathematics
Apply advanced mathematical equations (rates of change, two equations, two variables, area under curve) to the solution of technical problems	Apply advanced mathematics to the solution of engineering design and analysis problems
1.1.1 — Algebra	1.1.1 — Algebra
Derive variable expressions	Derive variable expressions
Apply order of operations	Apply order of operations properly to the solution of equations
Derive equations	Derive linear equations
Derive inequalities	Derive inequalities
Derive linear equations in one variable	Derive linear equations in one variable
Solve systems of linear equations	Derive systems of linear equations
Solve quadratic equations	Solve quadratic equations
Apply exponents and logarithms	Apply exponents and logarithms
	Recognize unsolvable, undetermined, and over/underdetermined systems – changed
1.1.2 — Trigonometry	1.1.2 — Trigonometry
Derive ratios and proportions	Derive ratios and proportions
Solve triangle relationships/similarity of figures	Solve triangle relationships/similarity of figures
Solve right triangles	Solve right triangles
Apply laws of sines and cosines	Apply laws of sines and cosines
Solve circle problems (area and circumference)	Solve circle problems (area and circumference)
Solve for areas of various figures	Solve for areas of various figures
Solve for angles and arcs	Solve for angles and arcs
Apply graphical methods to create plots of trigonometric functions	Apply graphical methods to create plots of trigonometric functions
1.1.3 — Analytical Geometry	1.1.3 — Analytical Geometry
Topic covered in algebra and trigonometry	Topic covered in algebra and trigonometry
1.1.4 — Calculus	1.1.4 — Calculus
Not applicable	Understand differential calculus methods for polynomials, trig functions, and applications.
1.1.5 — Statistics	1.1.5 — Statistics
Apply descriptive statistics to numerical data (mean, mode, median, standard deviation/variance)	Apply descriptive statistics to numerical data (mean, mode, median, standard deviation/variance)

TECHNICAL CERTIFICATION COMPETENCY MODEL

Calculate event probability	Apply linear regression techniques to numerical data
	Apply hypothesis testing methods to numerical data (chi-square, F-test)
	Apply basic counting methods (permutations, combinations)
	Calculate event probability and normal probability
	Apply the central limit theorem
1.1.6 — Measurement	1.1.6 — Measurement
Apply metric system properly, including units, and prefixes	Apply metric system properly, including units, and prefixes
1.2 — Print Reading	1.2 — Print Reading
Read drawings/prints	Read drawing/print
Apply the different use of line types	Apply the different use of line types
Apply the different symbols and uses	Apply the different symbols and uses
Provide drawing tolerance data for actual parts	Provide drawing tolerance data for actual parts
Use drawing notes	Use drawing notes
Review and verify title block to configuration requirements	Review and verify title block to configuration requirements
Provide feedback to manufacturing and design group	Provide feedback to technologist and design group
	Analyze pertinent information and apply to processing
	Review drawings and make suggestions for improvement
	Provide documentation and deliver to drawing requirements.
1.3 — Geometric Dimensioning and Tolerancing	1.3 — Geometric Dimensioning and Tolerancing
<i>These competencies apply to all 3rd level topics; unique topics only are covered at the 3rd level.</i>	
Interpretation and application of tolerances	Interpretation and application of tolerances
	Collaborate with designers on GD&T requirements
Understand temperature, climate, and environmental impacts on tolerance	Interpret GD&T on the print and translate to the application
Understand basic GD&T	Understand temperature, climate, and environmental impacts on tolerance
Understand tolerance stack-up analysis	Select methods and conduct tolerance stack-up analysis
	Establish datum scheme/reference points
1.4 - Engineering Science	1.4 - Engineering Science
1.4.1 — Chemistry	1.4.1 — Chemistry
Understand basic knowledge of periodic table and bonding	Apply basic knowledge of periodic table and bonding

TECHNICAL CERTIFICATION COMPETENCY MODEL

Understand acids/bases, pH level	Understand acids/bases, pH level
Write a balance chemical reaction	Solve a balance chemical reaction equation
Understand valence and crystal structure	Understand valence and crystal structure
Understand effect of parameters on reaction rates	Understand effect of parameters on reaction rates
	Understand quantum mechanical structure of atoms
	Understand models of chemical bonding
	Understand models of chemical equilibrium
	Understand thermo chemistry
1.4.2 — Physics	1.4.2 — Physics
Classical physics, non-calculus based	Classical physics, calculus based
Solve equations to fundamental problems of wavelengths and calculations	Apply principles of kinematics and mechanics of a particle to determine work, energy and momentum
Solve equations to calculate sound levels	Apply associated conservation laws for rotation, torque and angular momentum of particles
Solve equations of particle kinematics and mechanics to find work and energy	Apply principles of oscillations and wave motions for particles
Solve equations for conservation of momentum	Solve equations in electrostatics, electrical current, and circuit
Solve equations to determine rotation and torque	Solve equations in magnetism, electromagnetic induction, and waves
Solve equations in electric current, and circuits	Solve equations in geometrical optics
1.4.3 — Fluid Mechanics	1.4.3 — Fluid Mechanics
Understand fluid properties and how they affect fluid systems design and operation	Solve problems in fluid kinematics
Understand fundamental laws of fluid mechanics and energy relationships for incompressible fluids	Solve for mass, momentum, energy of fluids using control volume methods
Solve for pressure loss	Solve dimensional analysis and dynamic similarity problems
Understand flow measurement	Understand turbulence
Solve equations related to pipe sizing and pump selection	
Solve problems related to open channel flow analysis	
1.4.4 — Thermodynamics/Heat Transfer	1.4.4 — Thermodynamics/Heat Transfer
Solution of problems related to the application of principles of thermodynamics in the analysis of vapor and gas power cycles	Apply First Law of Thermodynamics to determine work, heat, properties of substances, and state equations
Solve problems in refrigeration and heat pump machinery	Apply Second Law of Thermodynamics to solve problems of steady state conduction, convection, and radiation
Understand properties of moist air (psychometrics)	
Solve problems in air distribution systems	

TECHNICAL CERTIFICATION COMPETENCY MODEL

Solve basic application problems of conduction, convection, and radiation	
1.4.5 — Mechanical Technologies in Statics & Dynamics	1.4.5 — Mechanical Technologies in Statics & Dynamics
Understand free-body diagrams for the solution of engineering mechanics problems	Derive free-body diagrams for the solution of engineering mechanics problems
Solve for reaction forces to determine stability and equilibrium of rigid bodies	Solve for reaction forces to determine stability and equilibrium of rigid bodies
Solve for shear and moment distributions in beams	Solve for internal forces, moments in trusses, and beams
	Solve equations to determine distributed loads and properties of areas in rigid bodies
	Solve for shear and moment distributions in beams
Solution of dynamical problems related to the motion of particles and rigid bodies.	Application of dynamics principles to particles, systems of particles, and planar rigid bodies
Solve kinematic equations to determine position, velocity and acceleration in single-degree-of-freedom and vector coordinate systems	Apply kinematic principles to determine position, velocity and acceleration in single-degree-of-freedom and vector coordinate systems
Solve kinetic equations to determine work (power) and energy	Apply kinetic principles to determine work (power) and energy
	Apply principles of linear and angular moment and impulses, including conservation
	Solve for mass moments of inertia
1.4.6 — Analytical Simulation, Methods and Techniques	1.4.6 — Analytical Simulation, Methods and Techniques
Perform Finite Element Analysis (FEA)	Perform Finite Element Analysis (FEA)
Use digital/virtual simulation tools & techniques	Select appropriate digital/virtual simulation and analytical tools
Run simulations (build, flow, etc.)	Create and run simulations
Read results/correlate to tests	Analyze results; implement/corrective actions
1.4.7 — Electrical Circuits and Electronics	1.4.7 — Electrical Circuits and Electronics
Solve series/parallel circuits using basic electrical principles	Apply basic circuit analysis methods to solve electrical design problems
Understand basic circuit elements (source, ground, resistor, capacitor)	Understand basic circuit elements (source, ground, resistor, capacitor)

TECHNICAL CERTIFICATION COMPETENCY MODEL

1.5 — Environmental Health & Safety	1.5 — Environmental Health and Safety
Define problems and situations, concerns, and violations	Understand range user calculations, limits, size, and parameters
Understand the sources that create the actual injury	Analyze and incorporate the human modeling methods
Understand OSHA and other safety regulations and comply	Conduct safety walks and audits
Identify problems, situations, concerns, and violations	Develop the safety standards
Implement safety resolutions and ergonomics	Determine tooling/assistant requirements
Communicate any requirements needing to be addressed in safety standards	Ensure compliance with OSHA and other safety regulations
Apply information from Safety Data Sheets (SDS)	Understand non-hazardous materials
Proper selection and use of Personal Protective Equipment (PPE)	Observe and monitor practices and implement improvements
	Apply information from Safety Data Sheets (SDS)
	Proper selection, use, and enforcement of use of Personal Protective Equipment (PPE)
1.5.1 — Human Factors	1.5.1 — Human Factors
Observe and monitor to identify opportunities to improve human factors — ensure compliance with proper processes	Observe and monitor to identify opportunities to improve human factors — ensure compliance with proper processes
1.5.2 — New Technologies Safety	1.5.2 — New Technologies Safety
Proper selection and use of PPE specified for the new technology	Proper selection, use, and enforcement of use of PPE specified for the new technology
Compliance with proper material handling protocols (correct storage, shelf life, contamination/environmental exposure, disposal, etc.)	Ensure compliance with proper material handling protocols (correct storage, shelf life, contamination/environmental exposure, disposal, etc.)
Apply information from Safety Data Sheets (SDS)	Apply information from Safety Data Sheets (SDS)
Compliance with hazmat protocols	Ensure compliance with hazmat protocols
Monitor equipment temperature and take corrective action	
Comply with proper handling procedures for inert gasses used in Additive Manufacturing; monitoring and alarm responses	Ensure compliance with proper handling procedures for inert gasses used in Additive Manufacturing; monitoring and alarm responses
Apply appropriate safety protocols on machines that are not designed for Lockout Tagout	Ensure compliance to safety protocols on machines that are not designed for Lockout Tagout
Understand the potential impact a cybersecurity breach may have on equipment (e.g. equipment controls taken over remotely)	Understand the potential impact a cybersecurity breach may have on equipment (e.g. equipment controls taken over remotely)
Ensure proper guarding is used and training is conducted on new technologies	Develop guarding and training procedures for new technologies
1.5.3 — Hazardous Materials	1.5.3 — Hazardous Materials

TECHNICAL CERTIFICATION COMPETENCY MODEL

Ensure chemicals are properly labeled/handled	Review drawings to ensure compliance with company policy relating to environmental impacts
Communicate safety practices for handling of waste, and in case of emergency	Review and encourage the wise use of resources to minimize waste
Review company policy for environmental practices and allowable/not allowable chemicals	Develop proper waste disposal methods and procedures
Apply information from Safety Data Sheets (SDS)	Work with environmental/safety department to make sure new chemicals are logged, necessary data attached, and proper labeling is affixed
Become aware of the MSDS systems in place	Identify hazardous materials and log them into the SDS database
1.5.4 — Personal Protective Equipment (PPE)	1.5.4 — Personal Protective Equipment (PPE)
Create an environment of compliance relating to personal protective equipment (PPE)	Define personal protective equipment (PPE) requirements
Proper selection and use of PPE	Proper selection, use, and enforcement of use of PPE specified for the new technology
1.5.5 — Situational Awareness	1.5.5 — Situational Awareness
Apply appropriate protocols within the work envelope	Ensure proper protocols are followed within the work envelope
Apply protocols within and when transitioning between work zones (e.g. one zone may require safety glasses, next zone may also require steel toed shoes, etc.)	Ensure compliance with protocols within and when transitioning between work zones
Conduct training on protocols within the work envelope and for transitioning between work zones	Collaborate on the development of training for the work envelope and for transitioning between work zones
1.5.6 — Ergonomics	1.5.6 — Ergonomics
Awareness of Ergonomic Safety Data Sheets (ESDS)	Awareness of Ergonomic Safety Data Sheets (ESDS)
Identify opportunities to improve ergonomics and ensure compliance with proper processes	Review and improve work bench/area design and facility layout
	Collaborate on the development of workplace design and plant layout
	Contribute to root cause analysis to identify the sources that create an actual injury
	Identify opportunities to improve ergonomics — ensure compliance with proper processes
	Development of production processes to minimize injury
1.5.7 — Hand Tool Use	1.5.7 — Hand Tool Use
Understand hand tool use and be able to train others	Research and make recommendations for hand tools and machines

TECHNICAL CERTIFICATION COMPETENCY MODEL

Understand how to use machines and be able to train others	Research and make recommendations for improvements
Analyze tooling needs, make suggestions	Create processes and safety procedures
Analyze and make suggestions for shop supplies relating to hand tool use and machine operations	Review personal protective equipment (PPE) requirements and help operators understand how to use it
1.6 — Ethics	1.6 — Ethics
Comply with ethics policies/standards of your employer and/or professional organization	Comply with ethics policies/standards of your employer and/or professional organization
Maintain confidentiality of company information and customer information	Maintain confidentiality of company information and customer information
As an individual, act in the best interest of your employee, your community, and the environment	As an individual, act in the best interest of your employee, your community, and the environment
Use company property in a proper manner in order to minimize loss, waste, or theft	Use company property in a proper manner in order to minimize loss, waste, or theft
Do not accept bribes or kickbacks from customers or colleagues	Do not accept bribes or kickbacks from customers or colleagues
Use appropriate protocols for reporting ethical violations	Use appropriate protocols for reporting ethical violations
2 — Manufacturing Process Application - 10%	2 — Manufacturing Process Application - 15%
Understand existing applications and uses	Research existing applications and be able to derive benefits, costs, and drawbacks of the ones in question
Understand how to use existing manufacturing applications efficiently	Provide suggestions based on investigative research
Understand where to look for new technology relating to new process applications and operation	Provide training for operators/technologists on new technology and how to use it
2.1 — Materials Properties & Applications of (topics below)	2.1 — Materials Properties & Applications of (topics below)
2.1.1 — Metals (Properties and Applications)	2.1.1 — Metals (Properties and Applications)
Apply principles of mechanical and thermal properties	Apply principles of mechanical and thermal properties
Awareness of materials standards, classifications, and certifications	Awareness of materials standards, classifications, and certifications
Conduct testing on incoming materials	Define testing protocols for incoming materials
2.1.2 — Plastics/Polymers (Properties and Applications)	2.1.2 — Plastics/Polymers (Properties and Applications)
Understand types of polymers in selection and design	Understand types of polymers in selection and design

TECHNICAL CERTIFICATION COMPETENCY MODEL

Apply general mechanical, electrical, thermal, elastic, and plastic properties and characteristics in selection and design	Apply general mechanical, electrical, thermal, elastic, and plastic properties and characteristics in selection and design
2.1.3 — Composites (Properties and Applications)	2.1.3 — Composites (Properties and Applications)
Understand types of composites (e.g. fiber reinforced, metal-matrix, thermosets, ceramic-matrix, etc.)	Apply proper criteria for composites selection
Understand general mechanical, electrical, and thermal properties	Understand general mechanical, electrical, and thermal properties
Apply proper safety protocols when working with composites	Apply proper safety protocols when working with composites
2.1.4 — Ceramics (Properties and Applications)	2.1.4 — Ceramics (Properties and Applications)
Understand selection criteria for ceramics	Apply proper selection criteria for types of ceramics
Understand general mechanical, electrical, and thermal properties	Understand structure of ceramics
	Understand general mechanical, electrical, and thermal properties
Apply proper safety protocols when working with ceramics	Apply proper safety protocols when working with ceramics
2.2 — Manufacturing Processes	2.2 — Manufacturing Processes
<i>These competencies should be applied to all manufacturing processes outlined below. Process-unique competencies are provided below for each unique process.</i>	
	Analyze customer requirements (work with customer to define requirements)
Understand existing manufacturing applications and uses	Research existing applications and derive benefits, costs, and drawbacks
Review and follow process	Create and optimize processes
Support research for new technology/processes	Design, selection and analysis of tooling, fixturing, and gauging
Troubleshoot machinery	Review supplier capabilities
Provide data to support process selection	Develop scope of work (e.g. equipment, process, etc.)
Document process parameters	Compliance with environmental regulations, protocols and controls.
Manage performance to schedules, track variances (actual to schedule/compliance)	Review controlling documents and be able to recognize and communicate controlling features
	Provide training for operators/technologist on new technology and how to use it
	Apply modeling and simulation software for specific manufacturing process
	Develop and implement new processes
	Develop inspection plan
	Comply with company policies and procedures

TECHNICAL CERTIFICATION COMPETENCY MODEL

2.2.1 — Additive Manufacturing/3D Printing	2.2.1 — Additive Manufacturing/3D Printing
Understand property differences when orientating properties	Understand property differences when orientating properties
Understand the ASTM definitions for the major additive manufacturing processes	Understand the ASTM definitions for the major additive manufacturing processes
Awareness that certain features require a support generation strategy	Awareness that certain features require a support generation strategy
Awareness of post-processing requirements	Awareness of post-processing requirements
Awareness of AM applications as a secondary process	Awareness of AM applications as a secondary process
	Understand the business case for AM including tradeoffs, feasibility, cost, etc.
Understand requirements for part traceability, part serialization, and traceability of materials	Understand requirements for part traceability, part serialization, and traceability of materials
Generate a model	Analyze the build and observe the methods
	Develop documented feedback
Provide feedback concerning the prototype build and test	Manage brainstorm session(s)
Provide input during brainstorming sessions for improvements	Provide equipment research for safe testing
Re develop, working model using alternate methods	Analyze design for manufacturing (DFM)
Conduct testing	Plan lean principal incorporation in additive manufacturing
	Provide documented build methods
	Analyze times to perform various operations
	Review time standards to actual build times
	Review and adjust time standards as necessary for planning
	Provide design improvement suggestions
Review rapid prototype model for brainstorming/improvements	Understand or research rapid prototype techniques available and the applications of each
Provide feedback to manufacturing and design group	Provide feedback to technologist and design group
Understand machine setup	Understand CAD software and machine parameters
Provide input on material selections	Provide input on material selections
Biomedical unique application: understand biomaterial compatibility	Biomedical unique application: understand biomaterial compatibility
2.2.2 — Subtractive Manufacturing/ Material Removal	2.2.2 — Subtractive Manufacturing/Material Removal
Understand speeds and feeds	Develop machine programs
Analyze programming code	Select tooling and fixturing
Understanding of tooling and fixturing	Analyze and anticipate tooling reactions
Understand tooling selection	
2.2.3 — Fabrication	2.2.3 — Fabrication

TECHNICAL CERTIFICATION COMPETENCY MODEL

Competencies under 2.2 Manufacturing Processes	Competencies under 2.2 Manufacturing Processes
2.2.4 — Electrical/Electronics Manufacturing	2.2.4 — Electrical/Electronics Manufacturing
Adhere to electric static discharge (ESD) controls	Application of appropriate processes for through vs surface mount components
Conduct functional testing of circuits	Work with electrical engineering and quality engineering to develop functional testing protocols of circuits.
	Develop and implement electric static discharge (ESD) controls
2.2.5 — Treatments (e.g. Heat Treatment) & Coatings	2.2.5 — Treatments (e.g. Heat Treatment) & Coatings
Competencies under 2.2 Manufacturing Processes	Competencies under 2.2 Manufacturing Processes
2.2.6 — Finishing	2.2.6 — Finishing
Competencies under 2.2 Manufacturing Processes	Competencies under 2.2 Manufacturing Processes
2.2.7— Joining, Welding, and Assembly	2.2.7 — Joining, Welding, and Assembly
Competencies under 2.2 Manufacturing Processes	Competencies under 2.2 Manufacturing Processes
2.2.8 — Material Handling and Packaging	2.2.8 — Material Handling and Packaging
Review practices to make sure processes are followed	Comply with regulations relating to packaging of liquids, hazmat, and size limits
Plan in order to keep supplies on hand	Develop and implement material handling controls
Provide feedback to engineer on what works and where improvements are necessary	
Provide recommendations for material handling needs	
3 – Design & Development- 20%	3 – Design & Development - 15%
Provide input during design review	Work with product designer on value added engineering
Provide input for how the product flows through facility	Provide input during design review
	Assess part(s) flow and handling for processing.
	Conduct capability and feasibility study
3.1 — Intellectual Property Protection	3.1 — Intellectual Property Protection
Provide testing/proving out new idea	Provide testing/proving out new idea
Provide report results of testing to engineer	Provide report results of testing to engineer
Comply with intellectual property laws (trademarks, patents, copyrights)	Comply with intellectual property laws (trademarks, patents, copyrights)
Understand import/export/regulatory (e.g. ITAR, FFL, etc.) requirements around IP, and associated data management protocols	Ensure compliance import/export/regulatory (e.g. ITAR, FFL, etc.) requirements around IP and associated data management protocols

TECHNICAL CERTIFICATION COMPETENCY MODEL

3.1.1 — Patents	3.1.1 — Patents
Awareness of patent rules/laws and how not to infringe	Work with patent attorneys
Awareness of internal processes and protocols for creation, solicitation and disclosure technology	Support research existing patents and pending patents
Compliance with non-disclosure agreements	Participate patent meetings
Awareness of internal processes and policies for creation, solicitation and disclosure technology	Participate in office actions to United States Patent and Trademark Office (USPTO)
	Compliance with non-disclosure agreements
	Awareness of internal processes and policies for creation, solicitation and disclosure technology
3.1.2 — Trademarks	3.1.2 — Trademarks
Awareness of trademark rules/laws, how not to infringe, and proper use of trademarks	Awareness of trademark rules/laws, how not to infringe, and proper use of trademarks
3.1.3 — Copyrights	3.1.3 — Copyrights
Awareness of copyright types/rules/laws and how not to infringe	Awareness of copyright types/rules/laws and how not to infringe
3.1.4 — Trade Secrets	3.1.4 — Trade Secrets
Protect trade secrets	Protect trade secrets
Awareness of company processes and protocols for trade secrets	Awareness of company processes and protocols for trade secrets
3.2 — Computer-Aided Design/Drafting/Engineering Graphics/Modeling/Bill of Materials	3.2 — Computer-Aided Design/Drafting/Engineering Graphics/Modeling/Bill of Materials
Use CAD system to access and analyze graphics, drawings and models	Use CAD system to develop and analyze graphics, drawings and models
Comply with drawing and modeling standards	Comply with drawing and modeling standards
	Collaborate with design on manufacturing-related initiatives
	Analyze competitor's product
3.2.1 — Software	3.2.1 — Software
Access and interrogate models	Create and analyze conceptual models Software selection (selecting the right software for the situation)
Create design	Conceptualize design and oversee creation of design
3.2.2 — Slice Files	3.2.2 — Slice Files
Access files and transfer to the machine	Set parameters of 3D printed design Create STL files
3.2.3 — 3D vs 2D Modeling	3.2.3 — 3D vs 2D Modeling

TECHNICAL CERTIFICATION COMPETENCY MODEL

Access the appropriate files	Understand the appropriate application for 2 vs 3D
3.2.4 — Drafting Standards Mechanism	3.2.4 — Drafting Standards Mechanism
Adherence to drafting standards	Develop/create; establish parameters/tolerances,
3.2.5 — Computer-Aided Drafting	3.2.5 — Computer-Aided Drafting
Develop drawing to spec	Develop/create drawings; establish parameters/tolerances
Revise drawings/refine drawings	Develop template files; establish methods Understand functions within the software tool
Revision control	Revision control & traceability
Follow/apply drafting standards	Manage & control configurations
Understand functions within the software tool	
3.3 — Concurrent Engineering/Design for X	3.3 — Concurrent Engineering/Design for X
<i>These competencies apply to all 3rd level topics; unique topics only are covered at the 3rd level.</i>	
Provide data on what the life cycle will be based on testing results	Provide life cycle analysis (from beginning to end, (cradle-to-grave) on how the product/process will function, how long will it last, warranty monitoring, disposal, and maintenance)
Provide estimates of time to build the product	Design review & validation
Provide input on manufacturing and assembly methods and tooling requirements	Develop the business case (financial, process, equipment, capacity, etc.)
Provide input on machine utilizations	Manage drawing release schedule
Understand and recognize consumer hazards/risks	Develop the manufacturing bill of material and routings
Provide standard component suggestions (OEM)	Compliance with existing laws and legal resources
Review for continuous Improvement	Understand risks and provide proactive risk assessments
Analyze part function (can part be simplified, eliminated, combined?)	Research and apply with safety and other government regulations
Provide standard component analysis (cost, inventory, overhead cost reductions)	Review marketing materials to help avoid unintentional marketing fraud
Research ease of accessibility, interchangeability, serviceability	Participate in qualification of supply chain/value chain partners
	Work with design, perform part function analysis (can part be simplified, eliminated, combined?)
	Provide standard component analysis (cost, inventory, overhead cost reductions)
	Review tolerance requirements.

TECHNICAL CERTIFICATION COMPETENCY MODEL

	Review features for manufacturability and recommend modifications as appropriate
	Review material selections
	Quantify impact of product and process alternatives
	Work with design to eliminate part features that are not Critical to Function
	Analyze part intent, structural compatibility through manufacturing processes (distortion control, material handling, etc.)
	Research expected service life, failure consequences, service kits
Below are a variety of “Design for X” processes. The competencies outlined above apply to these DfX concepts for Manufacturing Technologists and Manufacturing Engineers.	
Technologist 3.3.1 — Design for Manufacture	Engineer 3.3.1 — Design for Manufacture
Technologist 3.3.2 — Design for Assembly	Engineer 3.3.2 — Design for Assembly
Technologist 3.3.3 — Design for Maintenance	Engineer 3.3.3 — Design for Maintenance
Technologist 3.3.4 — Design for Sustainability	Engineer 3.3.4 — Design for Sustainability
Technologist 3.3.5 — Design for Serviceability	Engineer 3.3.5 — Design for Serviceability
Technologist 3.3.6 — Design for Reliability	Engineer 3.3.6 — Design for Reliability
Technologist 3.3.7 — Design for Environment	Engineer 3.3.7 — Design for Environment
Technologist 3.3.8 — Design for Affordability	Engineer 3.3.8 — Design for Affordability
Technologist 3.3.9 — Design for Lightweighting	Engineer 3.3.9 — Design for Lightweighting
Technologist 3.3.10 — Design for Additive Manufacturing	Engineer 3.3.10 — Design for Additive Manufacturing
3.4 – Computer-Aided Engineering (CAE) Design and Manufacturing Tools	3.4 – Computer-Aided Engineering (CAE) Design and Manufacturing Tools
3.4.1 Engineering Analysis Tasks	3.4.1 Engineering Analysis Tasks
Provide input for relevant boundary conditions and input parameters for the analysis	Define and apply relevant boundary conditions and input parameters for the analysis
Provide input for analysis process and tools required	Define the analysis process and tools required
Provide input into the use case for each type of engineering analysis to be performed	Define and develop the use case for each type of engineering analysis to be performed
	Comply with appropriate standards and procedures for engineering analysis
	Establish acceptance criteria
3.5 – Equipment/Tool Design & Development	3.5 – Equipment/Tool Design & Development
Provide feedback on equipment/tool requirements	Develop equipment/tool requirements
Provide input for tool material selections	Select tool material
Validation of tool and equipment capabilities/limitations	Research tool and equipment capabilities/limitations

TECHNICAL CERTIFICATION COMPETENCY MODEL

Understand company policy and guidelines on tool and equipment selection	Apply company policy and guidelines on tool and equipment selection
Support business case development	Develop the business case (financial, process, equipment, capacity, etc.)
Provide input into space requirements and ergonomics	Defining space requirements and address ergonomic concerns (counterweights, etc.)
Provide input on tooling requirements	Define and develop tooling/equipment functions
Apply tooling/equipment appropriately	Interpret and translate tolerance requirements
	Determine applicability of motion controls
	Review design to ensure safety and ergonomics are addressed
3.5.1 – Cutting Tool Design	3.5.1 – Cutting Tool Design
Understand tooling material requirements based on part materials and tolerance, and desired tool life	Defining tooling material requirements based on part materials and tolerance, and desired tool life
Understand design requirements	Analyze design requirements
Understand tool life, options for tool rehabilitation, etc.	Define tool life, options for tool rehabilitation, etc.
Understand tool holder requirements	Define tool holder requirements
3.5.2 – Workholding Tool Design	3.5.2 – Workholding Tool Design
Understand tooling requirements based on tolerance requirements	Understand tooling requirements based on tolerance requirements
Interpret datum targets and how the finished product will be inspected	Interpret and translate datum targets and how the finished product will be inspected
Verify work holding design	Design work holding
3.5.3 – Die/Mold Design	3.5.3 – Die/Mold Design
Understanding of tooling requirements based on tolerance requirements	Understanding of tooling requirements based on tolerance requirements
Understand how die/mold will be used in production	Define how die/mold will be used in production
Understand tool life, options for tool rehabilitation, etc.	Define tool life, options for tool rehabilitation, etc.
3.5.4 – Gage Design	3.5.4 – Gage Design
Interpret tolerance requirements	Interpret and translate tolerance requirements
Interpret datum targets and how the finished product will be inspected	Interpret and translate datum targets and how the finished product will be inspected
Apply inspection techniques	Develop of inspection techniques
3.5.5 – Machine Design	3.5.5 – Machine Design
3.5.6 – Power Systems Design (Mech/Elec/Fluid)	3.5.6 – Power Systems Design (Mech/Elec/Fluid)
3.5.7 – Control Systems Design (Mech/Elec/Fluid)	3.5.7 – Control Systems Design (Mech/Elec/Fluid)

TECHNICAL CERTIFICATION COMPETENCY MODEL

Provide input to functional requirements	Develop functional requirements
Create and initiate part orders	Develop design
Conduct tests	Define functional tests
Conduct training	Develop training plan
	Develop maintenance plan (schedule drawing/spare parts, lead time)
3.5.8 – Nanotechnology	3.5.8 – Nanotechnology
Define nanotechnology	Define nanotechnology
Know the basic materials used for nano-applications	Know the basic materials used for nano-applications
a) For 2D – films and coatings	a) For 2D – films and coatings
b) For 3D – nanotubes, wafers, etc.	b) For 3D – nanotubes, wafers, etc.
Identify the basic nanomanufacturing / nanofabrication methods	Identify the basic nanomanufacturing / nanofabrication methods
a) Bottom-up methods	a) Bottom-up methods
b) Top-down methods	b) Top-down methods
	Understand how measurement and testing methods apply to nano related materials and products
	Understand unique manufacturing facility, handling, and safety aspects of dealing with nano-materials
3.5.9 – Packaging	3.5.9 – Packaging
Ship test packaging	Develop packaging specification
Participate in studies for returnable vs. disposable packaging	Lead studies for returnable vs. disposable packaging
Understand point of use packaging/kitting	Develop point of use packaging/kitting
Compliance to government regulations (e.g. Dept of Transportation, EPA, etc.) on treated packaging	Compliance to regulations (e.g. Dept of Transportation, EPA, etc.) on treated packaging
Compliance with regulations or protocols for traceability	Compliance with regulations or protocols for traceability
3.6 – Additive Manufacturing/3D Printing Applications	3.6 – Additive Manufacturing/3D Printing Applications
3.6.1 – Rapid Prototyping	3.6.1 – Rapid Prototyping
Understand capabilities of machine, feasibility of prototyping – AM process selection & material selection	Understand capabilities of machine, feasibility of prototyping – AM process selection & material selection
3.6.2 –Production Parts	3.6.2 – Production Parts
Feasibility – AM process selection & material selection	Productionization - turning the prototype of a design into a version that could be more easily mass produced (reDFX)

TECHNICAL CERTIFICATION COMPETENCY MODEL

3.6.3 – Tooling	3.6.3 – Tooling
Support feasibility of additive manufacturing for tooling	Determine feasibility of additive manufacturing for tooling
Support development of the business case	Develop the business case (financial, process, equipment, capacity, etc.)
	Schedule production
	Monitor and manage performance
3.6.4 – 3D Scan and Print	3.6.4 – 3D Scan and Print
Prepare data	Prepare data
Support scanning and data refinement process	Determine feasibility of 3D scanning
	Determine if metrology methods exist
	Conduct scanning and refine data
	Conduct reverse engineering on obsolete parts/products
4 – Digital Enterprise - 5%	4 – Digital Enterprise – 6%
4.1 – Digital Organization	4.1 – Digital Organization
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Comply with protocols for traceability	Apply appropriate protocols for traceability
Apply appropriate practices for product data management/product lifecycle management	Apply appropriate practices for product data management/product lifecycle management
Comply with cybersecurity principles and protocols	Comply with cybersecurity principles and protocols
4.2 – Industrial Internet of Things (IIOT)	4.2 – Industrial Internet of Things (IIOT)
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Support the use case for IIOT processes and protocols	Determine appropriate use cases and application of IIOT processes and protocols
Comply with protocols for IIOT applications	Develop processes and protocols for IIOT and ensure compliance
4.3 – Data Science	4.3 – Data Science
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Understand the difference between good and bad data	Develop appropriate questions to ask of data scientists for root cause analysis
Understand good data structure	Collect the appropriate data and prioritize the sequence of data to analyze
Save appropriate files and data	For manufacturing processes, determine what data streams need to be established, for what purpose the

TECHNICAL CERTIFICATION COMPETENCY MODEL

	data will be used, and the appropriate analytical tools to apply
Apply provided instructions for working with data to gain insights	Extract insights from data to understand and improve operations
Identify when to bring in an expert to analyze data	Identify when to bring in an expert to support data analysis
4.4 – Digital Performance Management (DPM)	4.4 – Digital Performance Management (DPM)
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Use and interpret DPM data	Use and interpret DPM data
	Select the appropriate tool for DPM data analysis
4.5 – Artificial and Augmented Intelligence	4.5 – Artificial and Augmented Intelligence
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Evaluate applications for manufacturing (e.g. adaptive controls, tool wear monitoring, predictive maintenance, etc.)	Evaluate applications for manufacturing (e.g. adaptive controls, tool wear monitoring, predictive maintenance, etc.)
4.6 – Machine Health, Asset Optimization and Industrial Maintenance	4.6 – Machine Health, Asset Optimization and Industrial Maintenance
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Implement and monitor maintenance guidelines/frequency of maintenance and tracking programs	Establish maintenance guidelines/frequency of maintenance and tracking programs
4.7 – Digital Twin	4.7 – Digital Twin
Understand the function and application of a digital twin	Apply digital twin in manufacturing environment
	Support integration of the digital twin as part of the DfX process
4.8 – Digital Thread	4.8 – Digital Thread
Awareness of the digital thread	Understanding limits and application of digital thread
5 – Automated Systems, Controls and Operational Technologies - 10%	5 – Automated Systems, Controls and Operational Technologies - 6%
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Understand automated material handling principles (conveyance, robotics)	Understand goals of implementing automation
Understand and describe the purpose of automation (hard, soft, flexible)	Apply classification/description schemes for manufacturing systems (job shop, work cell, flexible lines, transfer lines, etc.)

TECHNICAL CERTIFICATION COMPETENCY MODEL

Identify equipment needs and availability	Apply design principles for automated material handling systems (conveyance, transfer, robotics)
	Understand and describe the purpose of automation (hard, soft, flexible)
	Create detailed assembly plans
	Create detailed assembly sequencing
	Identify tooling/fixtures/equipment needs
	Create the written assembly/process plan
5.1 – Controls	5.1 – Controls
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Understand flowcharts	Understand and develop pseudo-code and flowcharts
Apply basic G-code programming for CNC	Understand basic G-code programming for CNC
Apply basic ladder-logic for PLC programming	Understand impact of interpolated versus point-to-point control
	Understand basic ladder-logic for PLC programming
5.2 – Computer Systems and Networks	5.2 – Computer Systems & Networks
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Understand purpose of computer networks in manufacturing and manufacturing engineering	Understand purpose of computer networks in manufacturing and manufacturing engineering
	Understand various network types (LAN, WAN) and advantages/disadvantages
	Understand various LAN configurations (star, rung, bus) and advantages/disadvantages
	Understand basic system manufacturing information system design/requirements
5.2.4 – Database Systems	5.2.4 – Database Systems
Understand purpose and capability of database technology	Understand purpose and capability of database technology
Understand types of data stored in databases	Understand types of data stored in databases
Utilize computer software to manage and share large amounts of information	Utilize computer software to manage and share large amounts of information
5.3 – Supply Chain	5.3 – Supply Chain
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Review processes and provide feedback	Develop and review processes
Implement change control process	Create layouts that support flow analysis and processes
Contribute to make/buy decisions	Manage change control process
	Lead make/buy decisions

TECHNICAL CERTIFICATION COMPETENCY MODEL

	Develop plans for movement and storage of products
	Collaborate to improve logistics (transportation)
	Comply with regulations, standards, and laws for importing and exporting of product
5.3.2 — Capacity Planning	5.3.2 — Capacity Planning
Identify resource requirements and provide feedback	Develop part flow mapping
Review and communicate space requirements	Analyze current capacities versus future production needs
Review flow options and provide feedback	Create resource plans
Provide feedback on engineering plans	Develop the business case (financial, process, equipment, capacity, etc.)
5.4 – Robotics	5.4 – Robotics
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Program robot protocols	Identify robot safety issues; support development and implement safety protocols
	Develop the business case for robotic implementations (e.g. identification, cost justification, safety, productivity, etc.)
	Awareness of simulations (programming, use of end effectors, etc.) for various robot types (e.g. robots, cobots, AGVs, etc.)
5.5 – Supervisory Control & Data Acquisition (SCADA)/Human-Machine Interface (HMI)	5.5 – Supervisory Control & Data Acquisition (SCADA)/Human-Machine Interface (HMI)
SCADA: supervisory control and data acquisition	
5.5.1 – Machine-to-Machine (M2M)	5.5.1 – Machine-to-Machine (M2M)
Integration of SCADA	Integration of SCADA
5.5.2 – Closed Loop Machine Interface	5.5.2 – Closed Loop Machine Interface
Integration of SCADA	Integration of SCADA
5.5.3 – Open Loop Machine Interface	5.5.3 – Open Loop Machine Interface
Integration of SCADA	Integration of SCADA
6 – Quality - 10%	6 – Quality – 15%
6.1 – Total Quality Management (TQM)	6.1 – Total Quality Management (TQM)
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Implement control and reaction plans for quality management systems	Develop control and reaction plans for quality management systems
Comply with appropriate standards	Identify and implement to appropriate standards

TECHNICAL CERTIFICATION COMPETENCY MODEL

Implement and validate process changes	Assess standards, changes, impacts, and set new processes
Comply with audit requirements (internal and external)	Conduct/comply audit requirements (internal and external)
6.2 – Statistical Control Methods	6.2 – Statistical Control Methods
Implement critical to quality, safety, and regulatory checks	Establish frequency of critical to quality, safety, and regulatory checks
Collect and analyze data	Select appropriate reporting/charting method
Recommend corrective action	Implement process changes
6.2.1 – Problem Solving & Analysis (e.g. Fishbone, Pareto, etc.)	6.2.1– Problem Solving & Analysis (e.g. Fishbone, Pareto, etc.)
Collect and supply relevant data	Conduct root cause analysis
	Apply appropriate analysis tools and solutions
6.2.2 – Factor Analysis (e.g. Design of Experiments (DOE), Correlation, etc.)	6.2.2 – Factor Analysis (e.g. Design of Experiments (DOE), Correlation, etc.)
Collect and supply relevant data	Define and perform DOE
	Define and perform correlation analysis
6.2.3 – Capability Analysis	6.2.3 – Capability Analysis
	Define process capability and monitoring plan
Monitor and collect data for Cp and Cpk	Define acceptance level for Cp and Cpk
Collect gage R&R data	Define gage R&R
6.2.4 – Reliability Analysis	6.2.4 – Reliability Analysis
Collect appropriate data	Calculate component, system, series, and parallel reliability principles in design and manufacturing
6.3 – Inspection, Test & Validation	6.3 – Inspection, Test & Validation
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Implement inspection, test and validation methods; collect and summarize data	Establish the appropriate inspection, test and validation methods
	Analyze data
6.3.1 – Metrology	6.3.1 – Metrology
Use appropriate measurement tools (e.g. micrometer, scale, caliper, CMM, vision system, laser scanning, etc.) and collect data for accuracy, resolution, repeatability, precision	Select appropriate measurement tools (e.g. micrometer, scale, caliper, CMM, vision system, laser scanning, etc.) based on accuracy, resolution, repeatability, precision
Train operators on proper use of selected measurement tools	Develop training for proper use of selected measurement tools

TECHNICAL CERTIFICATION COMPETENCY MODEL

Schedule and monitor calibration and certification of measurement tools	Define parameters of required calibration and certification of measurement tools
6.4 – Quality for Additive Manufacturing	6.4 – Quality for Additive Manufacturing
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Adherence to rules	Adherence to rules
Support QE's/AM specialists in establishing standards & AM specific acceptable and reject able defects	Support QE's/AM specialists in establishing standards & AM specific acceptable and rejectable defects
7 – Continuous Improvement - 15%	7 – Continuous Improvement – 15%
Understand Deming's 14 Points for management	Apply Deming's 14 Points for management
Understand Kaizen (Deming Cycle/PDCA/DMAIC)	Understand Kaizen (Deming Cycle/PDCA/DMAIC)
7.1 – Systems, Processes & Tools (e.g. Lean, Six Sigma, etc.)	7.1 – Systems, Processes & Tools (e.g. Lean, Six Sigma, etc.)
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Application of lean/six sigma/other continuous improvement tools and methods (such as benchmarking, just-in-time manufacturing, workflow analysis, kanban, standardized work, poke yoke, root cause analysis, SPC, SMED, Heijunka, Jidoka, PDCA, DMAIC, etc.)	Application of lean/six sigma/other continuous improvement tools and methods (such as benchmarking, just-in-time manufacturing, workflow analysis, kanban, standardized work, poke yoke, root cause analysis, SPC, SMED, Heijunka, Jidoka, PDCA, DMAIC etc.)
7.2 – Business Results & Measurement System	7.2 – Business Results & Measurement Systems
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Collect data to support evaluation of performance to plan	Select appropriate metrics to evaluate performance to strategic plan/goals
	Understand the interdependencies between measures and measurement categories
	Develop appropriate mechanisms for reporting performance to plan/goals
7.2.7 – Customer Focus	7.2.7 – Customer Focus
Deliver product/service to customer specifications	Delivering product/service to customer specifications
Implement countermeasures based on lessons learned	Develop and implement countermeasures based on lessons learned
7.3 – Quality, Cost & Delivery (QCD)	7.3 – Quality, Cost & Delivery (QCD)
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Collect and summarize data	Establish appropriate metrics and evaluate and improve as necessary
Use metrics to support the identification issues related to QCD including takt time, cycle time, inventory turns,	Use metrics to identify issues related to QCD including takt time, cycle time, inventory turns, queue times,

TECHNICAL CERTIFICATION COMPETENCY MODEL

queue times, wait time/delays, OEE, changeover time, scrap and rework, etc.	wait time/delays, OEE, changeover time, scrap and rework, etc.
Identification of abnormal conditions and implement corrective action; use of metrics to drive improvement	Identification of abnormal conditions and implement corrective action; use of metrics to drive improvement
8 – Business Acumen - 10%	8 – Business Acumen – 13%
Show innovation and creativity when helping others solve problems	Show innovation and creativity when helping others solve problems
Follow industry and market changes to help with creation of new ideas	Follow industry and market changes to help with creation of new ideas
Be open-minded, look for the unexpected, and be willing to take risks	Be open-minded, look for the unexpected, and be willing to take risks
Identify and share sources of information relevant to new methodologies, technologies, tools, machine tools, materials, etc.	Identify and share sources of information relevant to new methodologies, technologies, tools, machine tools, materials, etc.
8.1 – Soft Skills/Personal Effectiveness	8.1 – Soft Skills/Personal Effectiveness
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Understand your role within the organizational structure	Be familiar with various organizational structures (line and staff, matrix, product)
	Maintain required documentation for direct reports
Apply the policies and regulations related to your work	Apply policies and regulations related to your work; ensure compliance to policies and regulations within the workplace
Understand the value of diversity in the workforce	Understand the value of diversity in the workforce
Seek challenging work assignments to position oneself for growth	Seek challenging work assignments to position oneself for growth
Take responsibility for your actions and decisions	Take responsibility for your actions and decisions
Complete work assigned/required through perseverance	Complete work assigned/required through perseverance
Influence and motivate others (through your actions) to work toward company objectives	Influence and motivate others (through your actions) to work toward company objectives
Change plans, actions, and/or priorities to deal with changing company objectives	Change plans, actions, and/or priorities to deal with changing company objectives
Demonstrate flexibility, considering new ways to accomplish company goals	Demonstrate flexibility, considering new ways to accomplish company goals
8.1.2 – Interpersonal Skills	8.1.2 – Interpersonal Skills
Show respect for co-workers	Show respect for co-workers
Listen respectfully to opinions of others from various backgrounds and cultures	Listen respectfully to opinions of others from various backgrounds and cultures

TECHNICAL CERTIFICATION COMPETENCY MODEL

Keep an open mind when dealing with people from backgrounds/cultures different from your own	Keep an open mind when dealing with people from backgrounds/cultures different from your own
Strive to be an effective team member in order to achieve goals of the company	Strive to be an effective team member in order to achieve goals of the company
Maintain honest and open working relationships with supervisors and co-workers	Maintain honest and open working relationships with supervisors and co-workers
Influence and motivate others (through your actions) to work toward company objectives	Influence and motivate others (through your actions) to work toward company objectives
Act in a courteous and professional manner when dealing with customers and colleagues	Act in a courteous and professional manner when dealing with customers and colleagues
Solve problems by using critical-thinking skills	Solve problems by using critical-thinking skills
8.1.3 - Negotiation and Conflict Management	8.1.3 - Negotiation and Conflict Management
Treat others fairly and with respect	Treat others fairly and with respect
Use active listening skills to understand the root of conflict	Use active listening skills to understand the root of conflict
Act in a professional manner always	Act in a professional manner always
Be objective and focused on professional solutions; do not make it personal	Be objective and focused on professional solutions; do not make it personal
Focus on the problem and work toward consensus	Focus on the problem and work toward consensus
Demonstrate flexibility, considering new ways to accomplish company goals	Demonstrate flexibility, considering new ways to accomplish company goals
Face conflicts directly	Face conflicts directly
Compromise during conflict management process, if necessary, so that both parties feel like they have gained in the process (win-win)	Compromise during conflict meeting so that both parties feel like they have gained in the process (win-win)
Facilitate conflict resolution between parties	Facilitate conflict resolution between parties
Deal calmly and professionally with conflict	Deal calmly and professionally with conflict
8.1.4 – Presentation Skills & Oral Communication	8.1.4 – Presentation Skills & Oral Communication
Evaluate audience and tailor specific communication to audience	Evaluate audience and tailor specific communication to audience
Use available software to convey clear messages	Use available software to convey clear messages
Utilize clear and unambiguous language for communicating with others	Utilize clear and unambiguous language for communicating with others
Plan oral presentations to ensure successful delivery of message	Plan oral presentations to ensure successful delivery of message
Make use of graphs, bar charts, pie charts, etc. to clarify message	Make use of graphs, bar charts, pie charts, etc. to clarify message
Strive to be an active and effective listener	Strive to be an active and effective listener
Focus on messages from others instead of formulating a response	Focus on messages from others instead of formulating a response
Remain unbiased when communicating with people of different cultures or backgrounds	Remain unbiased when communicating with people of different cultures or backgrounds
Communicate clearly all thoughts, ideas, and suggestions in a well-organized (logical, coherent)	Communicate clearly all thoughts, ideas, and suggestions in a well-organized (logical, coherent)

TECHNICAL CERTIFICATION COMPETENCY MODEL

persuasive manner (correct spelling, punctuation, and appropriate grammar is expected)	persuasive manner (correct spelling, punctuation, and appropriate grammar is expected)
8.1.5 — Written Communication Skills	8.1.5 — Written Communication Skills
Evaluate audience and tailor specific communication to audience	Evaluate audience and tailor specific communication to audience
Use available software to convey clear messages	Use available software to convey clear messages
Utilize clear and unambiguous language for communicating with others	Utilize clear and unambiguous language for communicating with others
Use graphs, bar charts, pie charts, etc. to clarify message	Use graphs, bar charts, pie charts, etc. to clarify message
Create documents including letters, manuals, flow charts, reports, graphs, and work instructions.	Create documents including letters, manuals, flow charts, reports, graphs, and work instructions.
Use factual, succinct written communication for reports and other work-related matters	Use factual, succinct written communication for reports and other work-related matters
Write coherently to avoid confusion and proofread	Write coherently to avoid confusion and proofread
Prepare technical reports	Prepare technical reports
Select the appropriate communication tool for written message (e.g. email, report, memo, etc.)	Select the appropriate communication tool for written message (e.g. email, report, memo, etc.)
Use various sources (including the internet) to locate information needed; evaluate information for relevance and completeness before sharing with colleagues	Use various sources (including the internet) to locate information needed; evaluate information for relevance and completeness before sharing with colleagues
8.1.6 — Continual Learning and Development	8.1.6 — Continual Learning and Development
Keep abreast of new technology	Keep abreast of new technology
Hold an active membership in professional organization(s)	Hold an active membership in professional organization(s)
Attend relevant training/seminars sponsored by vendors or customers	Attend relevant training/seminars sponsored by vendors or customers
Partake in lifelong learning to benefit yourself and your employer	Partake in lifelong learning to benefit yourself and your employer
Take advantage (full participation) of company sponsored training	Take advantage (full participation) of company sponsored training
Maintain certifications, as required, through testing, or acquiring needed PDUs, CEUs, etc.	Maintain certifications, as required, through testing, or acquiring needed PDUs, CEUs, etc.
Seek learning and knowledge by setting challenging goals in your field of expertise	Seek learning and knowledge by setting challenging goals in your field of expertise
8.2 – Project Management	8.2 – Project Management
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Report task status for which you have responsibility	Use of project management tools and software
Provide time estimates for tasks	Obtain, justify, track and manage resources (personnel)
Prioritize work duties and specific project tasks	Develop and manage project plans and budget as appropriate; set milestones
Participate in change management process	Train project team members (terminology, templates, expectations)

TECHNICAL CERTIFICATION COMPETENCY MODEL

	Communicate project status of the overall project to sponsor and plan approvers
	Determine project requirements
	Assign action items/project tasks and prioritize work duties
	Perform risk assessment of project
	Manage changes in a project, ensure proper approval of changes, and keep team members apprised of approved changes
	Implement corrective actions when projects veer off course
	Anticipate obstacles to the successful completion of your project and develop a contingency plan(s) to overcome these obstacles
	Follow up with customers, vendors, and colleagues during projects and after project completion
	Address customer concerns, comments, or objections in a timely manner
8.3 – Finance	8.3 – Finance
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Gather production data (rates, per piece cost, tooling costs, etc.) to aid in justifying machine replacement or rebuild	Gather production data (rates, per piece cost, tooling costs) to aid in justifying machine replacement or rebuild
Interpret equipment specifications	Interpret equipment specifications
Be familiar with various methods for depreciating equipment	Be familiar with various methods for depreciating equipment
Use estimation techniques for time, costs, materials, resources, etc. required for projects	Use estimation techniques for time, costs, materials, resources, etc. required for projects
Apply statistics and probabilities (mean, median, standard deviation)	Apply statistics and probabilities (mean, median, standard deviation)
Understand basic business principles including supply/demand, market characteristics, profit and loss, make versus buy, ROI, etc.	Apply basic business principles including supply/demand, market characteristics, profit and loss, make versus buy, ROI, etc.
	Develop the business plan for new or modifications to processes, equipment and other activities
8.4 – Training & Development	8.4 – Training & Development
<i>These competencies apply to all 3rd level topics of the BOK; unique topics only are covered at the 3rd level.</i>	
Setup simulations	Assess knowledge, skills, and abilities (KSAs)
Freely share knowledge and expertise with others	Recommend and/or develop training programs (e.g. online, instructor-led courses, simulations, etc.)
Participate in application and skills training	Pursue lifelong education
Evaluate and validate training	Mentor others
Pursue lifelong education	Deliver training

TECHNICAL CERTIFICATION COMPETENCY MODEL

Read and interpret technical manuals, technical specifications, and appropriation requests	Read and interpret technical manuals, technical specifications, and appropriation requests
Deliver training	Determine knowledge gaps in direct reports and staff, and act to remedy
8.5 – Labor Relations	8.5 – Labor Relations
Comply with labor contracts	Contribute to contract negotiation points
	Recognize contributions and performance of union labor and develop performance incentives, if required.
	Comply with labor contracts