Summary of Changes
Automation Model

The Automation Model was updated twice in November 2018 and February 2025.

**February 2025 Update:**

Updates have been made on Tiers 1 and 2, to align with the new Building Blocks Model, including the addition of new digital literacy competencies.

**November 2018 Update: Health and Safety Related Competencies**

# Tier 1 – Personal Effectiveness Competencies

* No changes were made to the Tier 1 Competencies.

# Tier 2 – Academic Competencies

* No changes were made to the Tier 2 Competencies.

# Tier 3 – Workplace Competencies

* No changes were made to the Tier 3 Competencies.

# Tier 4- General Technical Competencies

* Removed *4.4 Production in the Supply Chain* block.

# *4.1 Design and Development Lifecycles*

* + Technical Content Areas
		- 4.1.6 Design Lifecycle
			* Deleted:
				+ 4.1.6.5 Utilization
				+ 4.1.6.6 Research and development fundamentals

Print reading

* + - 4.1.7 Development Lifecycle
			* 4.1.7.1 Commissioning
				+ Added: Field and Input/Output (IO) installation checks
				+ Deleted: Loop checks
			* 4.1.7.2 Periodic Testing (previously called Testing)
				+ Added: Configuration functionality

# *4.2 Operations Management*

* + Technical Content Areas
		- *4.2.7 Industrial production and process basics*
			* Deleted: Hybrid manufacturing – the packaging or bottling of manufactured goods
		- *4.2.8 Production/process monitoring*
			* Edited: 4.2.8.3 Controlling process ~~flow~~ efficiency and capacity
		- *4.2.9 Industry-wide standards*
			* Deleted: Manufacturing and control systems security (ISA 99)
			* Added:
				+ 4.2.9.3 ISA/IEC 62443 – Security for Industrial Automation and Control Systems
				+ 4.2.9.4 ISA 61511 – Safety Instrumented Systems
				+ 4.2.9.5 ISA 88 – Production and Batch Standards
				+ 4.2.9.6 ISA 18.2 – Alarm Management for Packaged Systems
			* *4.2.10 Project management and execution*
				+ Edited:

4.2.10.4 ~~Personnel~~ Project team management methods

# *4.3 Maintenance, Installation and Repair*

* + Technical Content Areas
		- *4.3.9 General Skills*
			* Edited:
				+ 4.3.9.7 Use of ~~hand~~ hardware and software tools
		- *4.3.10 Maintenance, installation, and repair skills*
			* Edited:
				+ 4.3.10.7 Piping operations and equipment installation best practices

# *4.4 Operational Quality Assurance*

* + Critical Work Functions
		- Edited: *4.4.3 Use quality management to ensure quality levels ~~are maintained~~*
		- Deleted: *Support and maintain quality systems*
	+ Technical Content Areas
		- *4.4.7 Corrective and preventive actions*
			* Edited:
				+ 4.4.7.1 Documentation ~~creation~~
				+ 4.4.7.3 Verification ~~and documentation~~
		- *4.4.10 Quality assurance audits*
			* Edited:
				+ 4.4.10.2 ISO 9000 – Quality management systems – Fundamentals and vocabulary
		- *4.4.11 Statistical process control methods*
			* Added:
				+ 4.4.11.6 Measurement uncertainty and dead time

# *4.5 Process and Equipment Health, Safety, and Environment*

* + Technical Content Areas
		- *4.5.11 Safety procedures*
			* Edited:
				+ 4.5.11.5 ~~Material~~ Safety Data Sheets ~~(MSDS)~~ (SDS)
			* Deleted: Response to shop emergencies

# Tier 5 – Specific Technical Competencies

* Added new block: ***5.7 Performance Management and Decision Support*** – please refer to the model for block content.
* ***5.1 Context of Automation***
	+ Critical Work Functions
		- Edited:
			* *5.1.1 Understand the role and impact of automation to increase process performance*
			* *5.1.3 Integrate automation in various manufacturing, industrial, utility, scientific, and technical applications*
	+ Technical Content Areas
		- New Technical Content Areas:
			* *5.1.9 Standards*
				+ 5.1.9.1 IEC 62381 – Factory Acceptance Test
				+ 5.1.9.2 IEC 62337 – Commissioning of Electrical, Instrumentation and Control Systems in the Process Industry
		- *5.1.6 Automation types*
			* + Added: 5.1.6.4 Building (e.g., commercial)
				+ Deleted: Hybrid (e.g., food, beverage packaging, printing, consumer packaging, pharmaceutical packaging)
			* *5.1.7 Automation project phases*
				+ Added: 5.1.7.12 Continuous improvement
			* *5.1.8 Codes, standards, and regulatory bodies*
				+ Added:

5.1.8.9 Occupational Safety and Health Administration (OSHA)

5.1.8.10 Environmental Protection Agency (EPA)

* ***5.2 Field Devices*** (previously titled Measurement, Sensors, and Actuation): The sensing, measurement, and final control elements necessary for automation.
	+ Critical Work Functions
		- Edited:
			* 5.2.4 Calibrate, troubleshoot, test, repair, and improve sensing, measurement, and ~~actuation devices~~ final control elements
			* 5.2.5 Document measurement, final control elements, and ~~actuation devices and~~ communications from these devices
	+ Technical Content Areas
		- Added new Technical Content Areas:
			* *5.2.14 Documentation*
				+ 5.2.14.1 Installation details
				+ 5.2.14.2 Instrument lists
				+ 5.2.14.3 Location plans (instrument location drawings)
				+ 5.2.14.4 Piping and Instrument Diagrams (P&ID)
				+ 5.2.14.5 Specification forms
			* *5.2.16 Standards*
				+ 5.2.16.1 ISA-RP105.00.01-2017 – Management of Calibration Program of an Industrial and Automation Control System
				+ 5.2.16.2 ISA-TR108.1-2015 Intelligent Device Management Part 1 Concepts and Terminology
				+ 5.2.16.3 IEC 60654 – Industrial-Process Measurement and Control Equipment
				+ 5.2.16.4 IEC 60770 – Transmitters for Use in Industrial-Process Control System
				+ 5.2.16.5 IEC 61069 – Industrial-Process Measurement, Control and Automation – Evaluation of System Properties for the Purpose of System Assessment
				+ 5.2.16.6 IEC 61298 – Process Measurement and Control Devices
		- *5.2.6 General*
			* Added:
				+ 5.2.6.5 Performance (e.g., drift linearity, offset reliability, precision, repeatability, rangeability, deadtime, and lag time)
			* Edited:
				+ 5.2.6.2 ~~Sample~~ Installation point selection
		- *5.2.7 Basic process instrumentation*
			* Added:
				+ 5.2.7.5 pH
				+ 5.2.7.6 Conductivity
		- *5.2.8 Specialized process instrumentation*
			* Added:
				+ 5.2.8.4 Dissolved oxygen
		- *5.2.10 High performance sensors*
			* Edited:
				+ 5.2.10.3 Specialized technologies (e.g., ~~Chemical~~ focused beam reflectance and laser based)
		- *5.2.11 Other measurements/sensors*
			* Deleted: Discrete
		- *5.2.15 Installations*
			* Edited:
				+ 5.2.15.2 Physical installation reliability and maintainability
			* Deleted:
				+ Grounding
				+ Power
				+ Surge suppressors
				+ Power quality/harmonics
				+ Uninterruptible Power Systems (UPS)
* ***5.3 Control***
	+ Critical Work Functions
		- Added:
			* 5.3.3 Programming/Configuration
		- Edited:
			* 5.3.2 Procedure development (e.g., startup and shutdown sequences) ~~Startup and shutdown sequences (procedural)~~
			* 5.3.4 Testing/Simulation/Training
		- Deleted:
			* Error handling
			* Basic control (regulatory)
			* Coordination control
			* Safety
			* Alarm handling
			* Development
	+ Technical Content Areas
		- Deleted Technical Content Areas *Motion Control,* *Robotics,* and *Visualization and display*
		- New Technical Content Areas:
			* *5.3.15 Mechatronics*
				+ 5.3.15.1 Robotic control
				+ 5.3.15.2 Machine control
				+ 5.3.15.3 Motion control
				+ 5.3.15.4 Automated guided vehicles (AGV)
			* *5.3.18 Human Machine Interface (HMI) Lifecycle*
				+ 5.3.18.1 System standards
				+ 5.3.18.2 Design
				+ 5.3.18.3 Implement
				+ 5.3.18.4 Operate
				+ 5.3.18.5 Continuous work processes
			* *5.3.19 Standards*
				+ 5.3.19.1 ISA 101 – Human Machine Interfaces
				+ 5.3.19.2 IEC 61131 – Programmable Controllers
				+ 5.3.19.3 IEC 61158 – Digital Data Communications for Measurement and Control
				+ 5.3.19.4 ISA 88 – Batch Control
				+ 5.3.19.5 IEC 61499 – Function Blocks
				+ 5.3.19.6 ISA-TR106 – Procedure Automation for Continuous Operations
				+ 5.3.19.7 ISA 112 – SCADA Systems
		- *5.3.7 Continuous control* (previously titled *Continuous and process control*)
			* Added:
				+ 5.3.7.3 Basic regulatory control
				+ 5.3.7.5 Parameter identification and adjustment
		- *5.3.8 Discrete and sequencing control*
			* Added:
				+ 5.3.8.2 Motion control system design
				+ 5.3.8.3 Performance V
		- *5.3.9 Batch control*
			* Added:
				+ 5.3.9.4 Error handling
			* Edited:
				+ 5.3.9.1 ~~Control~~ Activity management
		- *5.3.10 Advanced control*
			* Added:
				+ 5.3.10.1 Inferential measurement
				+ 5.3.10.2 Model predictive control
			* Deleted:
				+ Fuzzy logic
				+ Non-linear
				+ Optimal control
				+ Robust control
				+ Expert systems
				+ Multivariable controls
				+ Model-based control
				+ Neural nets
		- *5.3.11 Building automation*
			* Edited:
				+ 5.3.11.1 Building environment~~al~~ monitoring
				+ 5.3.11.3 Building security (e.g., access control, cameras)
		- *5.3.12 Control equipment* (previously titled Controller equipment)
			* Edited:
				+ 5.3.12.1 ~~Distributed~~ Control systems: hardware and configuration

Distributed control systems (DCS)

Programmable logic controllers (PLC)

Process automation controllers (PAC)

Supervisory Control and Data Acquisition (SCADA)

* + - * Added:
				+ Packaged systems (e.g., Refrigeration, UPS, Burner Management)
			* Deleted:
				+ Embedded systems
		- *5.3.13 Control system documentation*
			* Deleted:
				+ Installation details
				+ Instrument lists
				+ Location plans (instrument location drawings)
				+ Operating instructions
				+ Specification forms
				+ Standards and regulations
		- *5.3.14 Modeling and simulation*
			* Added:
				+ 5.3.14.1 Measurement and final control element dynamics
				+ 5.3.14.2 Loop tieback models
				+ 5.3.14.3 First principle models
				+ 5.3.14.4 Virtual plant (digital twin)

Real-time

Accelerated time

Replay scenarios

* + - * Deleted:
				+ Hardware device emulation
				+ Integration simulation
				+ Co-simulation
				+ Linear dynamic estimators
				+ First principle models
				+ Techniques for running simulations
				+ Virtual plant

Actual control system configuration

Advanced control tools

Process model

* + - *5.3.16 Software development*
			* Deleted:
				+ Basic software engineering
				+ Programming mobile systems
		- *5.3.17 Programming languages*
			* Added:
				+ Common programming languages (e.g., C/C++, HTML, Java, Visual Basic)
				+ Computer Numerical Control (CNC) (e.g., G-Code)
			* Deleted:
				+ Procedural (FORTRAN, C/C++, PASCAL)
				+ Functional (e.g., LISP, HASKELL)
				+ Declarative (e.g., SQL)
				+ Object oriented (e.g., .NET, Java)
				+ G-Code (CNC)
				+ Visual basic
				+ Electronic Device Description Language (EDDL)
* ***5.4 Infrastructure*** (previously titled Communication, Integration, and Software): Design and implement the operational technology infrastructure for Automation Systems.
	+ Critical Work Functions
		- Added:
			* 5.4.3 Address environmental aspects of equipment installation
			* 5.4.4 Specify and select networking and communication hardware
			* 5.4.5 Utilize system virtualization appropriately
		- Deleted:
			* Perform data historian duties: data curation, archiving, retrieval
			* Integrate real-time data with enterprise systems
			* Apply Manufacturing Operations Management systems (MOM)
	+ Technical Content Areas
		- Deleted Technical Content Areas *Manufacturing operations management (MOM) and business integration* and *Data management*
		- Added new Technical Content Areas:
			* *5.4.9 Radio Communications*
				+ 5.4.9.1 Cellular, UHF, VHF, microwave, satellite
				+ 5.4.9.2 Path study
				+ 5.4.9.3 Noise handling
			* *5.4.10 System virtualization*
				+ 5.4.10.1 Hardware requirements
				+ 5.4.10.2 Operating system
			* *5.4.11 Server hardware*
				+ 5.4.11.1 Closet layout
				+ 5.4.11.2 Installation best practice
			* *5.4.12 Standards*
				+ 5.4.12.1 ANSI/ISA 50 Parts 2-6 – Fieldbus Standard for Use in Industrial Control Systems
				+ 5.4.12.2 IEC 61158 – Digital Data Communications for Measurement and Control
				+ 5.4.12.3 IEC 61784 – Industrial Communication Networks
				+ 5.4.12.4 IEC 61987 – Industrial-Process Measurement and Control
		- Edited Technical Content Areas
			* *5.4.6 Network Configuration*
				+ Edited 5.4.6.5 ~~Large scale sensor~~ Wireless networks
			* *5.4.7 Digital Device Communication Protocols* (previously titled Industrial digital field protocols
				+ Added:

5.4.7.9 BACnet

5.4.7.10 ControlNet

5.4.7.11 LonWorks

5.4.7.12 PROFINET

* + - * *5.4.8 Open Connectivity Protocols* (previously titled Industrial communication protocols)
				+ Added:

5.4.8.4 Open Platform Communications (OPC)

* + - * + Deleted:

BACnet

Common industrial protocols

ControlNet

LonWorks

Object-linked Embedding for Process Control (OPC)

PROFINET

* ***5.5 System Safety and Reliability*** (previously titled Automation System Safety and Reliability
	+ Technical Content Areas
		- Deleted Technical Content Areas: *Alarm management* and *Manufacturing safety: process, discrete, and hybrid*
		- Added new Technical Content Areas:
			* *5.5.7 Alarm management lifecycle*
				+ 5.5.7.1 Philosophy
				+ 5.5.7.2 Identification
				+ 5.5.7.3 Rationalization
				+ 5.5.7.4 Detailed design
				+ 5.5.7.5 Implementation
				+ 5.5.7.6 Operation
				+ 5.5.7.7 Maintenance
				+ 5.5.7.8 Monitoring and assessment
				+ 5.5.7.9 Management of change
				+ 5.5.7.10 Audit
			* *5.5.10 Safety lifecycle*
				+ 5.5.10.1 Safety lifecycle
				+ 5.5.10.2 Allocation of safety functions to protective layers
				+ 5.5.10.3 Determination of safety integrity levels
				+ 5.5.10.4 Safety requirements specification
				+ 5.5.10.5 Design and engineering issues and system technologies
				+ 5.5.10.6 Installation, commissioning, and validation
				+ 5.5.10.7 Operations and maintenance
			* *5.5.13 Documentation*
				+ 5.5.13.1 Piping and Instrument Diagrams (P&ID)
		- *5.5.11 Safety equipment* (previously titled Safety controller equipment)
		- *5.5.12 Safe use and application of electrical apparatus*
			* Added: 5.5.12.2 Equipment selection for hazardous areas
			* Deleted:
				+ Installation design for hazardous areas
				+ General purpose requirements
		- *5.5.14 Standards*
			* Added:
				+ 5.5.14.2 ISA 18 (IEC) 62682) – Alarm Management
				+ 5.5.14.5 NFPA 497 – Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
				+ 5.5.14.6 NFPA 499 – Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
				+ 5.5.14.7 EIC 61508 – Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems
* ***5.6 Industrial Automation and Control Systems (IACS) Cybersecurity***
	+ Critical Work Functions:
		- Edited:
			* 5.6.5 Understand ~~Cybersecurity~~ Security Level (SL) per zone
		- Deleted Technical Content Area: *Operational Technology (OT) architecture*
	+ Technical Content Areas:
		- Edited:
			* 5.6.19.1 Response/business continuity planning/resilience ~~– understand the risks associated with OT systems and be able to identify practical mitigation measures to manage these risks~~

Summary of Changes

Automation Model

September 2017

# Tier 1 – Personal Effectiveness Competencies

* No changes were made to the Tier 1 Competencies.

# Tier 2 – Academic Competencies

* Added key behavior description to Communication block.

## 2.5 Communication

* *2.5.2 Communicating*
	+ Added key behavior description: *2.5.2.4 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.*

# Tier 3- Workplace Competencies

* Added key behavior descriptions to 3.9 Personal Health and Safety block and updated several existing key behavior descriptions.
* Updated key behavior title *3.9.1 Maintaining a safe environment* to *3.9.1 Maintaining a healthy and safe environment.*

## 3.9 Personal Health and Safety

* 3.9.1 Maintaining a safe environment
	+ Updated key behavior title from *3.9.1 Maintaining a safe environment* to *3.9.1 Maintaining a healthy and safe environment.*
	+ Edited key behavior descriptions:
		- 3.9.1.1 ~~Follow~~ Take actions to ensure the safety of self and others, in accordance with established personal and jobsite safety practices.
		- ~~3.9.1.2~~ 3.9.1.3 Comply with federal, state, and local regulations and company health and safety ~~regulations~~ policies.
		- 3.9.1.5 Follow organizational procedures and protocols for workplace emergencies, including safe evacuation and emergency response.
		- 3.9.1.7 Administer first aid or CPR, if trained, and summon assistance as needed.
	+ Added key behavior descriptions:
		- 3.9.1.2 Anticipate and prevent work-related injuries and illnesses.
		- 3.9.1.4 Recognize common hazards and unsafe conditions that occur at work, their risks, and appropriate controls to address them.
	+ Deleted key behavior description:
		- 3.9.1.3 Identify unsafe conditions and take corrective action.
* 3.9.2 Safeguarding one’s person
	+ Added key behavior descriptions:
		- 3.9.2.1 Engage in safety training.
		- 3.9.2.4 Recognize how workplace risks can affect one’s life and one’s family.
		- 3.9.2.5 Understand the legal rights of workers regarding workplace safety and protections from hazards.
		- 3.9.2.6 Report injuries, incidents, and workplace hazards to a supervisor as soon as safely possible.
		- 3.9.2.7 Contribute to discussions of safety concerns in the workplace, making suggestions as appropriate.