

**Year-1 Regional Manufacturing Industry Focus Groups**

**-Report of Findings-**

**February 15, 2007**



**Prepared for:**

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and  
Agency for Workforce Innovation**

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## **Manufacturing Focus Groups: A Report of Findings**

### **February 15, 2007**

#### **PURPOSE OF THE MANUFACTURING FOCUS GROUPS**

The focus groups were a key element of an ongoing dialogue with the manufacturing industry community, where the dialogue provided an information exchange essential to addressing the significant and emerging training requirements for manufacturing companies located in Duval, Hillsborough, Manatee, Pasco-Hernando, and Polk counties. Specific to each group activity was the gathering of opinions—pertaining to the industry’s workforce training needs—from the key stakeholders in the manufacturing community representing the following organizations:

- Duval area manufacturing companies, Jacksonville Regional Chamber of Commerce, Pasco-Hernando Community College, Polk Community College, and Florida Community College at Jacksonville
- Greater Tampa Bay area manufacturing companies, Bay Area Manufacturers Association, Tampa Bay Workforce Alliance, and Pasco-Hernando, Polk, and Hillsborough Community Colleges
- Manatee-Sarasota area manufacturing companies, Sarasota/Manatee Area Manufacturers Association, Suncoast Workforce Board, and Manatee Community College
- Pasco-Hernando area manufacturing companies, Pasco Economic Development and Manufacturers Councils, Pasco Hernando Jobs & Education Partnership Regional Board, Inc., and Pasco-Hernando Community College
- Polk area manufacturing companies, Lakeland Economic Development Council, Polk Works, State Senator J. D. Alexander’s office, and Polk Community College

The Center held five manufacturing focus groups throughout the state, and 157 representatives from the manufacturing community participated. Peter Straw, executive director of the Sarasota/Manatee Area Manufacturers Association, was contracted to facilitate all five groups to ensure continuity of results. The meetings served as a qualitative tool to gain insight and understanding into the nature of the production workforce needs of the manufacturing community. This type of research forum facilitated direct interaction with the group respondents and allowed opportunities for clarification, follow-up questioning, and probing responses. However, the findings garnered from the group meetings were not survey results. Rather, these initial findings provided insight into manufacturing industry production workforce-related issues under study, but not for statistical inference.

## **MANUFACTURING FOCUS GROUP TOPICS**

Mr. Straw used a portfolio of approaches to ensure the industry members, comprised of expert workers in a wide spectrum of fields, adequately addressed the topics. In collaboration with the Center director and project manager, the following three forums comprised each group meeting:

- A Center Introduction and Focus Group Orientation
- Four individual Breakout Group discussions, which served as brainstorming sessions that addressed specific skill and knowledge-based production workforce topics
- A General discussion, which was an aggregate group brainstorming session addressing broad manufacturing industry topics

During the both discussion forums, the groups addressed the following topics:

### **Breakout Group Discussions**

- Manufacturing production and processes
- Safety
- Quality assurance
- Maintenance awareness

### **General Discussion**

- Current and future trends in the manufacturing industry, which will drive production workforce training needs for entry-level and incumbent workers
- MSSC certification and curriculum alignment
- Training format and delivery

## **POST-FOCUS GROUP ASSESSMENT**

At the end of each focus group, the group facilitator, Center Director and Manager, and the key contact from the respective host institution performed a post-focus group assessment. Material and group process findings received a cursory analysis, followed-up by appropriate improvements.

## **SUMMARY OF FOCUS GROUP FINDINGS**

The Center sent individual focus group reports to its partners—for their information and use and for distribution to focus group participants—and Workforce Florida. As such, replications of those individual reports are not included in this report, but rather, a compilation of findings follows.

**Breakout Group Findings.** Due to the extensive amount of data collected, the Breakout Group Sessions Summary of Highlights is next followed by the combined Breakout Group Session findings. Please note in the combined findings that the “Instances” refer to the number of times a particular finding occurred during the five focus groups. Additionally, to ensure the best possible follow-up phase (i.e., an online survey) to the focus group effort, the Center assigned groupings (**P=production; S=safety; Q=quality; M=maintenance**) to each finding to determine cross-functional relevance of production worker knowledge/skill sets.

### Breakout Group Sessions Summary of Highlights

Key findings of the Manufacturing Production and Processes Entry-Level Worker Immediate and Future Knowledge/Skill Set requirements are:

- Computers
- Mathematics
- Tool use
- Statistical process control
- CNC/CAD
- Electrical
- Basic business fundamentals
- Measures

Key findings of the Manufacturing Production and Processes Incumbent Worker Immediate and Future Knowledge/Skill Set requirements are:

- Troubleshooting
- CNC/PLC
- Precision machining
- Computers and automated systems
- Lean manufacturing
- Cost accounting
- Process and material control
- Six Sigma

Key findings of the Manufacturing Safety Entry-Level Worker Immediate and Future Knowledge/Skill Set requirements are:

- Risk management
- OSHA
- Personal protection equipment
- First aid
- Follow procedures
- Accident reporting
- Safe use of equipment
- HAZMAT

Key findings of the Manufacturing Safety Incumbent Worker Immediate and Future Knowledge/Skill Set requirements are:

- Basic safety practices
- Lock out/Tag out
- Tiered EMS
- OSHA
- Safe use of equipment
- Advanced first aid
- Workplace security/violence
- MSDS

Key findings of the Manufacturing Quality Assurance Entry-Level Worker Immediate and Future Knowledge/Skill Set requirements are:

- Mathematics
- Accounting
- Interpret statistics and charts
- Standards and measures
- Statistical process control
- Measuring and tolerancing
- Quality principles
- Lean manufacturing

Key findings of the Manufacturing Quality Assurance Incumbent Worker Immediate and Future Knowledge/Skill Set requirements are:

- Customer service
- Teamwork
- Computers
- Good manufacturing practices
- Six Sigma
- Cause and effect/probable outcomes
- Poka Yoke
- Statistical process control

Key findings of the Manufacturing Maintenance Awareness Entry-Level Worker Immediate and Future Knowledge/Skill Set requirements are:

- Tool use
- Computers
- Troubleshooting
- Preventative maintenance
- Mathematics
- Hydraulics, pneumatics, and electrical
- Lubrication
- Cost of outages

Key findings of the Manufacturing Maintenance Awareness Incumbent Worker Immediate and Future Knowledge/Skill Set requirements are:

- Computers
- Preventative maintenance
- Troubleshooting
- Interpreting technical manuals/information
- Root cause analysis
- Mechanical
- PLC
- Processes

## Manufacturing Production and Processes

Entry-Level Worker Immediate Skill Sets	Entry-Level Worker Future Skill Sets
<p><b>Five Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Read, write, and communicate in English</li> <li>• Computers: P-Q-M</li> </ul> <p><b>Four Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Problem solving: P-S-Q-M</li> <li>• Mathematics: P-Q-M</li> <li>• Tool use: P-Q-M</li> </ul> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Critical thinking: P-S-Q-M</li> <li>• Teamwork: P</li> <li>• Measure-record-calculations: P-Q-M</li> <li>• Blueprint reading: P-M</li> <li>• CNC/CAD: P-M</li> <li>• Electrical: P-M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Plot diagrams and flowcharts: P-Q</li> <li>• Mechanical: P-M</li> <li>• Machining: P-M</li> <li>• Lean processes: P-Q</li> <li>• Statistical process control: Q</li> <li>• Troubleshooting: P-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Inventory control: P</li> <li>• Organizational: P-Q-M</li> <li>• Production data input: P</li> <li>• Geometric tolerance and interpretation: P-Q</li> <li>• Machine set-up and operation: P-M</li> <li>• Forklift operation: P</li> <li>• Good manufacturing practices: P</li> <li>• Preventative maintenance: M</li> <li>• Complete tasks/focus: P-S-Q-M</li> <li>• Adaptable to learn complex systems within an organization: P-Q-M</li> <li>• Understanding directions: P-S-Q-M</li> <li>• Pipe fitting: P-M</li> <li>• Welding: P-M</li> <li>• Painter: P-M</li> <li>• Sheet metal: P-M</li> <li>• Rigging: P-S-M</li> <li>• Wiring: P-M</li> <li>• PLCs: P-M</li> <li>• Millwright: P</li> <li>• Safety awareness: P-S-Q-M</li> <li>• Coatings: P-M</li> <li>• Just-In-Time: P</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Statistical process control: Q</li> <li>• Troubleshooting: P-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Mathematics: P-Q-M</li> <li>• Reading: P-S-Q-M</li> <li>• Writing: P-S-Q-M</li> <li>• Manufacturing process awareness: P-Q-M</li> <li>• System awareness for problem solving: P-Q-M</li> <li>• Interpersonal: P-S-Q-M</li> <li>• Some machining: P-M</li> <li>• Measurement: P-Q-M</li> <li>• Computers: P-Q-M</li> <li>• Six Sigma: P-Q</li> <li>• Lean manufacturing: P-Q</li> <li>• Certification: P-S-Q-M</li> <li>• Portable production: P-S-Q-M</li> <li>• Customer service: P-S-Q-M</li> <li>• Teamwork: P</li> <li>• Creativity: P-S-Q-M</li> <li>• Commitment to cause: P-S-Q-M</li> <li>• Data acquisition: P-Q</li> </ul>

<ul style="list-style-type: none"> <li>• Lubrication: P-M</li> <li>• Alignment: P-M</li> <li>• Equipment specific: P</li> <li>• Process flow mapping: P-Q</li> </ul>	
<p><u>Incumbent Worker Immediate Skill Sets</u></p>	<p><u>Incumbent Worker Future Skill Sets</u></p>
<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Troubleshooting: P-M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Problem solving: P-Q-M</li> <li>• CNC/PLC: P-M</li> <li>• Read and interpret graphs/flowcharts: P-Q</li> <li>• Technical reading/comprehension: P-S-Q-M</li> <li>• Teamwork: P</li> <li>• Precision machining: P-M</li> <li>• Rigging: P-S-M</li> <li>• Blueprint reading: P-M</li> <li>• Computers: P-Q-M</li> <li>• Mechanical: P-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Statistical process control: P-Q</li> <li>• Analytical: P-S-Q-M</li> <li>• Tool use: P-M</li> <li>• MSSC assessment: P-S-Q-M</li> <li>• Soldering to IPC standard: P-M</li> <li>• Time and motion: N/A</li> <li>• Automation: P-Q-M</li> <li>• Operator driven reliability: P</li> <li>• Security: S</li> <li>• Auto CAD programming: P-M</li> <li>• Communications: P-S-Q-M</li> <li>• Waste reduction: P-Q</li> <li>• High production: P</li> <li>• Hand-held monitors: P-M</li> <li>• Preventative maintenance techniques: M</li> <li>• Flexibility/multitasking: P-S-Q-M</li> <li>• Good manufacturing practices: P</li> <li>• Hazard Analysis Awareness Continuous Process (HAACP): S</li> <li>• Certification: P-S-Q-M</li> <li>• Quality: Q</li> <li>• Identify constraints/bottlenecks: P-Q-M</li> <li>• Systems: P-Q-M</li> <li>• Write reduction strategies: P-S-Q-M</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Computers and automated systems: P-Q-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Troubleshooting: P-M</li> <li>• Reliability and maintenance: M</li> <li>• Technical writing: P-Q-M</li> <li>• Group leadership: P-S-Q-M</li> <li>• Office integration: P-Q-M</li> <li>• Certification: P-S-Q-M</li> <li>• Statistical process control: Q</li> </ul>

<ul style="list-style-type: none"> <li>• Train others: P-S-Q-M</li> <li>• Tool and die: P-M</li> <li>• Pipefitting: P-M</li> <li>• Welding: P-M</li> <li>• Lubrication: P-M</li> <li>• Critical thinking: P-S-Q-M</li> <li>• Multitasking: P-S-Q-M</li> </ul>	
<u>Entry-Level Worker Immediate Knowledge Base</u>	<u>Entry-Level Worker Future Knowledge Base</u>
<p><b>Five Instance of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Mathematics: P-Q-M</li> <li>• Read, write, and communicate in English: P-S-Q-M</li> </ul> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Basic business fundamentals: P-Q</li> <li>• Measures: P-Q-M</li> <li>• Computers: P-Q-M</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Problem solving: P-S-Q-M</li> <li>• Problem identification: P-S-Q-M</li> <li>• Schematics/blueprints/flowcharts: P-Q-M</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Cause and effect: P-S-Q-M</li> <li>• Metrics: P-Q</li> <li>• Mechanical: P-M</li> <li>• Basic understanding of what powers equipment: P-M</li> <li>• Lean process: P-Q</li> <li>• Teamwork: P</li> <li>• Value stream and supply chain: P</li> <li>• Geometric tolerancing: P-M</li> <li>• Basic electricity: P-S-M</li> <li>• Good manufacturing practices certification: P</li> <li>• Safety/safety awareness: S</li> <li>• SAE-to-Metric conversion: P-Q-M</li> <li>• Servo drives: P-M</li> <li>• Basic tool awareness: P-M</li> <li>• HAZMAT: S</li> <li>• Process flow mapping: P-Q</li> <li>• English for non-English speakers: P-S-Q-M</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b> N/A</p> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Writing and computation: P-Q-M</li> <li>• Metric system: P-Q-M</li> <li>• Mathematics: P-Q-M</li> <li>• Metallurgy: P-M</li> <li>• Supervisory methods: P</li> <li>• Succession planning: N/A</li> </ul>
<u>Incumbent Worker Immediate Knowledge Base</u>	<u>Incumbent Worker Future Knowledge Base</u>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p>

<p><b>Four Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Lean manufacturing: P-Q</li> </ul> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• PLC: P-M</li> <li>• Cost accounting: P</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Supervisory certification: N/A</li> <li>• Process improvement concepts and techniques: P-Q</li> <li>• Process and material control: P-Q</li> <li>• Computers: P-Q-M</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Automation: P-M</li> <li>• Read graphs and understand signs: P-S-Q-M</li> <li>• Recognize changes/standards: P-M</li> <li>• How to train entry-level workers: P-S-Q-M</li> <li>• Project management: P</li> <li>• Electrical and mechanical principles: P-M</li> <li>• Graphs and charts: P-Q-M</li> <li>• Root cause analysis: P-Q</li> <li>• Troubleshooting: P-M</li> <li>• Problem solving: P-Q-M</li> <li>• Value stream: P-Q</li> <li>• Networked machines: P-Q-M</li> <li>• Preventative maintenance: M</li> <li>• Good manufacturing practices: P</li> <li>• Hazard Analysis and Critical Control Point (HAACP): P-S</li> <li>• Hazard analysis: P-S</li> <li>• Mistake/fail-proofing: P-Q</li> <li>• Time management: P-S-Q-M</li> <li>• Instrumentation: P-M</li> <li>• Tool and die: P-M</li> <li>• Truck driver and forklift: P</li> <li>• Statistical process control: P-Q</li> <li>• Just-In-Time: P</li> <li>• Alignment: P-M</li> <li>• Predictive maintenance: M</li> <li>• Standard measurements of production: P</li> <li>• How to communicate problems: P-S-Q-M</li> <li>• Data analysis: P-Q-M</li> <li>• Physics: P</li> <li>• Chemistry: P</li> <li>• Basic tool awareness: P-M</li> </ul>	<p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Lean: P-Q</li> <li>• Six Sigma: P-Q</li> <li>• Statistics: P-Q</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Proportional Integral Derivative (PID) controllers: P-Q-M</li> <li>• Hazard Analysis and Critical Control Point (HAACP): P-S</li> <li>• Programming: P-M</li> <li>• Thinking in loops rather than linear: P-Q-M</li> <li>• Troubleshooting: P-M</li> </ul>
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## Manufacturing Safety

<u>Entry-Level Worker Immediate Skill Sets</u>	<u>Entry-Level Worker Future Skill Sets</u>
<p><b>Five Instance of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>Follow procedures: P-S-Q-M</li> <li>Personal protection equipment use: S</li> <li>Reading, writing, and speaking English: S</li> <li>Risk management-figuring out consequences: S</li> <li>OSHA: S</li> <li>First aid: S</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>Report problems, mistakes, accidents and near misses: S</li> <li>911-directions: S</li> <li>Brownfield status: S</li> <li>Orientation to equipment: S</li> <li>Bilingual safety directions: S</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>Forklift training: P-S-M</li> <li>Ergonomics: S</li> <li>Mathematics: P-Q-M</li> <li>Understanding directions/instructions: P-S-Q-M</li> <li>Basic assessment: P-S-Q-M</li> <li>Interpersonal: P-S-Q-M</li> <li>DOT shipping safety: S</li> <li>Hazard awareness: P-S-M</li> <li>Hygiene: S</li> <li>Ownership of errors: P-S-Q-M</li> <li>Spill clean up: S</li> <li>Handling hazardous materials: P-S-M</li> <li>Machine guards: P-S-M</li> <li>Safety mats and curtains: S</li> <li>Signs: S</li> <li>Material Safety Data Sheets (MSDS): S</li> <li>Interpret safety and health promotion guidelines: S</li> <li>Securing the workplace: S</li> <li>Basic safety practices: S</li> <li>Contingency planning: S</li> <li>Lock out/tag out: P-S-M</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>CPR recertification: S</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>Specifications per technical drawing: P-S-M</li> <li>Interpret safety and health promotion guidelines: S</li> <li>Determine impact of risk taking behavior on job safety: S</li> <li>Securing the workplace: S</li> <li>First aid: S</li> <li>Communication on risk behaviors and results, such as accidents: S</li> <li>Safe use of equipment: S</li> <li>Contingency planning: S</li> <li>Timely reporting of accidents: S</li> <li>Basic safety practices: S</li> <li>OSHA safety card: S</li> <li>Know what questions to ask employers: S</li> <li>Forklift training: P-S-Q-M</li> <li>DOT shipping safety: S</li> <li>Environmental safety: S</li> </ul>
<u>Incumbent Worker Immediate Skill Sets</u>	<u>Incumbent Worker Future Skill Sets</u>
<b>Five Instances of Reported Skill Sets</b>	<b>Five Instances of Reported Skill Sets</b>

<p>N/A</p> <p><b>Four Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Basic safety practices: S</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Operate a fire extinguisher: S</li> <li>• Lock out, tag out, confined space: S</li> <li>• First aid: S</li> <li>• Tiered EMS: S</li> <li>• First responder: S</li> <li>• Recognize and report safety problems: S</li> <li>• OSHA guidelines: S</li> <li>• Safe use of equipment: S</li> <li>• Hand tools training: P-S-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Rigging: P-S-M</li> <li>• Defibrillator use: S</li> <li>• ARC flash training (safety/gear): S</li> <li>• Tiered mobile equipment: S</li> <li>• Tier set of supervisory, safety, and communications: S</li> <li>• Identify hazardous materials: S</li> <li>• Follow workstation-specific instructions: S</li> <li>• Handle and transport materials properly and successfully: S</li> <li>• Keep work area safe and clean: S</li> <li>• MSDS-bilingual: S</li> <li>• Everyone is responsible and empowered: S</li> <li>• Hand tools training: P-S-M</li> <li>• Read and write English: P-S-Q-M</li> <li>• Dealing with disabled people: S</li> <li>• Ladder safety: S</li> <li>• Harnesses: S</li> <li>• Interpret safety and health promotion guidelines: S</li> <li>• Determine impact of risk-taking behavior on job safety: S</li> <li>• Securing the workplace: S</li> <li>• Contingency planning: S</li> <li>• Timely reporting of accidents: S</li> <li>• Mentor forklift operations: S</li> <li>• Mentor electrical safety: S</li> <li>• Mentor metals: S</li> <li>• Mentor machinery: S</li> <li>• Mentor lifting practices: S</li> </ul>	<p>N/A</p> <p><b>Four Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Observation: S</li> <li>• Drawings and schematics: P-S-M</li> <li>• Interpret safety and health promotion guidelines: S</li> <li>• Determine impact of risk taking behavior on job safety: S</li> <li>• Securing the workplace: S</li> <li>• First response: S</li> <li>• Communication on risk behaviors and results, such as accidents: S</li> <li>• Safe use of equipment: S</li> <li>• Contingency planning: S</li> <li>• Timely reporting of accidents: S</li> <li>• Basic safety practices: S</li> <li>• HAZMAT: S</li> <li>• MSDS: S</li> <li>• Incident command: S</li> <li>• Operational, job, and site-specific safety aspects: S</li> </ul>
<p><u>Entry-Level Worker Immediate Knowledge Base</u></p>	<p><u>Entry-Level Worker Future Knowledge Base</u></p>

<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Hygiene and health effects: S</li> <li>• First aid: S</li> <li>• Personal protection equipment: S</li> <li>• Blood borne pathogens: S</li> <li>• Basic OSHA: S</li> <li>• Accident reporting procedures: S</li> </ul> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Standard operating procedures: S</li> <li>• HAZMAT: S</li> <li>• Safe use of equipment: S</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Safety as priority over production: P-S</li> <li>• Lock out and tag out: P-S-M</li> <li>• Drug awareness: S</li> <li>• Homeland security/DOT/EPA: S</li> <li>• Clothing/jewelry restrictions around equipment: P-S-M</li> <li>• Signage, symbols, and colors: S</li> <li>• Risk management: S</li> <li>• First response: S</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Basic Mine Safety and Health Administration (MSHA): S</li> <li>• Fire safety: S</li> <li>• Good manufacturing practices: P-S</li> <li>• General food safety: P-S</li> <li>• Manufacturing environment: S</li> <li>• Forklift operations: P-S-M</li> <li>• Basic MSDS: S</li> <li>• Read and write English: S</li> <li>• Contact procedures: S</li> <li>• Contamination issues: S</li> <li>• Admitting errors: S</li> <li>• Written and verbal bilingual: P-S-Q-M</li> <li>• Safety risk tree: S</li> <li>• Clip-On Trailer (COT) crew: S</li> <li>• Pregnancy restrictions: S</li> <li>• Falling and slipping prevention: S</li> <li>• Ergonomics/human factor engineering: S</li> <li>• ADA: S</li> <li>• Personal protection critical: S</li> <li>• Transport/handling of materials: S</li> <li>• Communicate hierarchy following OSHA/PPC and value to employers: S</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• First aid: S</li> <li>• Safe use of equipment: S</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Awareness training: S</li> <li>• MSDS: S</li> <li>• Government agencies: S</li> <li>• HAZMAT and disposal: S</li> <li>• Computers: S</li> <li>• Safety training: S</li> <li>• Forklift operation: P-S-M</li> <li>• Written and verbal communication: S</li> <li>• Personal protection equipment: S</li> <li>• Workplace violence procedures: S</li> <li>• Fire drill simulations: S</li> <li>• Drug awareness: S</li> <li>• OSHA: S</li> <li>• Importance/impact of safety on production: S</li> <li>• Ergonomics/human factor engineering: S</li> <li>• Health promotion: S</li> <li>• Contingency planning: S</li> <li>• ADA: S</li> <li>• First response: S</li> <li>• Importance of timely accident reporting: S</li> <li>• Internal/external security issues: S</li> </ul>
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<ul style="list-style-type: none"> <li>• Safety protocols and procedures: S</li> <li>• Colored lines and lights: S</li> <li>• Dangerous environments: S</li> <li>• Workplace violence: S</li> <li>• Use of guards: S</li> </ul>	
<u>Incumbent Worker Immediate Knowledge Base</u>	<u>Incumbent Worker Future Knowledge Base</u>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Workplace security/violence: S</li> <li>• Advanced first aid: S</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• MSDS-read OSHA/ISO/FDA/DOH regulations: S</li> <li>• Closed/confined area processes: S</li> <li>• Ergonomics: S</li> <li>• Drug awareness: S</li> <li>• ADA compliance: S</li> <li>• Continuing safety education: S</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Proper lifting techniques: S</li> <li>• Process safety management: S</li> <li>• Anger management: S</li> <li>• Chemical safety training: S</li> <li>• Tiered mobile equipment: S</li> <li>• General safety practices: S</li> <li>• Forklift operation: P-S-M</li> <li>• Read, write, and speak English: P-S-Q-M</li> <li>• Fact-based decision making: S</li> <li>• Instructions at each workstation: S</li> <li>• Equipment maintenance safety: S</li> <li>• Use of cones and markers: S</li> <li>• Ladder climbing: S</li> <li>• Harnesses: S</li> <li>• Material disposal techniques: S</li> <li>• Personal protection equipment: S</li> <li>• General sign recognition: S</li> <li>• ARC/flash welding: S</li> <li>• Use of cell phones, iPods, and text messaging: S</li> <li>• Contact procedures: S</li> <li>• Emergency response plan: S</li> <li>• Hurricane preparedness: S</li> <li>• Business continuity: S</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b> N/A</p> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Drug awareness: S</li> <li>• OSHA: S</li> <li>• Importance and impact of safety on production: S</li> <li>• Ergonomics/human factor engineering: S</li> <li>• Health promotion: S</li> <li>• First aid: S</li> <li>• ADA: S</li> <li>• Importance of timely accident reporting: S</li> <li>• Safe use of equipment: S</li> <li>• Internal/external security issues: S</li> <li>• MSDS: S</li> </ul>

<ul style="list-style-type: none"><li>• HAZMAT: S</li><li>• First responder accessibility: S</li><li>• Evacuating personnel: S</li><li>• Importance and impact of safety on production: S</li><li>• Health promotion: S</li><li>• Importance of timely accident reporting: S</li><li>• Safe use of equipment: S</li><li>• Dealing with chemical spills: S</li><li>• Fire outage: S</li><li>• Train others in safety: S</li><li>• Risk management: S</li><li>• Safety programs: S</li></ul>	
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## Manufacturing Quality Assurance

Entry-Level Worker Immediate Skill Sets	Entry-Level Worker Future Skill Sets
<p><b>Five Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Reading, writing, and communications in English: P-S-Q-M</li> <li>• Mathematics: P-Q-M</li> </ul> <p><b>Four Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Accounting: P-Q</li> <li>• Interpret statistics and charts: P-Q</li> </ul> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Teamwork: P-Q</li> <li>• Customer service: P-S-Q-M</li> <li>• Computers and Internet: P-Q-M</li> <li>• Blueprint reading: P-Q-M</li> <li>• Standards and measures: P-Q-M</li> <li>• Following quality standards: P-Q-M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Critical thinking: P-S-Q-M</li> <li>• Measuring equipment: P-Q-M</li> <li>• Geometric tolerancing: P-Q-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Business fundamentals: P-Q</li> <li>• Goal setting: P-Q-M</li> <li>• Data collection and analysis: P-Q-M</li> <li>• Being organized: P-S-Q-M</li> <li>• Statistical process control: P-Q</li> <li>• MS Office: P-Q-M</li> <li>• Analysis and troubleshooting: P-Q-M</li> <li>• Adaptability: P-S-Q-M</li> <li>• Cause and effect related to quality: P-Q-M</li> <li>• Measure waste: P-Q</li> <li>• Waste reduction: P-Q</li> <li>• Documentation: P-Q-M</li> <li>• Organizational: P-S-Q-M</li> <li>• Interpersonal: P-S-Q-M</li> <li>• Accuracy/details: P-S-Q-M</li> <li>• Mechanical dexterity: P-Q-M</li> <li>• Accepting and handling change: P-S-Q-M</li> <li>• Promote/challenge improvement: P-Q-M</li> <li>• SM and Through Hole soldering: P-Q-M</li> <li>• Read and interpret technical reports: P-Q-M</li> <li>• Use paperless technology: P-Q-M</li> <li>• Analyze chemical components: P-Q-M</li> <li>• Audit manufacturing practices: Q</li> <li>• Root cause analysis: Q</li> <li>• Creative thinking: P-S-Q-M</li> <li>• Use of sample planning: Q</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b> N/A</p> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Critical thinking: P-S-Q-M</li> <li>• Organizational: P-S-Q-M</li> <li>• Decision making: P-S-Q-M</li> <li>• Computerized systems: P-Q-M</li> <li>• Computer technology application: P-Q-M</li> <li>• Engage the continuing enhancement of immediate skills in a new technology: P-Q-M</li> </ul>

<ul style="list-style-type: none"> <li>• Use of tools: P-S-Q-M</li> <li>• Accountability: P-S-Q-M</li> <li>• Flexibility: P-S-Q-M</li> <li>• Gauging acceptable performance: P-Q-M</li> <li>• Good manufacturing practices: P-Q</li> </ul>	
<u>Incumbent Worker Immediate Skill Sets</u>	<u>Incumbent Worker Future Skill Sets</u>
<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Teamwork: P-Q-M</li> </ul> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Customer service: P-S-Q-M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Computers: P-Q-M</li> <li>• Good manufacturing practices: P-Q</li> <li>• Mathematics: P-Q-M</li> <li>• Perform an internal audit of the manufacturing processes: P-Q</li> <li>• Comprehensive writing and reading: P-S-Q-M</li> <li>• Six Sigma: Q</li> <li>• Good management practices: P-Q</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Assessment analysis: Q</li> <li>• Business communications: P-S-Q-M</li> <li>• Cost accounting/control: P-Q</li> <li>• Critical thinking: P-S-Q-M</li> <li>• Sequencing: P-Q-M</li> <li>• Project management: P-Q</li> <li>• Apply processes and procedures to identify customer defects: P-Q-M</li> <li>• Continuous improvement: Q</li> <li>• Critical control points: P-Q</li> <li>• Follow quality inspection procedures: P-Q</li> <li>• Organizational: P-S-Q-M</li> <li>• Decision making: P-S-Q-M</li> <li>• Read and interpret technical terminology: P-Q-M</li> <li>• Measurement: P-Q-M</li> <li>• Monitor quality with real-time processes: P-Q</li> <li>• Report writing: P-Q-M</li> <li>• Blueprint reading: P-Q-M</li> <li>• Lean: P-Q</li> <li>• Advanced automation: P-Q-M</li> <li>• Empowerment: P-S-Q-M</li> <li>• Motivation: P-S-Q-M</li> <li>• Surfing Internet: P-Q-M</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b> N/A</p> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Assessment: Q</li> <li>• Research: P-Q-M</li> <li>• Problem solving: P-S-Q-M</li> <li>• Organizational: P-S-Q-M</li> <li>• Decision making: P-S-Q-M</li> </ul>

<ul style="list-style-type: none"> <li>• Troubleshooting: P-Q-M</li> <li>• Reliability and maintenance: P-Q-M</li> <li>• Accepting and handling change: P-S-Q-M</li> <li>• Statistical process control: Q</li> <li>• Good housekeeping: P-S-Q-M</li> <li>• All traditional tools listed on the MSSC assessment set: P-S-Q-M</li> <li>• Use of charts: P-Q-M</li> <li>• Application of quality metrics: P-Q-M</li> <li>• Cost of quality training: P-S-Q-M</li> <li>• Reading shop documents: P-S-Q-M</li> <li>• Read and communicate scales: P-Q-M</li> </ul>	
<p><u>Entry-Level Worker Immediate Knowledge Base</u></p>	<p><u>Entry-Level Worker Future Knowledge Base</u></p>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Mathematics</li> </ul> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• English communications: P-S-Q-M</li> <li>• Teamwork: P-Q-M</li> <li>• Statistical process control: Q</li> <li>• Measuring and tolerancing: P-Q-M</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Customer service: P-S-Q-M</li> <li>• Computers: P-Q-M</li> <li>• Manufacturing processes: P-Q-M</li> <li>• Quality principles: P-Q-M</li> <li>• Lean manufacturing: P-Q</li> <li>• Cost factors when not conforming: P-Q</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Economics-globalization and competition for market share: P-Q</li> <li>• Cause and effect: P-Q-M</li> <li>• Documentation: P-S-Q-M</li> <li>• Calibration: P-Q-M</li> <li>• Waste management: P-Q</li> <li>• Expiration/issue dates: P-S-Q-M</li> <li>• ISO standards: P-Q</li> <li>• Clean rooms: P-S-Q-M</li> <li>• Handling complaints: P-S-Q-M</li> <li>• Sampling plans: Q</li> <li>• Good manufacturing practices: P-Q</li> <li>• Values and commitment: P-S-Q-M</li> <li>• Accountability and responsibility: P-S-Q-M</li> <li>• Organization structure: P-S-Q-M</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Statistics: P-Q</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Drug awareness: S</li> </ul>

<ul style="list-style-type: none"> <li>• Business fundamentals: P-Q</li> <li>• Importance of data: P-Q-M</li> <li>• Change management: P-Q</li> <li>• Quality systems: P-Q</li> <li>• Measurement tools: P-Q-M</li> <li>• Measurement computations: P-Q-M</li> <li>• Internal/external customers: P-S-Q-M</li> <li>• Technical terms: P-S-Q-M</li> <li>• MS Office: P-Q-M</li> <li>• Flowcharts: P-Q-M</li> <li>• First article quality testing: P-Q</li> <li>• Quality as it relates to manufacturing process: P-Q</li> <li>• Control check: P-Q</li> <li>• Cellular manufacturing: P-Q</li> <li>• Electronic components: P-Q-M</li> <li>• Value of quality: P-Q</li> <li>• Blueprint reading: P-Q-M</li> <li>• How to spot defects: P-Q-M</li> <li>• Accuracy: P-Q-M</li> </ul>	
<u>Incumbent Worker Immediate Knowledge Base</u>	<u>Incumbent Worker Future Knowledge Base</u>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Project management: P-Q</li> <li>• Cause and effect/probable outcomes: P-Q-M</li> <li>• Cross-trained in all aspects of production: P-S-Q-M</li> <li>• Poka Yoke: P-Q-M</li> <li>• Reporting: P-S-Q-M</li> <li>• Error correction: P-Q</li> <li>• Process improvement: P-Q</li> <li>• Quality circles: Q</li> <li>• ISO standards: P-Q</li> <li>• Audit: Q</li> <li>• Statistical process control: P-Q</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Positive progressive performance records: P-S-Q-M</li> <li>• Organizational concerns/issues: P-S-Q-M</li> <li>• Best manufacturing practices: P-Q</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p> <p><b>Two Instances of Reported Knowledge Base</b> N/A</p> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Cause and effect: P-Q-M</li> <li>• Automation: P-Q-M</li> </ul>

<ul style="list-style-type: none"> <li>• Supervisory training: N/A</li> <li>• Manufacturing process: P-Q-M</li> <li>• Lean process: P-Q</li> <li>• Change input: P-Q</li> <li>• Customer service: P-S-Q-M</li> <li>• Empowerment to stop process as necessary: P-Q</li> <li>• Hazard analysis-CCN: P-S-Q-M</li> <li>• Mathematics: P-Q-M</li> <li>• Technical terms: P-S-Q-M</li> <li>• Enhanced level of entry-level knowledge: Q</li> <li>• Taking corrective action: P-Q-M</li> <li>• Process control: P-Q</li> <li>• Reading and writing: P-S-Q-M</li> <li>• Data analysis: P-Q-M</li> <li>• Cost accounting: P-Q</li> <li>• Charts and graphs: P-Q-M</li> <li>• Preventative maintenance: M</li> </ul>	
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## Manufacturing Maintenance Awareness

Entry-Level Worker Immediate Skill Sets	Entry-Level Worker Future Skill Sets
<p><b>Five Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Use of tools: P-S-Q-M</li> </ul> <p><b>Four Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Computers: P-Q-M</li> <li>• Communications: P-S-Q-M</li> </ul> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Troubleshooting: P-Q-M</li> <li>• Preventative maintenance: M</li> <li>• Critical thinking: P-S-Q-M</li> <li>• Mathematics: P-Q-M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Organizational: P-S-Q-M</li> <li>• Equipment specific training: P-M</li> <li>• Read meters: P-Q-M</li> <li>• Science: P</li> <li>• Chemistry: P</li> <li>• PLC: P-Q-M</li> <li>• Measurements: P-Q-M</li> <li>• Welding: P-M</li> <li>• Lubrication: P-M</li> <li>• Mechanics: P-M</li> <li>• Technical drawing/reading: P-Q-M</li> <li>• Pneumatics and hydraulics: P-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Corrective methods: P-Q-M</li> <li>• Reliability: P-M</li> <li>• Recognize problems: P-Q-M</li> <li>• Programming: P-M</li> <li>• Customer service: P-S-Q-M</li> <li>• Take ownership of equipment: P-Q-M</li> <li>• Carpentry: P-M</li> <li>• Teamwork: P-Q-M</li> <li>• Problem solving: P-S-Q-M</li> <li>• Interpersonal: P-S-Q-M</li> <li>• Use of multimeters: P-Q-M</li> <li>• Conflict resolution: P-S-Q-M</li> <li>• Safety awareness: P-S-Q-M</li> <li>• Electricity: P-M</li> <li>• Lock out and tag out: P-S-Q-M</li> <li>• Electric equipment and tools: P-M</li> <li>• Plumbing: P-M</li> <li>• Document work orders: P-M</li> <li>• Read, write, and speak English: P-S-Q-M</li> <li>• Reading gauges: P-Q-M</li> <li>• Meaning of colors: P-S-M</li> <li>• Robotics: P-M</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Four Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <p>N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Analytical troubleshooting: P-Q-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Advanced computers: P-Q-M</li> <li>• Lockout and tagout: P-S-Q-M</li> <li>• HAZMAT: P-S-M</li> <li>• Specific equipment: P-Q-M</li> <li>• Working with voltage above 240 VAC: P-M</li> <li>• Robotics: P-S-Q-M</li> <li>• PLC: P-M</li> <li>• Preventative maintenance: M</li> <li>• Interpreting technical manuals and information: P-Q-M</li> <li>• Multimeters: P-Q-M</li> <li>• Digital meters: P-Q-M</li> <li>• Read Process Design and Innovation (PDI) drawings: P-Q-M</li> <li>• Monitor costs: P-Q-M</li> </ul>

<ul style="list-style-type: none"> <li>• Device communication, applications, and sensors: P-Q-M</li> <li>• Precision measurement: P-Q-M</li> <li>• Work order management: P-Q-M</li> <li>• Operator-involved maintenance: P-M</li> </ul>	
<u>Incumbent Worker Immediate Skill Sets</u>	<u>Incumbent Worker Future Skill Sets</u>
<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Computers: P-Q-M</li> <li>• Preventative maintenance: M</li> </ul> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Troubleshooting: P-Q-M</li> <li>• Equipment specific: P-M</li> <li>• Interpreting technical manuals/information: P-Q-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Problem solving: P-S-Q-M</li> <li>• Electrical: P-M</li> <li>• Critical thinking: P-S-Q-M</li> <li>• Teamwork: P-Q-M</li> <li>• Interacting with food safety: P-S-Q-M</li> <li>• Vibration analysis: P-M</li> <li>• Conflict resolution: P-S-Q-M</li> <li>• Communications: P-S-Q-M</li> <li>• Multimeters: P-Q-M</li> <li>• Read schematics: P-Q-M</li> <li>• Lathes: P-M</li> <li>• Welding: P-M</li> <li>• Pipefitting: P-M</li> <li>• Inventory control: P-Q</li> <li>• Changeovers: P-M</li> </ul>	<p><b>Five Instances of Reported Skill Sets</b> N/A</p> <p><b>Four Instances of Reported Skill Sets</b> N/A</p> <p><b>Three Instances of Reported Skill Sets</b> N/A</p> <p><b>Two Instances of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Analytical troubleshooting: P-Q-M</li> </ul> <p><b>One Instance of Reported Skill Sets</b></p> <ul style="list-style-type: none"> <li>• Advanced computers: P-Q-M</li> <li>• Equipment specific: P-M</li> <li>• Time management: P-M</li> <li>• PLC maintenance: M</li> <li>• Problem solving methodology: P-S-Q-M</li> <li>• Autonomous maintenance: P-M</li> <li>• Predictive maintenance: P-M</li> <li>• Data collection and analysis: P-Q-M</li> <li>• Troubleshooting networks: P-M</li> <li>• Maintenance procedures: P-M</li> <li>• Technical writing: P-Q-M</li> <li>• Welding: P-M</li> <li>• Machining: P-M</li> <li>• Motor control: P-M</li> <li>• Hydraulics: P-M</li> </ul>
<u>Entry-Level Worker Immediate Knowledge Base</u>	<u>Entry-Level Worker Future Knowledge Base</u>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Hydraulics, pneumatics, and electrical: P-M</li> <li>• Mechanics: P-M</li> <li>• Preventative maintenance: M</li> </ul> <p><b>Three Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• General safety awareness (OSHA): P-S-Q-M</li> <li>• General tools and equipment: P-Q-M</li> <li>• Electrical: P-M</li> </ul>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p> <p><b>Four Instances of Reported Knowledge Base</b> N/A</p> <p><b>Three Instances of Reported Knowledge Base</b> N/A</p>

<ul style="list-style-type: none"> <li>• Lubrication: P-M</li> <li>• Computers: P-Q-M</li> </ul> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Read a tape measure: P-M</li> <li>• Communications: P-S-Q-M</li> <li>• Know what to look for: P-M</li> <li>• Cost of outages: P-Q-M</li> <li>• Mathematics: P-Q-M</li> <li>• PLC training: P-Q-M</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Standardization: P-Q-M</li> <li>• Measurement equipment: P-Q-M</li> <li>• Fluid levels: P-M</li> <li>• Temperature regulation: P-M</li> <li>• Awareness: P-M</li> <li>• Checklists: P-M</li> <li>• Calibrating machines: P-M</li> <li>• Cost of equipment: P-M</li> <li>• Effects of poor maintenance: P-M</li> <li>• Plumbing: P-M</li> <li>• Problem solving: P-S-Q-M</li> <li>• Environmental safety: P-S-Q-M</li> <li>• Job/cost analysis: P-Q</li> <li>• Operator driven reliability: P</li> <li>• Chemical corrosion: P-S-Q-M</li> <li>• U.S. versus European standards: P-M</li> <li>• Fasteners: P-M</li> <li>• Controls and automation: P-Q-M</li> <li>• Change management: P-Q-M</li> <li>• Electro-mechanical: P-M</li> <li>• Machine safety: P-S-Q-M</li> <li>• Gear ratios: P-M</li> <li>• Sprocket drives: P-M</li> <li>• Measurements: P-Q-M</li> <li>• Zurk fittings: P-M</li> <li>• Filter changes: P-M</li> <li>• Use of proper fluids: P-M</li> <li>• Machine shop safety: P-S-M</li> <li>• Electrical safety: P-S-Q-M</li> <li>• Lock out/tag out: P-S-M</li> </ul>	<p><b>Two Instances of Reported Knowledge Base</b> N/A</p> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Change management: P-Q-M</li> <li>• Computers: P-Q-M</li> <li>• Business fundamentals: P-Q-M</li> <li>• Digital sensors: P-Q-M</li> <li>• Networks: P-Q-M</li> <li>• PLC programming: P-M</li> <li>• CNC programming: P-M</li> <li>• Overall systems and variables: P-Q-M</li> <li>• Maintenance log tracking: P-M</li> <li>• Trend analysis and taking appropriate action: P-Q-M</li> <li>• Automation: P-Q-M</li> <li>• PLC sensors and devices they control: P-M</li> <li>• Process flow: P-Q-M</li> <li>• PDI drawings and their symbols: P-Q-M</li> <li>• Thermography: P-M</li> <li>• Vibration analysis: P-M</li> <li>• Principles of preventative/predictive/reactive maintenance: P-M</li> <li>• Use of tools: P-M</li> <li>• Baker testing: P-M</li> <li>• Work order processing: P-M</li> <li>• Regulatory compliance: P-Q-M</li> </ul>
<p><u>Incumbent Worker Immediate Knowledge Base</u></p>	<p><u>Incumbent Worker Future Knowledge Base</u></p>
<p><b>Five Instances of Reported Knowledge Base</b> N/A</p>	<p><b>Five Instances of Reported Knowledge Base</b> N/A</p>
<p><b>Four Instances of Reported Knowledge Base</b> N/A</p>	<p><b>Four Instances of Reported Knowledge Base</b> N/A</p>
<p><b>Three Instances of Reported Knowledge Base</b></p>	<p><b>Three Instances of Reported Knowledge Base</b></p>

<p>N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Specific equipment: P-M</li> <li>• Root cause analysis: P-Q-M</li> <li>• Processes: P-Q-M</li> <li>• Empowerment: P-Q-M</li> <li>• Mechanical: P-M</li> <li>• PLC: P-M</li> </ul> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• Reliability practices: P-M</li> <li>• Communications: P-Q-M</li> <li>• Documentation: P-Q-M</li> <li>• Hydraulic, mechanical, and pneumatic systems: P-M</li> <li>• Variable frequency drives: P-M</li> <li>• Conveying systems: P-M</li> <li>• Preventative maintenance: M</li> <li>• How to deal with change: P-Q-M</li> <li>• Motor controls: P-M</li> <li>• Schematics: P-M</li> <li>• Wiring: P-M</li> <li>• Robotics: P-M</li> <li>• Troubleshooting techniques: P-Q-M</li> <li>• Process and machinery: P-Q-M</li> <li>• Safety: S</li> <li>• Computer maintenance: P-M</li> <li>• Management of systems: P-M</li> <li>• Maintenance awareness for production worker: P-M</li> <li>• Analytical meters: P-M</li> <li>• Computerized maintenance management system (CMMS): P-M</li> </ul>	<p>N/A</p> <p><b>Two Instances of Reported Knowledge Base</b></p> <p>N/A</p> <p><b>One Instance of Reported Knowledge Base</b></p> <ul style="list-style-type: none"> <li>• PLC: P-M</li> <li>• Variable frequency drives: P-M</li> <li>• Knowledge database: P-M</li> <li>• Standard operating procedures: P-M</li> <li>• Overall equipment effectiveness: P-M</li> <li>• Cost of downtime: P-M</li> <li>• Prevention: P-M</li> <li>• Smart devices: P-M</li> </ul>
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## General Discussion Findings

### Current and future trends in the manufacturing industry, which will drive workforce training needs for incumbent and entry-level workers

- Increased computerization and automation, e.g., robotics, process control
- Teams
- Lean manufacturing
- Six Sigma
- Leaner and more sophisticated supply chain management, inventory control, and tracking work progress, e.g., use of radio frequency identification technology
- Systems thinking
- Quality methods/continuous improvement
- Increased computerization
- Adoption of/compliance with ISO standards
- Cellular manufacturing
- Value stream mapping
- Increased need for knowledge-based workforce
- Shorter time to market
- Human-machine interfacing
- Increased digital technologies
- New materials
- Flexible/adaptable workforce
- Root cause analysis
- Data management
- Increased use of networks
- Real-time systems data accuracy
- Regulatory compliance
- Pneumatics versus hydraulics
- Automatic data recording
- Employee self-service (i.e., taking charge of their career/future)
- Increased use of servo motors
- Sustainability (i.e., the greening of business, material resource reduction while maintaining the same outcomes)
- Machine-operator-mechanic integration
- Restriction of hazardous substances (ROHS)
- Global production networks
- Reverse logistics
- Multinational workforce and associated cultural differences
- Increased complex machine processes
- Cost of doing business increases, e.g., energy costs, transportation costs
- Pull through versus inventory
- Rapid changes in production demands
- Customer demands, e.g., lower costs, higher quality, and customization
- Paperless business/electronic commerce

### MSSC certification and curriculum alignment

- Curriculum must be portable
- Certification is seen as a preferred condition of employment now but will be a hiring requirement in the future
- Certification automatically raises the bar for employees compared to non-certified employees, since it shows an employee's ability to learn, desire to learn, and to be a future leader
- Follow-up certification with a pay differential
- Certified workforce would help with contract bids
- Certification could cut time to train new employees
- Consider a certification portfolio, e.g., MSSC, ASQ's Lean and Six Sigma, NIMS, AWS, etc.
- Certification equates to work readiness
- Certification must demonstrate a contribution to the value stream
- Certification should become the baseline
- Equates to a higher starting salary
- Equates to employee promotions/growth if certification is acquired after hired
- Can reduce turnover

### Training format and delivery

- Classroom is typically 20% and hands-on training is 80%
- Hybrid of online and direct delivery methods
- On-site training could be done for four to eight hours per week for two months
- On-site training could be done for two to three hours per day
- One to two hours of training per session
- Having an on-site instructor means teaching a nominal class size of 12 trainees
- Self-directed, online training is often underutilized
- Establish attainable completion points
- Smaller companies have a difficult time taking workers off the line for training
- Administer proctored assessment
- Follow-up training with employer to gauge success
- All training requires reinforcement to ensure success
- Train during the workday vice after shift motivates employee to learn
- Can accommodate a 16-hour training class
- Work-based training with a practical component
- Must be flexible to meet different companies' needs
- Train-the-Trainer so they can deliver training to employees
- Courses need to be accredited/certifiable
- Deliver on-site with advanced technology center instructor
- Two-hour blocks of instruction (done after shift and overtime is paid) twice per week for 40 hours total
- Share training space with other employers for training, but not where proprietary/union matters are concerned

- Use proctored instruction/testing
- Deliver training at shift change to facilitate a larger group of trainees
- Use pod casting
- One-stop training areas such as workforce boards, where people gather to seek employment. Also consider prisons where inmates are ending their sentences.
- Make it part of high school curriculum and integrate it into community college programs

## **SUMMARY OF ONLINE SURVEY RESULTS**

To achieve statistical inference and reach areas of the state where physical focus groups were not conducted, a follow-up phase to the meetings involved the compilation of the groups' predominant findings, and a formulation of these findings into an online survey. The Center offered the survey to the statewide manufacturing community to respond to during December 15, 2006 through January 12, 2007. This effort served to refine and validate the combined findings of the focus groups.

In the interests of capturing the best picture relevant to the focus group findings—and in the time allotted and within the availability of related/available Contract resources—the survey design combined individual “knowledge” and “skill” sets into “knowledge/skill” sets. It also did not incorporate a mechanism to provide “absolute” assurance that the responses were representative of all manufacturing industries throughout Florida. For example, the online survey did not ask the respondents to identify their:

- Location in Florida
- Company size
- Number of entry-level and incumbent production workers
- Production workforce turnover rates

However, the Center made every possible effort to engage all Florida's manufacturers by directly notifying Hillsborough County manufacturers (who did and/or did not participate in the Hillsborough Community College focus group), and soliciting assistance from the following organizations to notify their area and/or statewide manufacturing community partners/members:

- Florida Community College at Jacksonville
- Manatee Community College
- Pasco-Hernando Community College
- Polk Community College
- Enterprise Florida: to notify statewide economic development councils
- Manufacturers Association of Florida
- Statewide Regional Manufacturers Associations
- Statewide Workforce Development Boards

While the survey results are notably limited in scope, they did serve to refine and validate the findings of the focus groups. They also mirrored many of the detailed—in breath and depth—findings of the National Association of Manufacturers' (NAM) *2005 Skills Gap Report—A Survey of the American Manufacturing Workforce*, referenced earlier in the body of the needs assessment. In summarizing the Center's online survey results, appropriate references and/or

comparisons to the NAM report provide online survey data validity and related inferences. Although the focus groups and/or online survey targeted primarily technical, “hard,” knowledge/skill sets requirements, instances of “soft” knowledge/skill sets also surfaced.

The main intent of the focus group findings and survey results was to allow the Center to incorporate appropriate technical findings into entry-level and incumbent production worker (i.e., skills upgrade) training curricula currently under development by the Center. As such, the NAM report and others provided abundant data regarding the soft knowledge/skill sets gap.

### **Manufacturing Processes and Production Knowledge/Skills Sets Currently Required of the Entry-level Production Worker (See Figure 1).**

When asked to select the top five manufacturing processes and production knowledge/skill sets that Florida manufacturers’ entry-level production workers currently need, the respondents indicated:

- Good manufacturing practices (63.0%)
- Computer use (50.0%)
- Measurements/conversion (48.9%)
- Tool use (48.9%)
- Critical thinking (48.9%)

These selections correlated to predominant focus group findings. However, a notable exception was “good manufacturing practices”—mention of this requirement occurred only once in five focus groups. The Center chose to include it in the survey since an abundance of literature (e.g., the NAM report) and experience indicate that such a knowledge/skill is a requisite to a high-performance production workforce. Additionally, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. Therefore, Center assumed that anticipated refinements occurred during the survey, resulting from respondents’ participation. Trailing close to the top five survey selections was “blueprint reading (43.5%)”—mention of this requirement occurred three times in five focus groups. Please note that 16.3% of the respondents selected the “Other” knowledge/skill sets category. However, as that category’s open responses, which received no ranking, indicated mostly soft knowledge/skill sets, this report makes no further mention of them until “Conclusions.”

### **Manufacturing Processes and Production Knowledge/Skills Sets Currently Required of the Experienced Production Worker (See Figure 2).**

When asked to select the top five manufacturing processes and production knowledge/skill sets that Florida manufacturers’ entry-level production workers will need within the next five years, the respondents indicated:

- Good manufacturing practices (65.6%)
- Troubleshooting (60.0%)
- Critical thinking (46.7%)
- Lean manufacturing (41.1%)
- Computer use (40.0%)

These selections correlated to predominant focus group findings. However, notable exceptions were “good manufacturing practices” and “critical thinking”—mention of these requirements occurred only once each in five focus groups. The Center chose to include them in the survey since an abundance of literature (e.g., the NAM report) and experience indicated that such a knowledge/skill is a requisite to a high-performance production workforce. Additionally, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. Therefore, Center assumed that anticipated refinements occurred during the survey, resulting from respondents’ participation. Trailing close to the top five survey selections were “blueprint reading,” “root cause analysis,” and “process and material control,” each selected by 30.0% of the respondents)—mention of these requirements occurred one to two times in five focus groups. Please note that 7.8% of the respondents selected the “Other” knowledge/skill sets category. However, given the low percentage of respondents selecting this category, and as that category’s open responses, which received no ranking, indicated mostly soft knowledge/skill sets, this report makes no further mention of them until “Conclusions.”

### **Manufacturing Processes and Production Knowledge/Skills Sets That Entry-level Production Workers Will Need Within the Next Five Years (See Figure 3).**

When asked to select the top five manufacturing processes and production knowledge/skill sets that Florida manufacturers’ entry-level production workers will need within the next five years, the respondents indicated:

- Manufacturing process awareness (75.6%)
- Teamwork (66.3%)
- Computer use (55.8%)
- Measurement (54.7%)
- Troubleshooting (47.7%)

These selections correlated to predominant focus group findings. However, in this category, predominant data equated to only each knowledge/skill set occurring once in five focus groups. However, notable exceptions was “statistical process control” and “troubleshooting”—mention of these requirements occurred twice in five focus groups. The Center chose to include them in the survey since these categories of knowledge/skill sets formed the main body of data, and an abundance of literature (e.g., the NAM report) and experience indicated that such knowledge/skill sets are requisite to a high-performance production workforce. Additionally, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. Therefore, Center assumed that anticipated refinements occurred during the survey, resulting from respondents’ participation. Trailing close to the top five survey selections was “lean manufacturing (44.2%)”—mention of this requirements occurred once in five focus groups, accompanying the main body of data collected. Please note that 10.5% of the respondents selected the “Other” knowledge/skill sets category. However, given the low percentage of respondents selecting this category, and as that category’s open responses, which received no ranking, indicated mostly soft knowledge/skill sets and no specific mention of hard knowledge/skill sets other than soldering and welding, this report makes no further mention of them until “Conclusions.”

### **Manufacturing Processes and Production Knowledge/Skills Sets That Experienced Production Workers Will Need Within the Next Five Years (See Figure 4).**

When asked to select the top five manufacturing processes and production knowledge/skill sets that Florida manufacturers' experienced production workers will need within the next five years, the respondents indicated:

- Troubleshooting (72.1%)
- Computer use (70.9%)
- Lean manufacturing (59.3%)
- Reliability and maintenance (59.3%)
- Thinking in loops rather than linear (40.7%)
- Statistical process control (40.7%: also included since selections five and six ranked equally)

These selections correlated to predominant focus group findings. However, in this category, predominant data equated to only each knowledge/skill set occurring once in five focus groups. However, notable exceptions were “computer use,” and “lean manufacturing”—mention of these requirements occurred twice in five focus groups. The Center chose to include them in the survey since these categories of knowledge/skill sets formed the main body of data, and an abundance of literature (e.g., the NAM report) and experience indicated that such knowledge/skill sets are requisite to a high-performance production workforce. Additionally, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. Therefore, Center assumed that anticipated refinements occurred during the survey, resulting from respondents' participation. Trailing close to the top six survey selections was “Six Sigma (36.0%)”—mention of this requirement occurred twice in five focus groups, accompanying the main body of data collected. Please note that 16.3% of the respondents selected the “Other” knowledge/skill sets category. However, although a low percentage of respondents selected this category, and as that category's open responses, which received no ranking, it indicated a balanced mix of hard and soft knowledge/skill sets. Additionally, “lean/six sigma” received further mention, inferring significance to the data collected.

### **Safety Knowledge/Skills Sets That Entry-level Production Workers Currently Need (See Figure 5).**

When asked to select the top five safety knowledge/skill sets that Florida manufacturers' entry-level production workers currently need, the respondents indicated:

- Personal protection equipment (83.5%)
- Safe use of equipment (68.4%)
- Hazard awareness (49.4%)
- Machine guards and safety mats and curtains (48.1%)
- Accident reporting (40.5%)

These selections correlated to predominant focus group findings. However, a notable exception was “machine guards and safety mats and curtains”—mention of this requirement occurred only once in five focus groups. The Center chose to include it in the survey since an abundance of literature (e.g., the NAM report) and experience indicated that such a knowledge/skill is a

requisite to a high-performance production workforce. Please note that no respondents selected the “Other” knowledge/skill sets category.

### **Safety Knowledge/Skills Sets That Experienced Production Workers Currently Need (See Figure 6).**

When asked to select the top five safety knowledge/skill sets that Florida manufacturers’ experienced production workers currently need, the respondents indicated:

- Basic safety practices (51.3%)
- Relationship between safety and production (50.0%)
- Lock out/tag out (48.7%)
- Personal protection equipment (48.1%)
- Accident reporting (41.0%)

These selections correlated to predominant focus group findings. However, notable exceptions were “relationship between safety and production,” and “personal protection equipment”—mention of this requirements occurred only once in five focus groups. The Center chose to include these in the survey since an abundance of literature (e.g., the NAM report) and experience indicated that such knowledge/skill sets are a requisite to a high-performance production workforce. Please note that although 1.3% of the respondents selected the “Other” knowledge/skill sets category, the mention of “Safe use of equipment” is in direct correlation to the predominant body of focus group data.

### **Safety Knowledge/Skills Sets That Entry-level Production Workers Will Need Within the Next Five Years (See Figure 7).**

When asked to select the top five safety knowledge/skill sets that Florida manufacturers’ entry-level production workers will need within the next five years, the respondents indicated:

- Safe use of equipment (73.4%)
- Personal protection equipment (60.8%)
- Relationship between safety and production (54.4%)
- Accident reporting (46.8%)
- Ergonomics (40.5%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected for this question occurred once in five focus groups. Please note that although 2.5% of the respondents selected the “Other” knowledge/skill sets category, the mention of “Safe use of equipment” is in direct correlation to the focus group data, and the survey selection receiving the highest percentage of respondents.

### **Safety Knowledge/Skills Sets That Experienced Production Workers Will Need Within the Next Five Years (See Figure 8).**

When asked to select the top five safety knowledge/skill sets that Florida manufacturers’ experienced production workers currently need, the respondents indicated:

- Safe use of equipment (67.1%)
- Relationship between safety and production (64.6%)

- Risk management (44.3%)
- Basic safety practices (43.0%)
- Health promotion (39.2%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected for this question occurred once in five focus groups. Please note that although 2.5% of the respondents selected the “Other” knowledge/skill sets category, the mention of “Safe use of equipment” is in direct correlation to the focus group data, and the survey selection receiving the highest percentage of respondents.

**Quality Assurance Knowledge/Skills Sets That Entry-level Production Workers Currently Need (See Figure 9).**

When asked to select the top five quality assurance knowledge/skill sets that Florida manufacturers’ entry-level production workers currently need, the respondents indicated:

- Quality principles (60.9%)
- Measurement equipment (49.3%)
- Blueprint reading (49.3%)
- Measuring and tolerancing (47.8%)
- Good manufacturing practices (47.8%)

These selections correlated to predominant focus group findings. However, notable exceptions were “quality principles” and “good manufacturing practices”—mention of these requirements occurred only once in five focus groups. Nevertheless, they are representative of the main body of data collected.

**Quality Assurance Knowledge/Skills Sets That Experienced Production Workers Currently Need (See Figure 10).**

When asked to select the top five quality assurance knowledge/skill sets that Florida manufacturers’ experienced production workers currently need, the respondents indicated:

- Good manufacturing practices (61.4%)
- Critical thinking (54.3%)
- Teamwork (54.3%)
- Troubleshooting (38.6%)
- Blueprint reading (31.4%)

These selections correlated to predominant focus group findings. However, notable exceptions were “critical thinking,” “troubleshooting,” and “blueprint reading”—mention of these requirements occurred only once in five focus groups. Nevertheless, they are representative of the main body of data collected.

**Quality Assurance Knowledge/Skills Sets That Entry-level Production Workers Will Need within the Next Five years (See Figure 11).**

When asked to select the top five quality assurance knowledge/skill sets that Florida manufacturers' experienced production workers will need within the next five years, the respondents indicated:

- Good manufacturing practices (71.0%)
- Teamwork (52.2%)
- Critical thinking (44.9%)
- Troubleshooting (37.7%)
- Computer use (34.8%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected was minimal. In that regard, data collected for this question occurred once in five focus groups and the Center chose to select data from the experienced production worker “currently need” category to provide further data for survey and curriculum integration purposes.

### **Quality Assurance Knowledge/Skills Sets That Experienced Production Workers Will Need within the Next Five years (See Figure 12).**

When asked to select the top five quality assurance knowledge/skill sets that Florida manufacturers' experienced production workers will need within the next five years, the respondents indicated:

- Good manufacturing practices (53.6%)
- Teamwork (46.4%)
- Critical thinking (44.9%)
- Quality metrics (34.8%)
- Cause and effect (31.9%)
- Lean manufacturing (31.9%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected was minimal. In that regard, data collected for this question occurred once in five focus groups and the Center chose to select data from the experienced production worker “currently need” category to provide further data for survey and curriculum integration purposes.

### **Maintenance Awareness Knowledge/Skills Sets That Entry-level Production Workers Currently Need (See Figure 13).**

When asked to select the top five maintenance awareness knowledge/skill sets that Florida manufacturers' entry-level production workers currently need, the respondents indicated:

- Preventative maintenance (69.2%)
- Hand tool use (64.6%)
- Troubleshooting (58.5%)
- Critical thinking (41.5%)
- Measurements/conversion (41.5%)

These selections correlated to predominant focus group findings. Please note that although 1.5% of the respondents selected the “Other” knowledge/skill sets category, the mention of “Attitude for quality work” is in direct correlation to the focus group data, and is indicative of those knowledge/skill sets requisite to a high-performance production workforce.

**Maintenance Awareness Knowledge/Skills Sets That Experienced Production Workers Currently Need (See Figure 14).**

When asked to select the top five maintenance awareness knowledge/skill sets that Florida manufacturers’ experienced production workers currently need, the respondents indicated:

- Troubleshooting (67.7%)
- Preventative maintenance (63.1%)
- Root cause analysis (55.4%)
- Teamwork (43.1%)
- Electrical (43.1%)
- Predictive maintenance (43.1%)

These selections correlated to predominant focus group findings.

**Maintenance Awareness Knowledge/Skills Sets That Entry-level Production Workers Will Need Within the Next Five Years (See Figure 15).**

When asked to select the top five maintenance awareness knowledge/skill sets that Florida manufacturers’ entry-level production workers will need within the next five years, the respondents indicated:

- Troubleshooting (79.7%)
- Preventative maintenance (65.6%)
- Tool use (56.2%)
- Predictive maintenance (51.6%)
- Computer use (46.9%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected for this question occurred once in five focus groups. The only exception was “troubleshooting,” which occurred twice in five focus groups.

**Maintenance Awareness Knowledge/Skills Sets That Experienced Production Workers Will Need Within the Next Five Years (See Figure 16).**

When asked to select the top five maintenance awareness knowledge/skill sets that Florida manufacturers’ experienced production workers will need within the next five years, the respondents indicated:

- Troubleshooting (81.5%)
- Preventative maintenance (70.8%)
- Cost of downtime (63.1%)
- Data collection and analysis (60.0%)
- Automation/PLC basics (52.3%)

These selections correlated to predominant focus group findings. However, during each focus group, the Breakout Group sessions resulted in data collection gaps—attributed to each group responding differently to the time constraints of the sessions. As a result, the predominant body of data collected for this question occurred once in five focus groups. The only exception was “troubleshooting,” which occurred twice in five focus groups. Please note that although 6.2% of the respondents selected the “Other” knowledge/skill sets category, the mention of “Knowledge of communication systems and data networks,” “Trend analysis,” and “Enterprise asset management/computerized maintenance management (EAM/CMM) systems” is in direct correlation to the focus group data, and indicative of those knowledge/skill sets requisite to a high-performance production workforce.

### **Manufacturing Trends Which Will Drive Entry-level and Experienced Production Workforce Training Within the Next Five Years (See Figure 17).**

When asked to select the top five manufacturing trends that will drive Florida’s manufacturers’ entry-level and experienced production workforce training within the next five years, the respondents indicated:

- Increased computerization and automation (58.8%)
- Lean manufacturing (54.4%)
- Teams (41.2%)
- Increased need for knowledge-based workforce (39.7%)
- Root cause analysis (35.3%)

The data collection design for this category of data did not take into account the number of instances for each trend. However, the survey selections correlated to the body of focus group findings. Please note that although 2.9% of the respondents selected the “Other” trend category, the mention of “Teaching the unique art of boat building” and “Total productive maintenance” is in direct correlation to the focus group data, and indicative of those trends that will impact directly the training of a high-performance production workforce.

### **Industry-recognized Production Workforce Certification Views (See Figure 18).**

When asked to select all applicable statements that reflect Florida’s manufacturers’ views about industry-recognized production workforce certifications, the respondents provided a nearly-bell-shaped curve. In keeping with the tone of this report, the top five responses indicated:

- Certification automatically raises the bar for employees compared to non-certified employees (66.2%)
- Certification would reduce the time needed to train new employees (64.7%)
- Certification equates to work readiness (54.4%)
- Certification must demonstrate a contribution to the value stream (42.6%)
- Certification is seen as a preferred condition of employment now but will be a hiring requirement in the future (33.8%)

The data collection design for this category of data did not take into account the number of instances for each trend. However, the survey selections correlated to the body of focus group findings. Please note two survey entries being the same—(Certification equates to work readiness). This is an error, the Center replaced the entry with the sixth highest ranked selection

“Certification is seen as a preferred condition of employment now but will be a hiring requirement in the future.” Also note that 14.7% of the respondents selected the “Other” category. The ten responses offered by the respondents (See Figure 18) are in direct correlation to the focus group data, and indicative of those views regarding the value of certification as it relates to a high-performance production workforce.

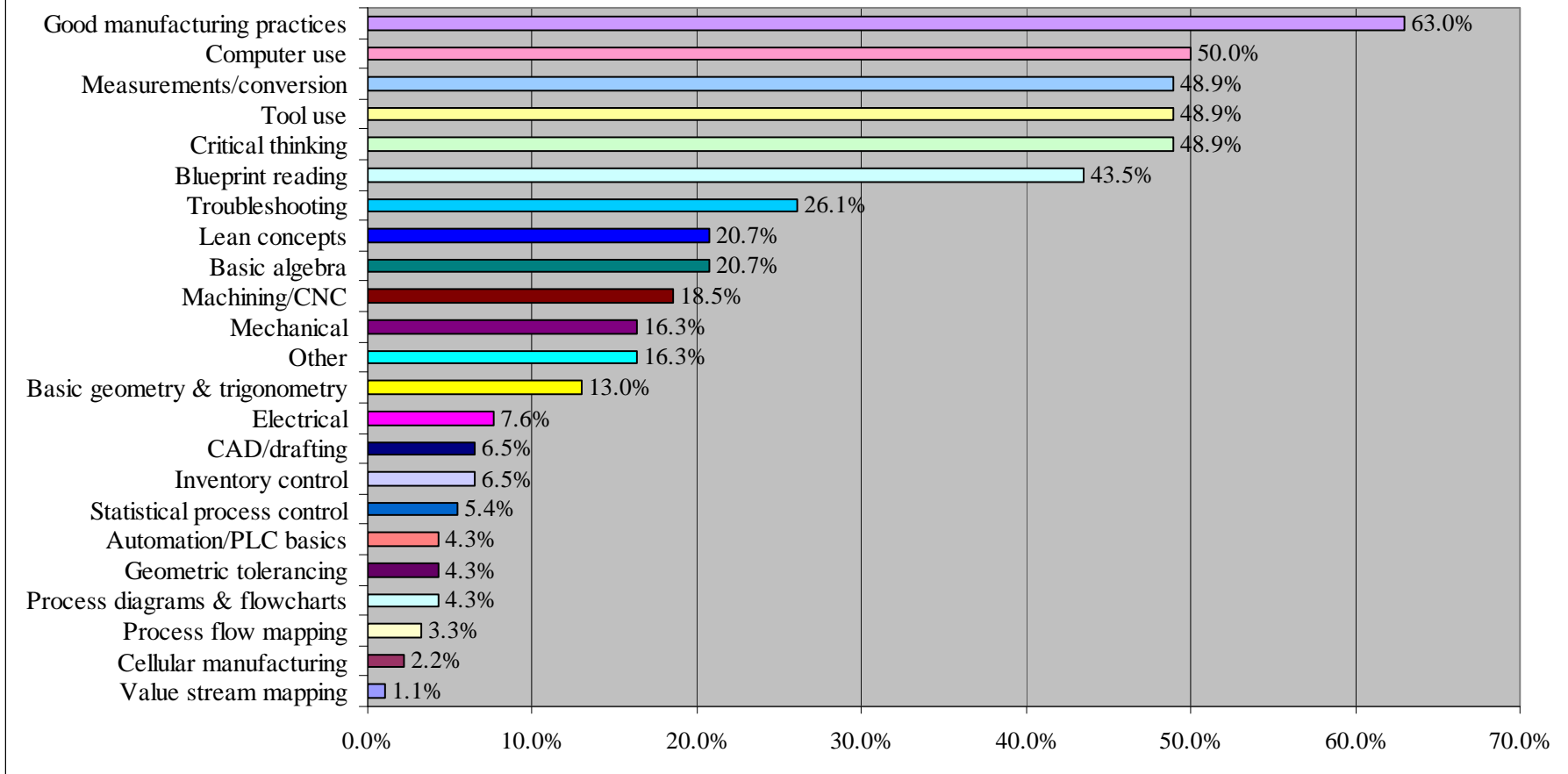
### **Production Workforce Training Format and Delivery (See Figure 19).**

When asked to select all applicable statements that reflect Florida’s manufacturers’ views about production workforce training format and delivery certifications, the respondents provided a nearly-bell-shaped curve. In keeping with the tone of this report, the top five responses indicated:

- All training requires reinforcement and follow-up to ensure success (81.2%)
- Training must be flexible to meet different companies’ needs (73.9%)
- Small companies have a difficult time taking workers off the line for training (60.9%)
- Training should use a hybrid of online and direct delivery methods (49.3%)
- Training during the workday versus after a shift motivates employees to learn (47.8%)

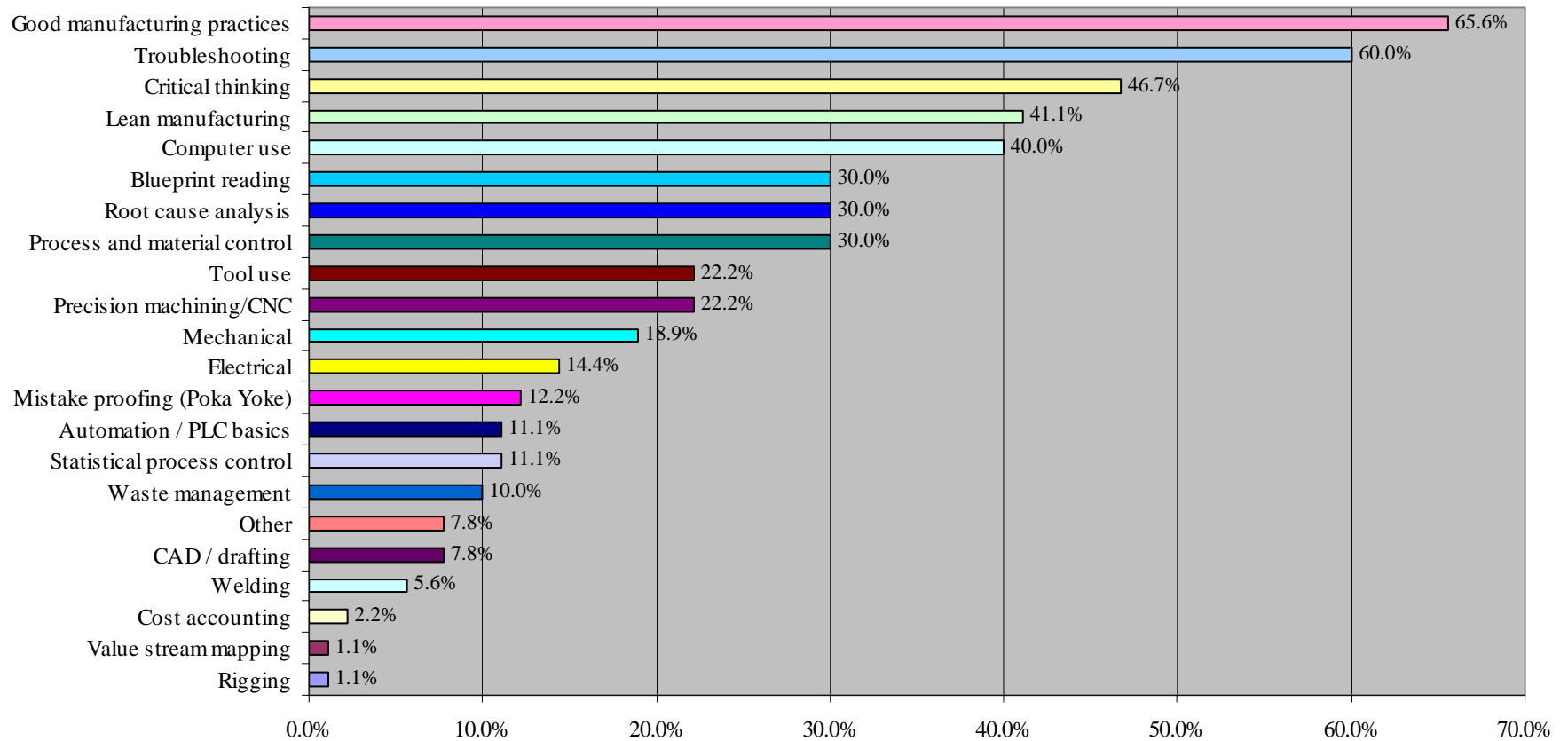
The data collection design for this category of data did not take into account the number of instances for each trend. However, the survey selections correlated to the body of focus group findings. Also note that 14.7% of the respondents selected the “Other” category. The responses offered by the respondents (See Figure 19) are in direct correlation to the focus group data, and indicative of those views regarding the complexity of each manufacturer’s high-performance environment and the need for flexibility in production workforce training to accommodate that complex, high-performance environment.

**Figure 1. Of the following processes and production knowledge/skill sets, check the top five sets that your entry-level production workers currently need.**



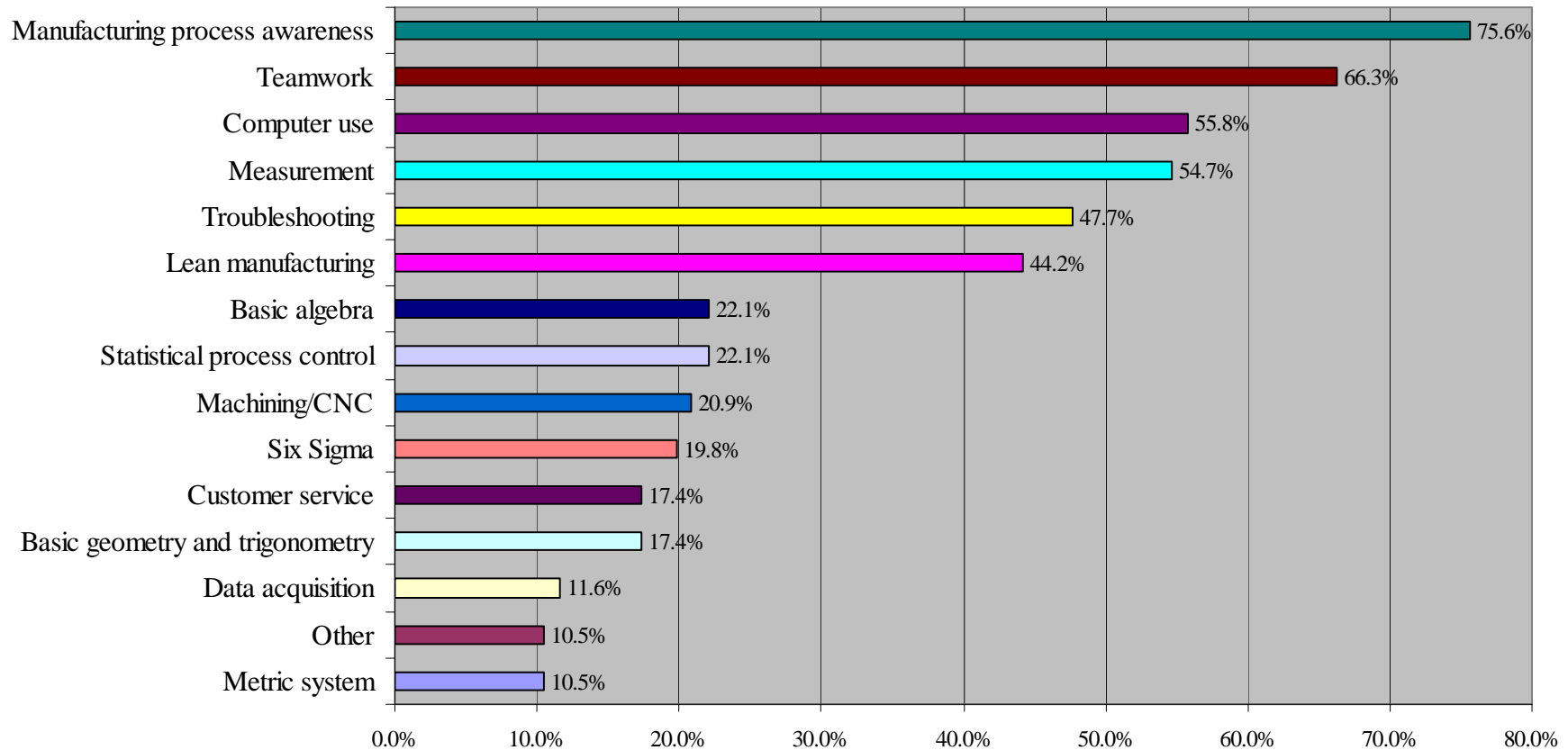
**Other (open response choices not ranked):** 1)Maturity, good critical thinking and sound judgment; 2)Heavy equipment operation; 3)Conversational English; 4)Inspection techniques and basic math; 5)Soft skills and working in a team environment—we take care of any technical training or OJT through bringing in blueprint/gage use/metrology classes with Pinellas Technical Education Center or internal trainers; 6)Soldering; 7)Fractions and decimals; 8)Reading and writing; 9)Teamwork; 10)Operational risk management; 11)Strong sense of pride in work and work ethics and readiness for work (promptness and sense of responsibility and accountability); 11)General woodworking; 12)Reading and writing at high school level and attitude to learn; and 13)Basic/applied mathematics.

**Figure 2. Of the following processes and production knowledge/skill sets, check the top five sets that your experienced production workers currently need.**



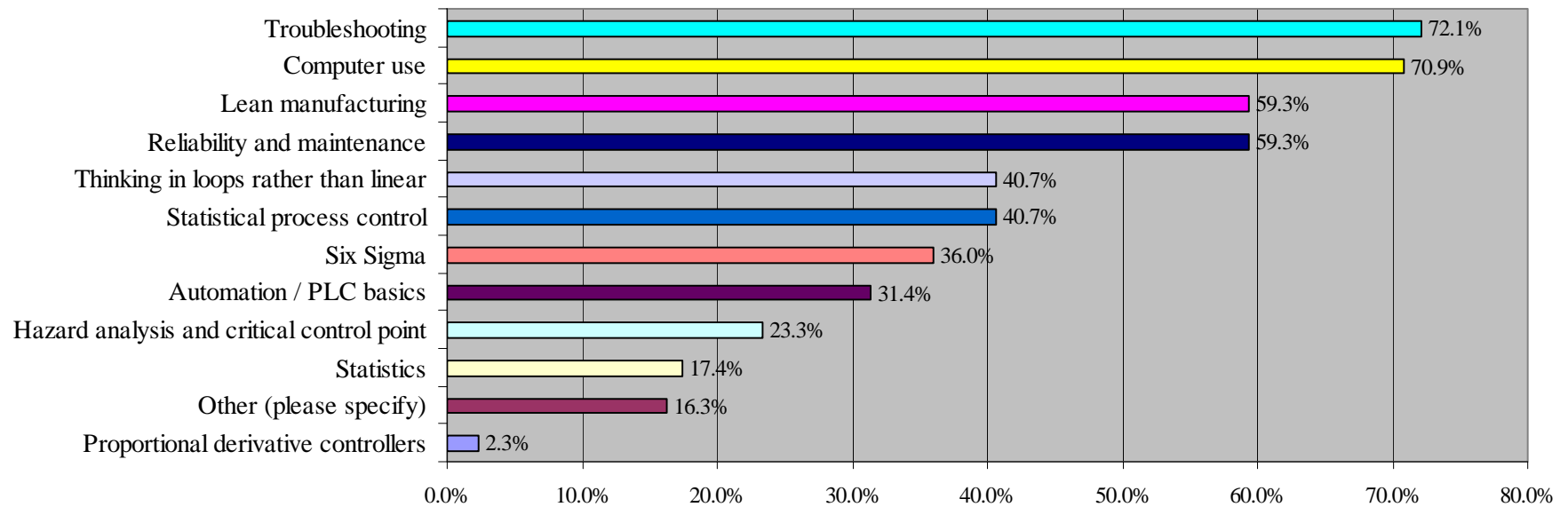
**Other (open response choices not ranked):** 1)Teamwork; 2) Heavy equipment operation; 3)Soft skills and working in a team environment; 4)Specific program knowledge—policies and procedures; 5)Simple math, reading, and writing; 6)Conflict resolution/consensus building; and 7)Positive thinking approach.

**Figure 3. Of the following processes and production knowledge/skill sets, check the top five sets that your entry-level production workers will need within the next five years.**



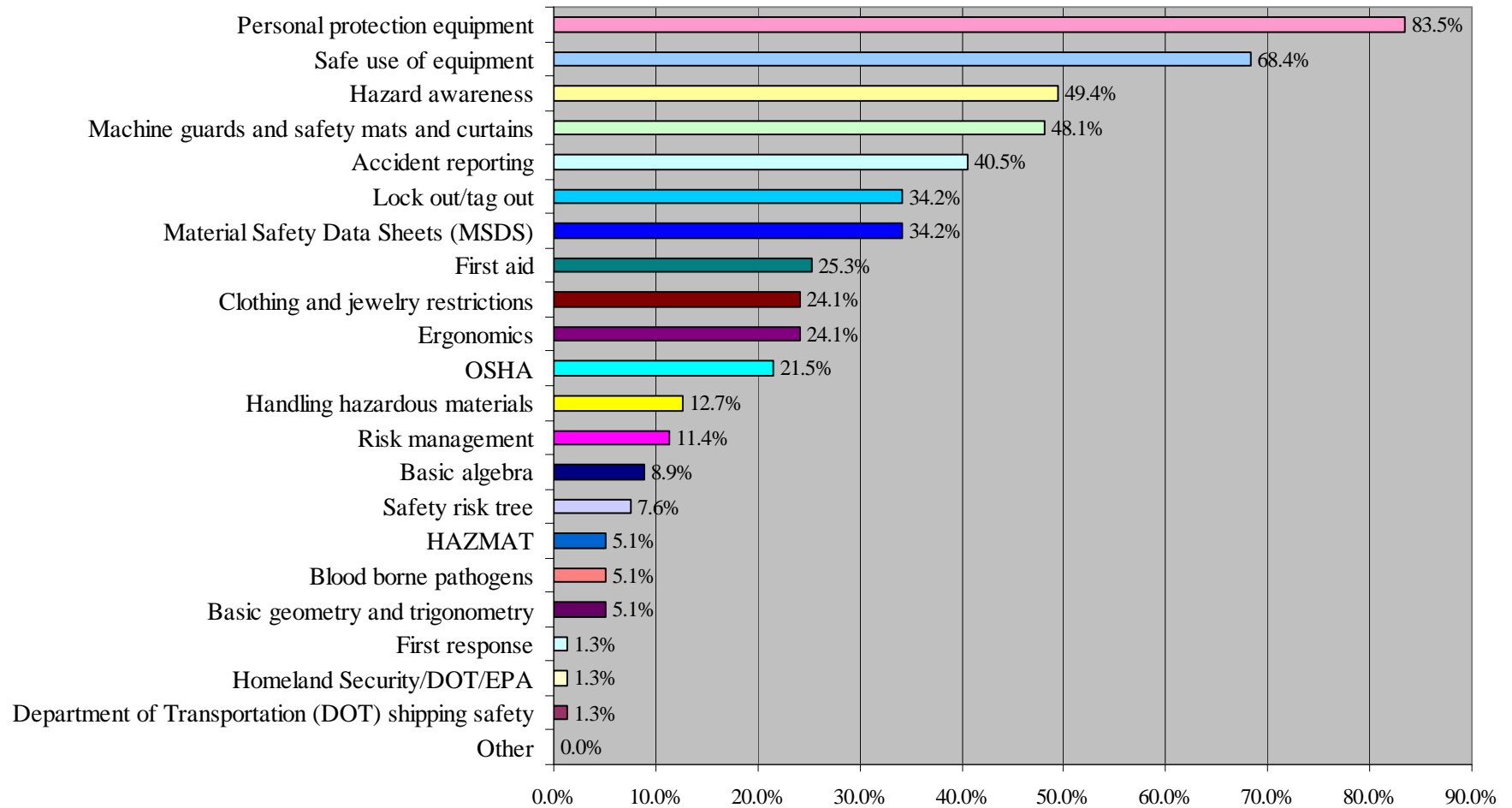
**Other (open response choices not ranked):** 1)Soldering; 2)Welding; 3)Simple math, reading, and writing; 4)Problem solving/critical thinking; 5)Basic woodworking; 6)Reading and writing at high school level; 6)Applied math; 7)Advancement in other skills as specified above for an experienced worker. The entry-level worker will need these skills in the future.

**Figure 4. Of the following processes and production knowledge/skill sets, check the top five sets that your experienced production workers will need within the next five years.**



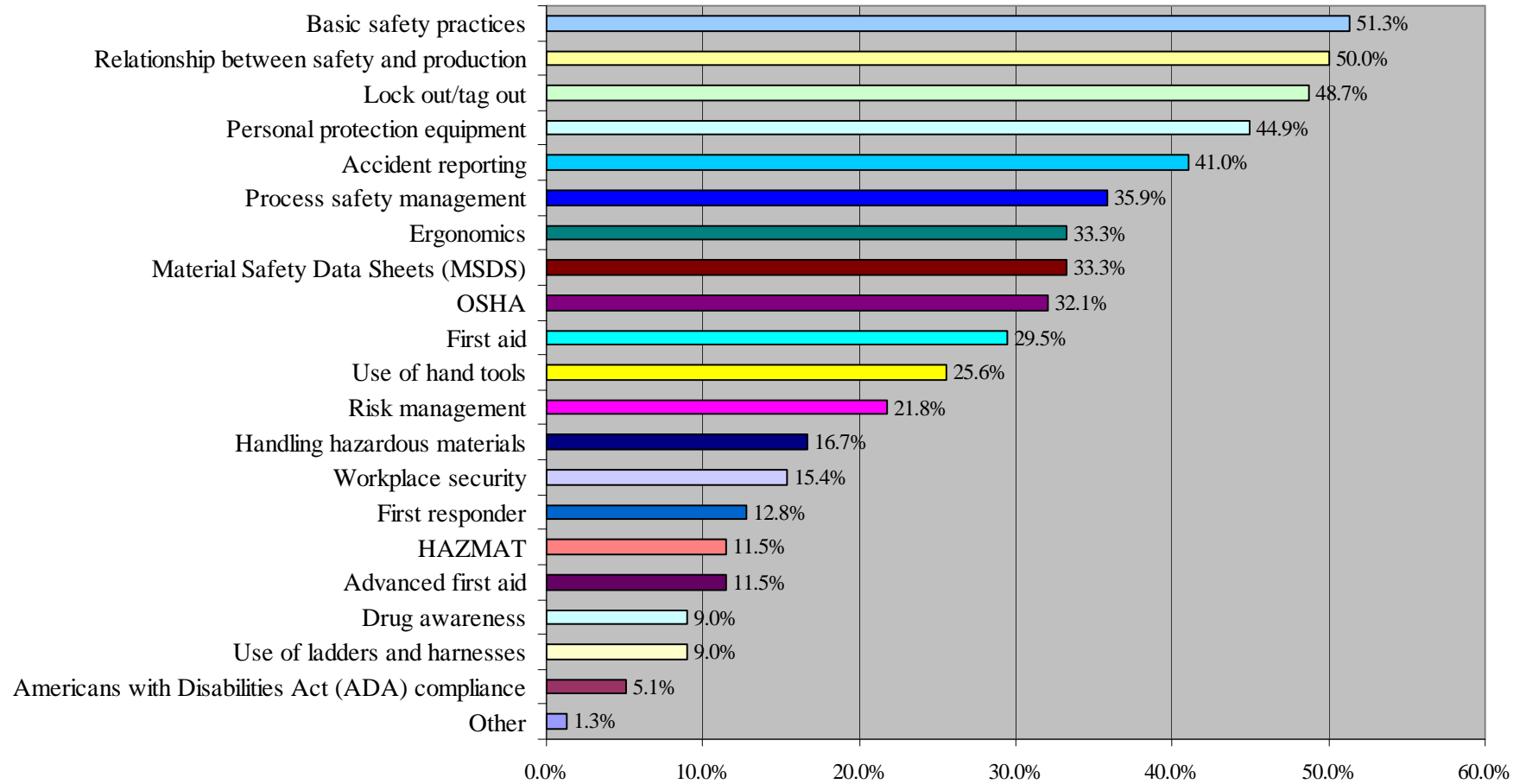
**Other (open response choices not ranked):** 1)Maturity, reliability, and good sound judgment; 2)Constraint-based production planning and improvement; 3)Not sure at this point; 4)Inventory control; 5)Electronic device assembly; 6)Quality improvement processes; 7)Teamwork; 8)Knowledge of communication systems and data networks; 9)Data acquisition; 10)Simple math and reading; 11)Customer service, phone, and field basic AutoCad; 12)Interdepartmental relationships (how manufacturing works with quality, materials management, engineering etc.–the big picture of impact of manufacturing/quality on other aspects of business); 13)Hard to pick only five items on this list. Really most of the above items are applicable. Might also include more in-depth measurement skills. Ideally, the future experienced worker needs to be able to actively participate and apply lean/six sigma concepts within a technical cross functional team setting.

**Figure 5. Of the following safety knowledge/skill sets, check the top five sets that your entry-level production workers currently need.**



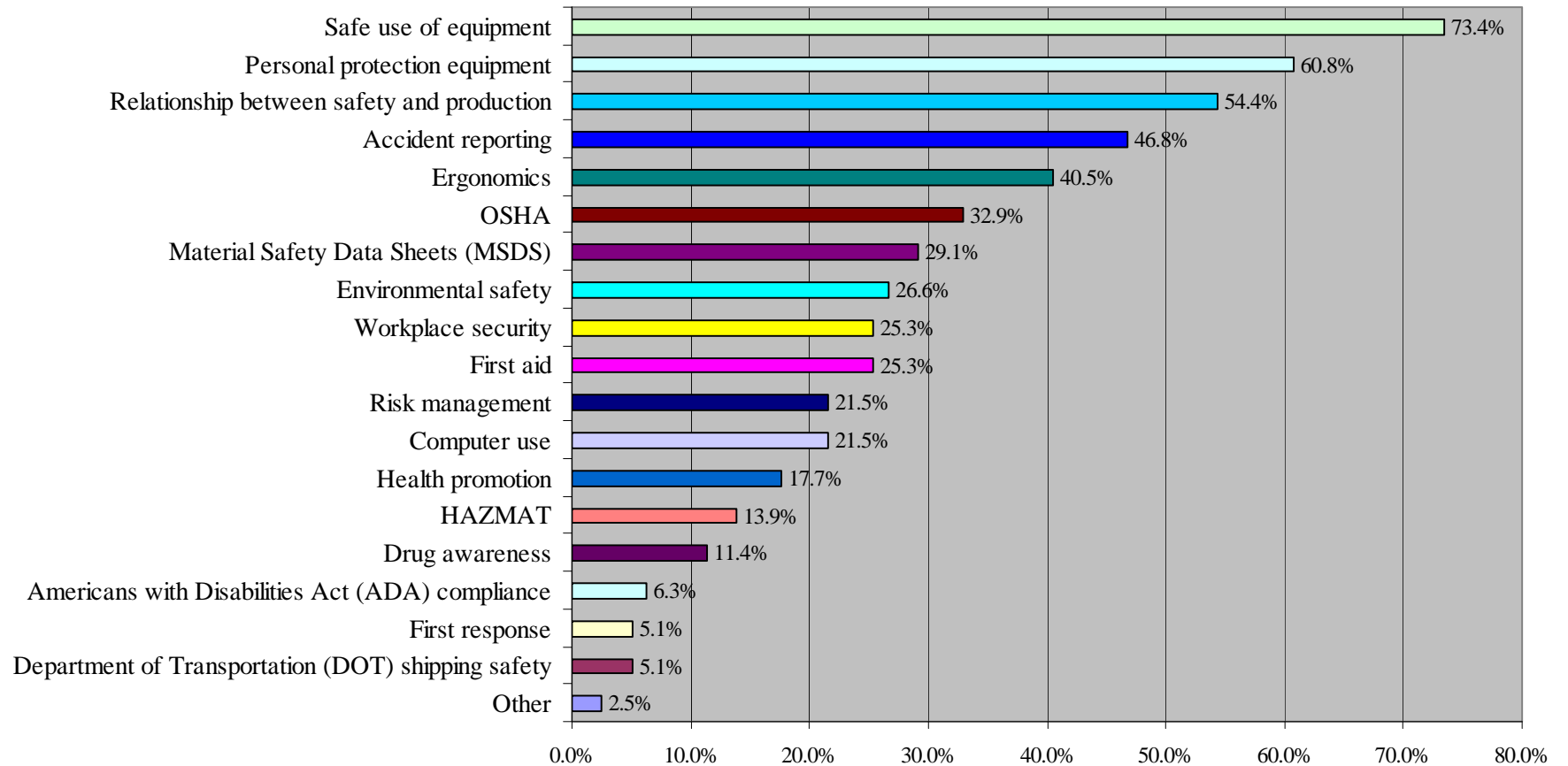
**Other (open response choices not ranked):** no responses collected.

**Figure 6. Of the following safety knowledge/skill sets, check the top five sets that your experienced production workers currently need.**



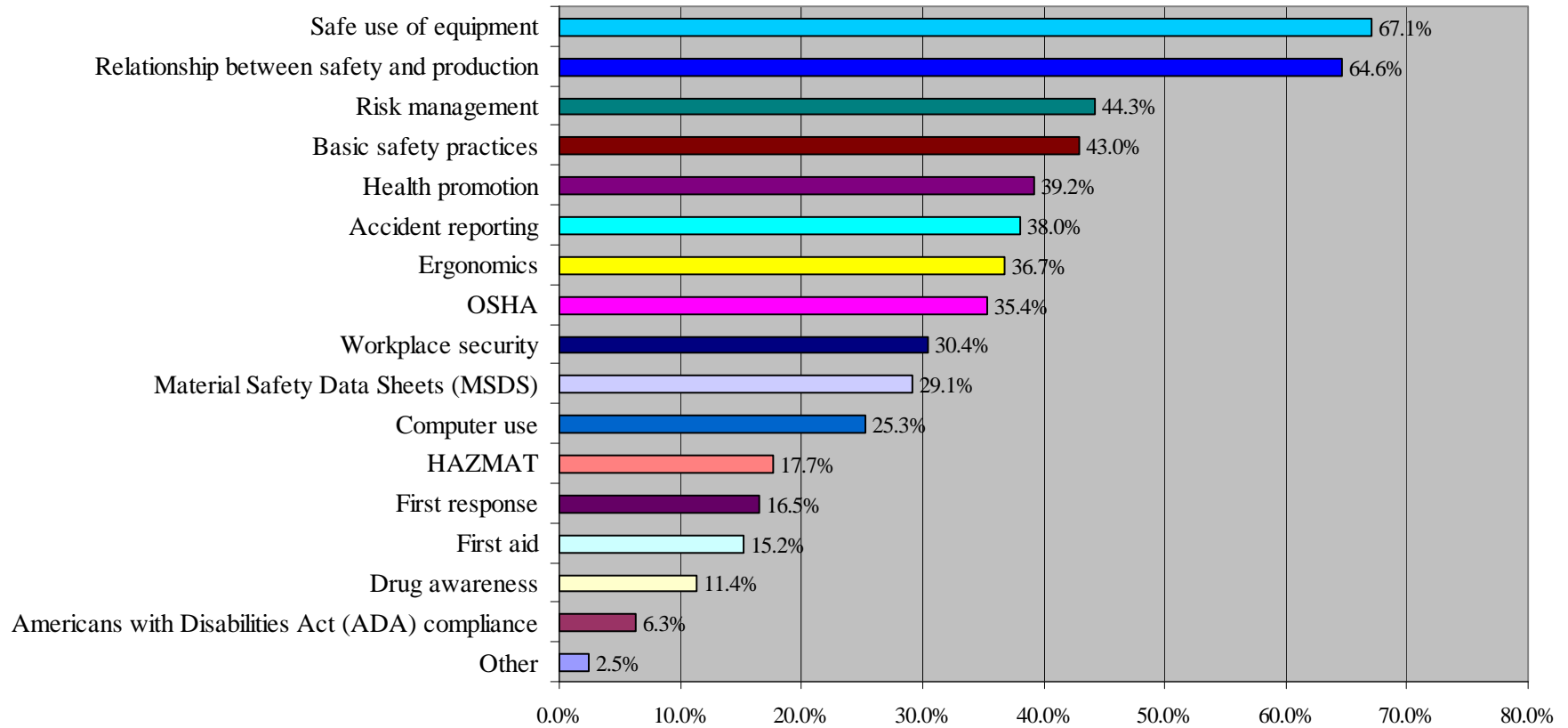
**Other (open response choices not ranked):** 1) Safe use of equipment.

**Figure 7. Of the following safety knowledge/skill sets, check the top five sets that your entry-level production workers will need within the next five years.**



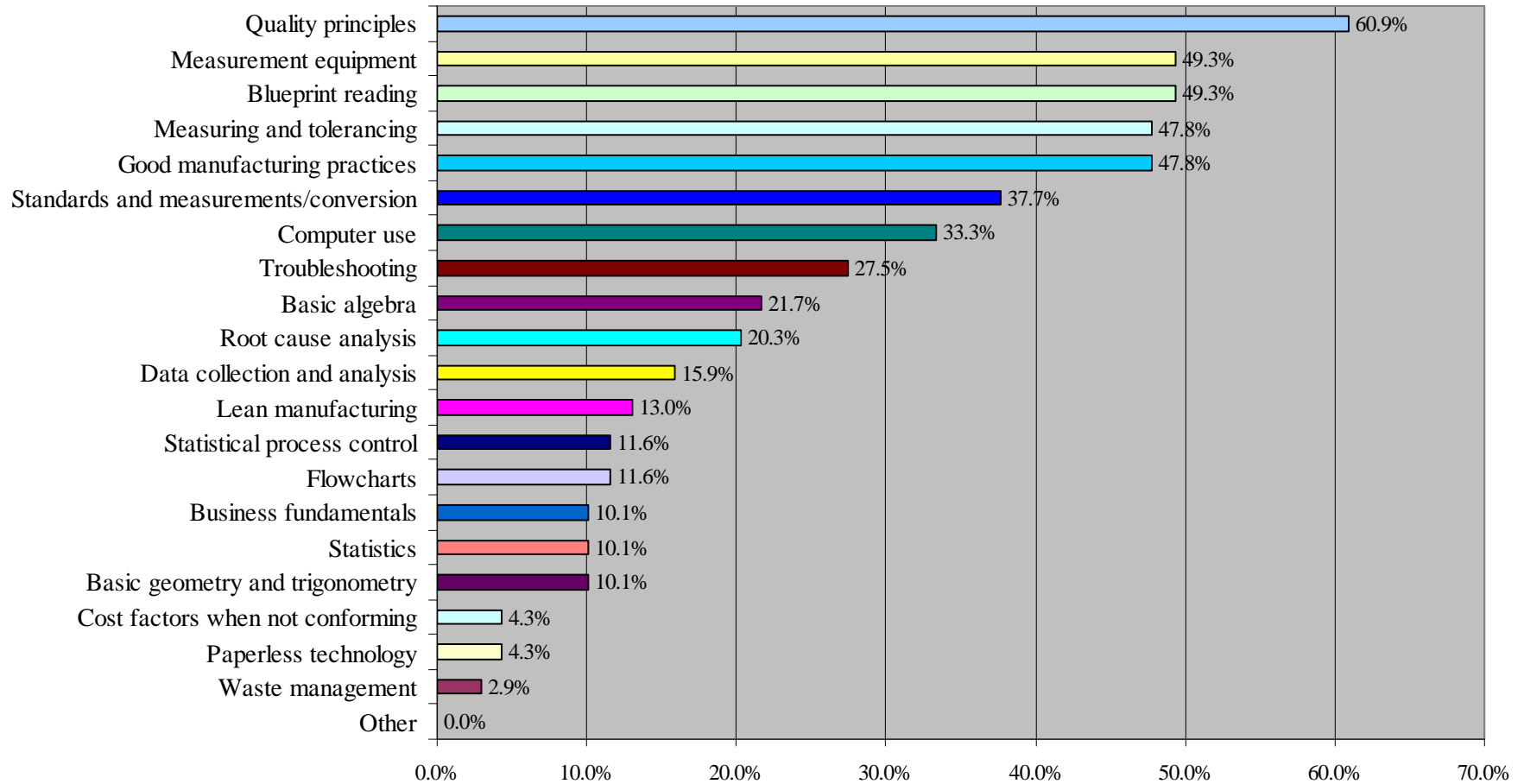
**Other (open response choices not ranked):** 1)Family wellness and 2)Safe use of equipment.

**Figure 8. Of the following safety knowledge/skill sets, check the top five sets that your experienced production workers will need within the next five years.**



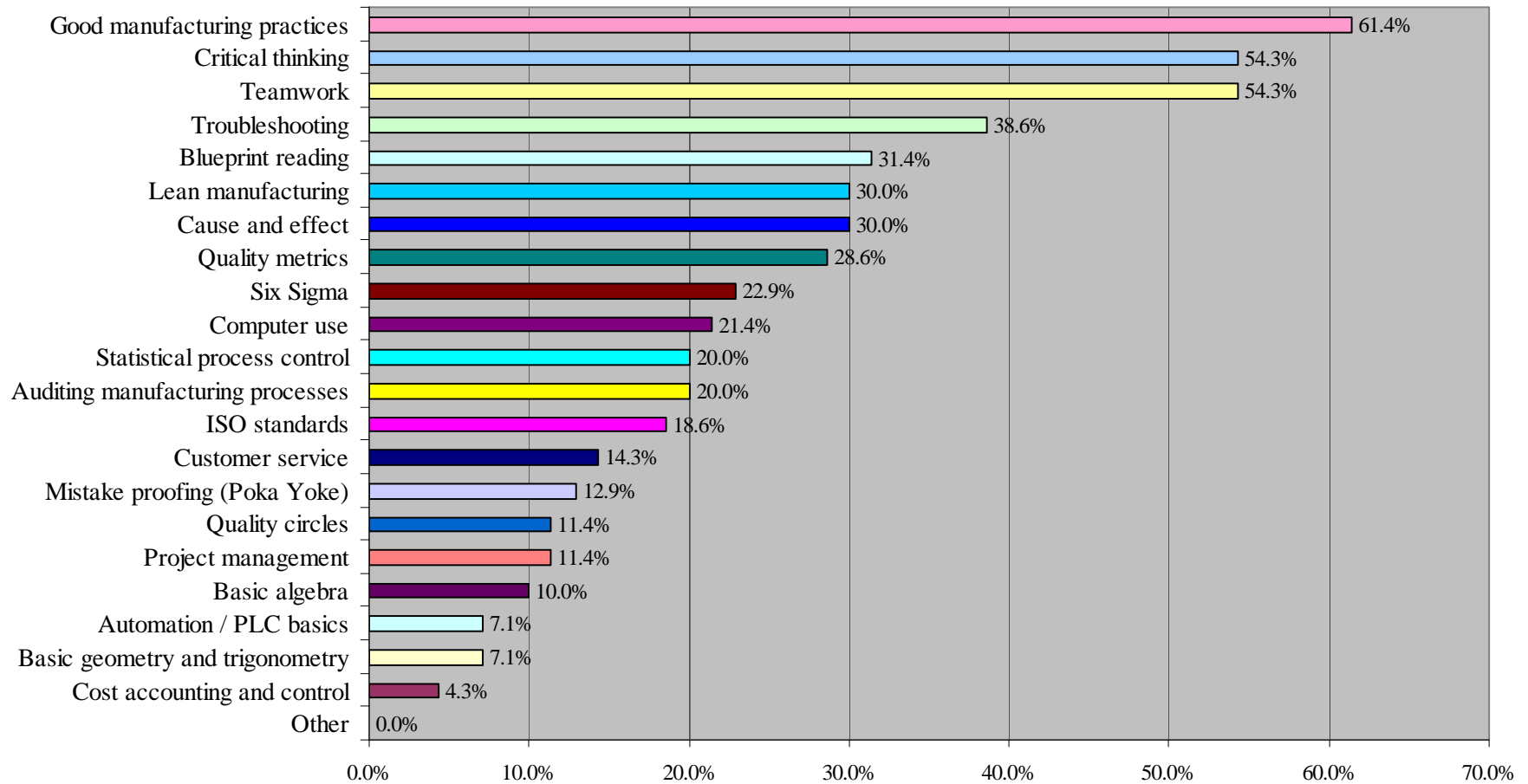
**Other (open response choices not ranked):** 1)Family wellness and 2)Safe use of equipment.

**Figure 9. Of the following quality assurance knowledge/skill sets, check the top five sets that your entry-level production workers currently need.**



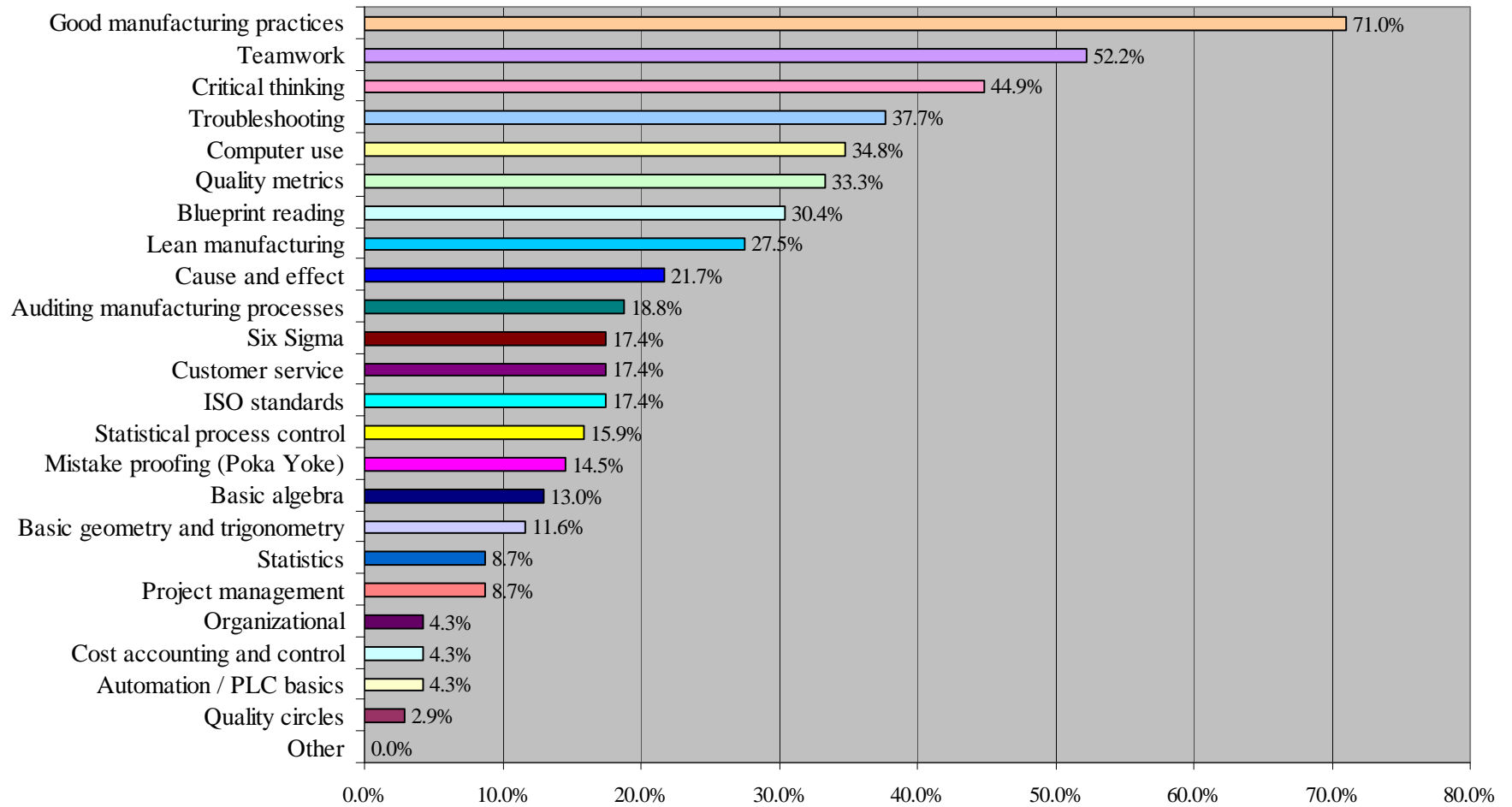
**Other (open response choices not ranked):** no responses collected.

**Figure 10. Of the following quality assurance knowledge/skill sets, check the top five sets that your experienced production workers currently need.**



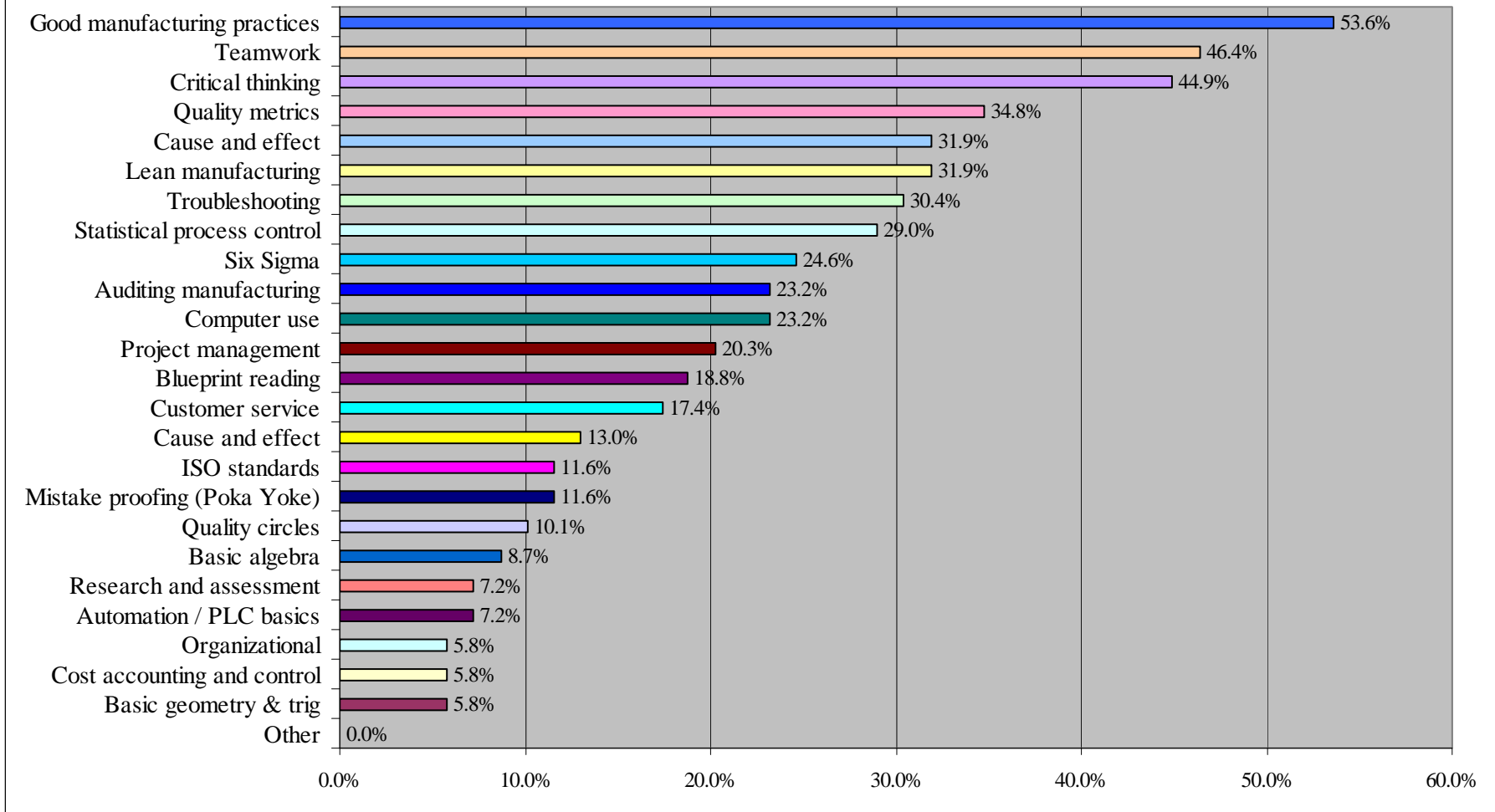
**Other (open response choices not ranked):** no responses collected.

**Figure 11. Of the following quality assurance knowledge/skill sets, check the top five sets that your entry-level production workers will need within the next five years.**



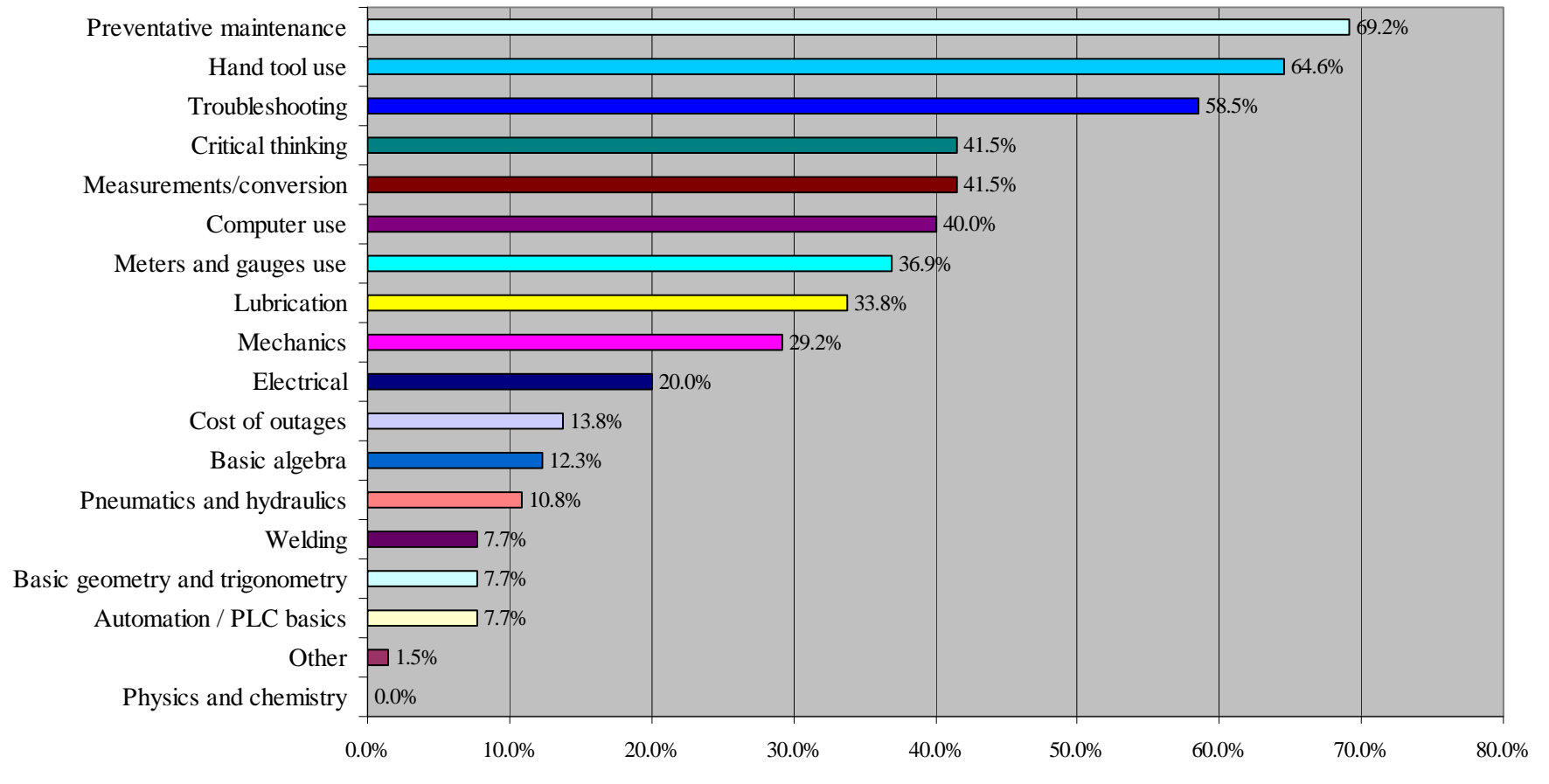
**Other (open response choices not ranked):** no responses collected.

**Figure 12. Of the following quality assurance knowledge/skill sets, check the top five sets that your experienced production workers will need within the next five years.**



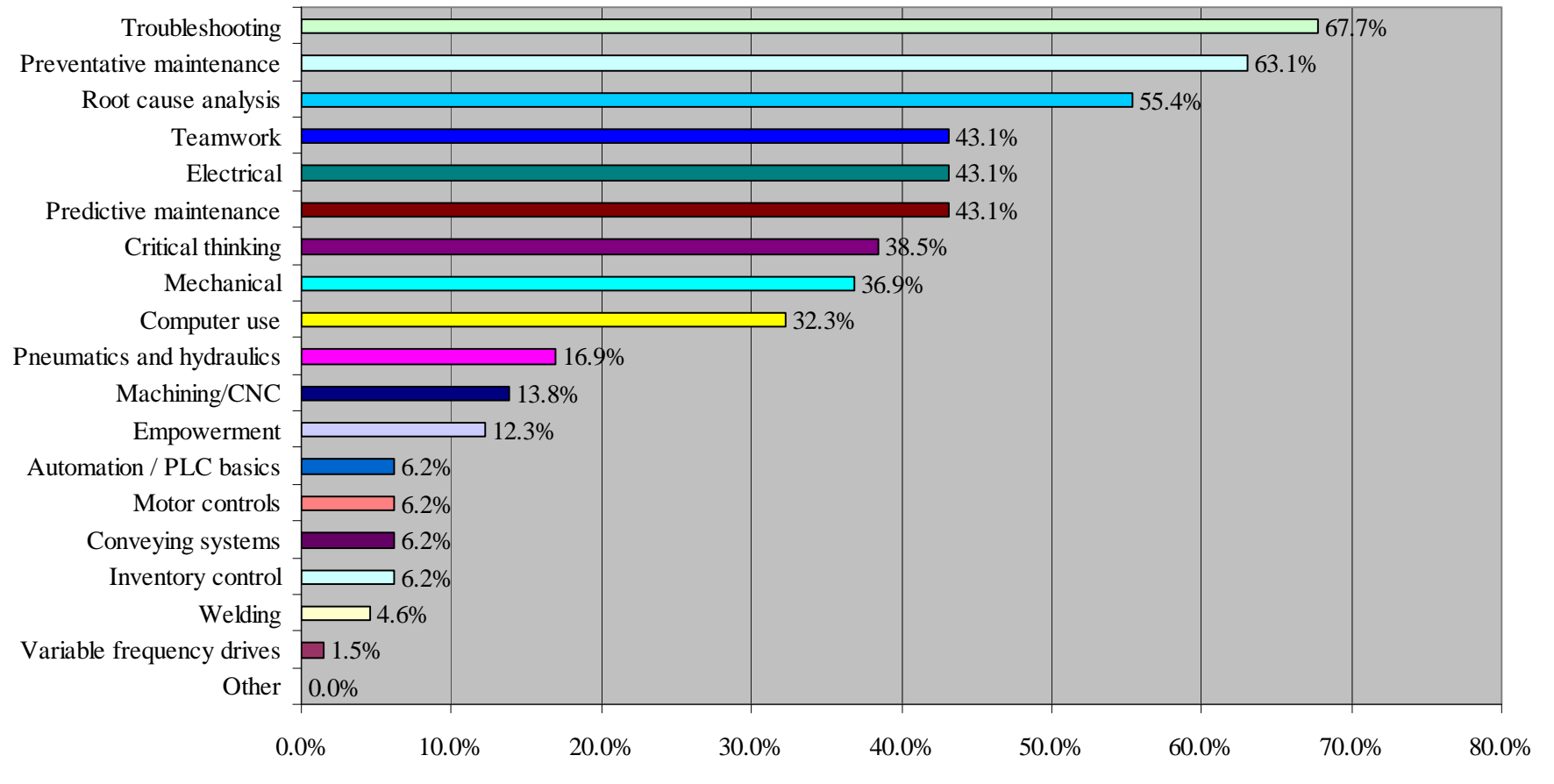
**Other (open response choices not ranked):** no responses collected.

**Figure 13. Of the following maintenance knowledge/skill sets, check the top five sets that your entry-level production workers currently need.**



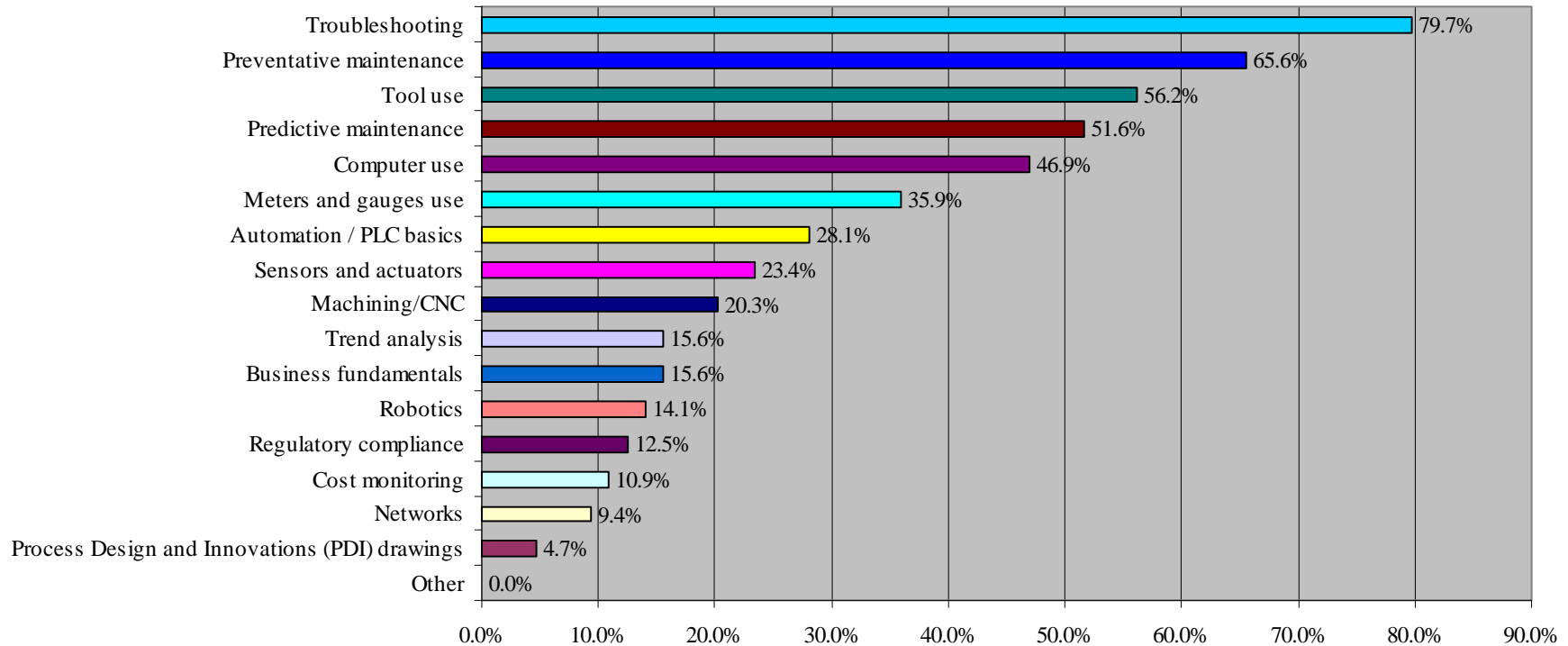
**Other (open response choices not ranked):** 1)Attitude for quality work.

**Figure 14. Of the following maintenance awareness knowledge/skill sets, check the top five sets that your experienced production workers currently need.**



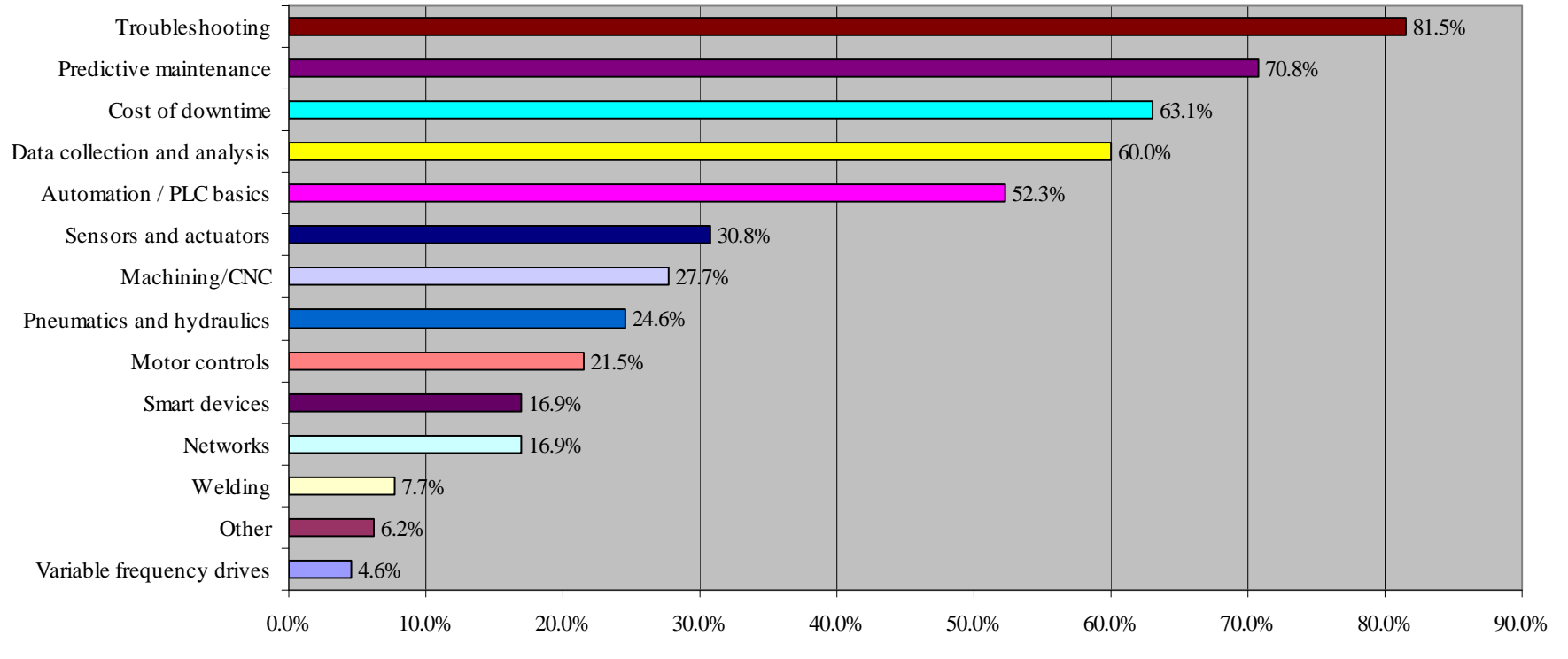
**Other (open response choices not ranked):** no responses collected.

**Figure 15. Of the following maintenance awareness knowledge/skill sets, check the top five sets that your entry-level production workers will need within the next five years.**



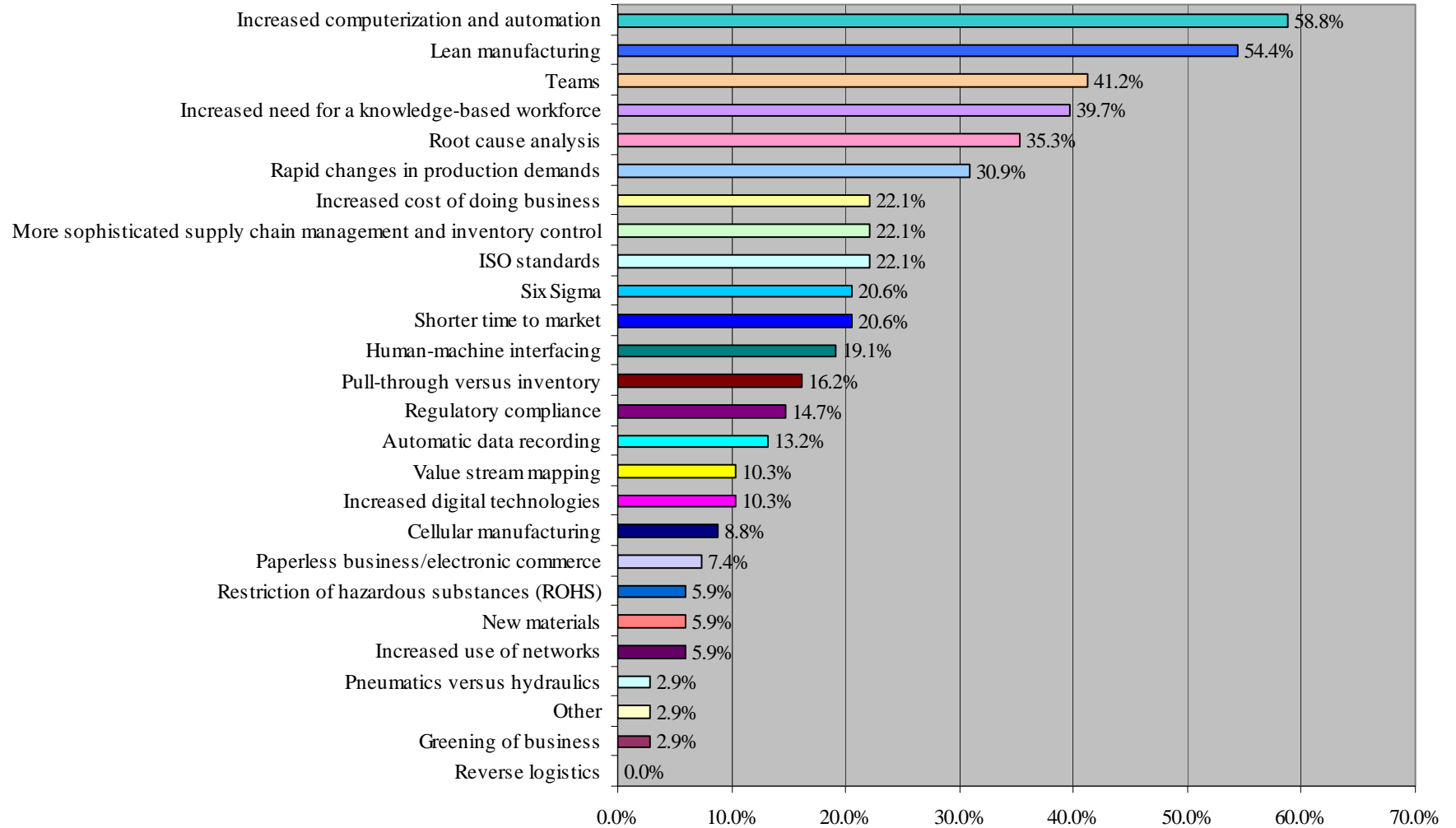
**Other (open response choices not ranked):** no responses collected.

**Figure 16. Of the following maintenance awareness knowledge/skill sets, check the top five sets that your experienced production workers will need within the next five years.**



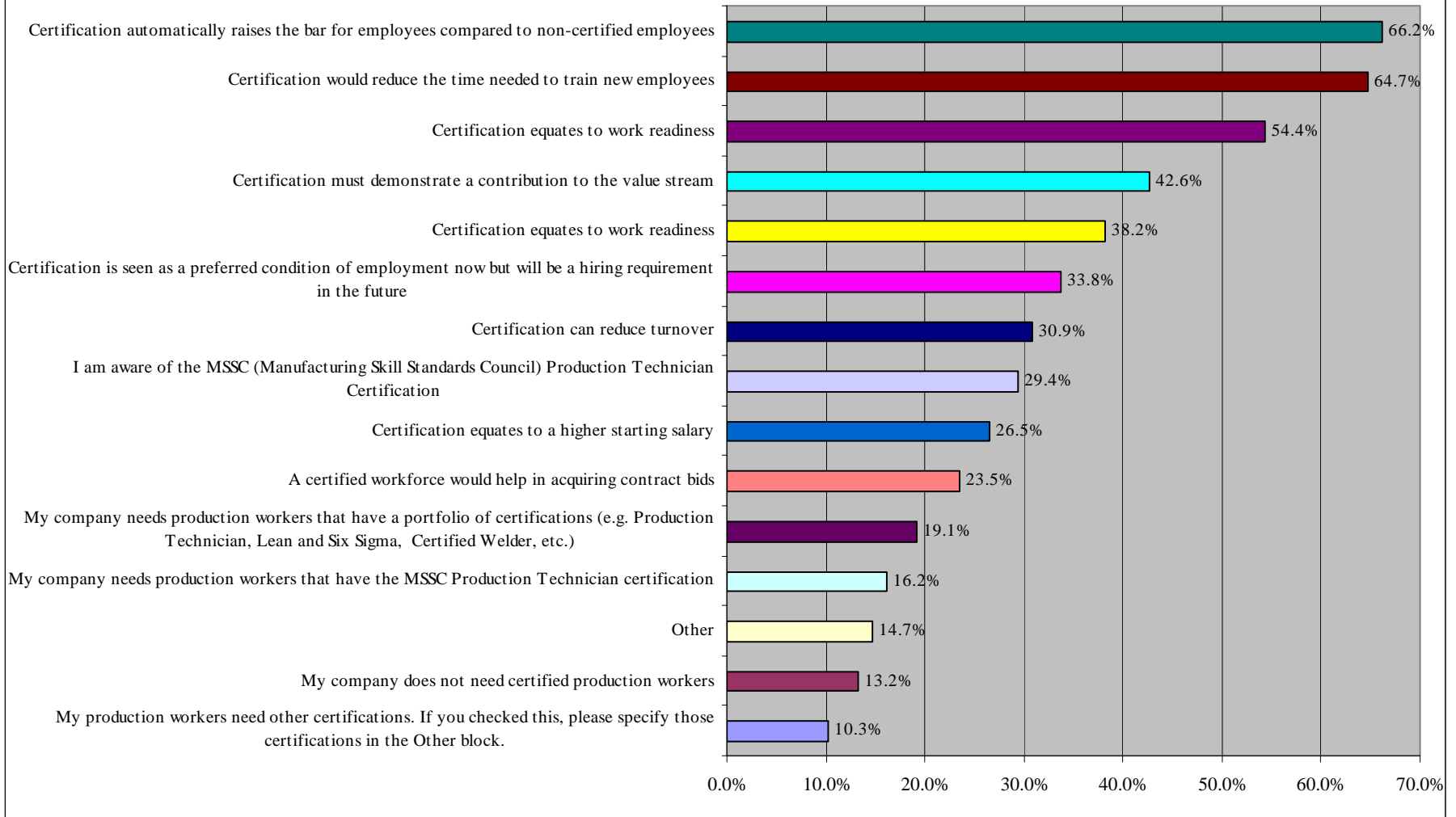
**Other (open response choices not ranked):** 1) Knowledge of communication systems and data networks; 2) Trend analysis; 3) Enterprise asset management/computerized maintenance management (EAM/CMM) systems; 4) Critical thinking and decision making/analysis.

**Figure 17. Of the following manufacturing industry trends, check the top five trends that will drive your entry-level and experienced production workforce training within the next five years.**



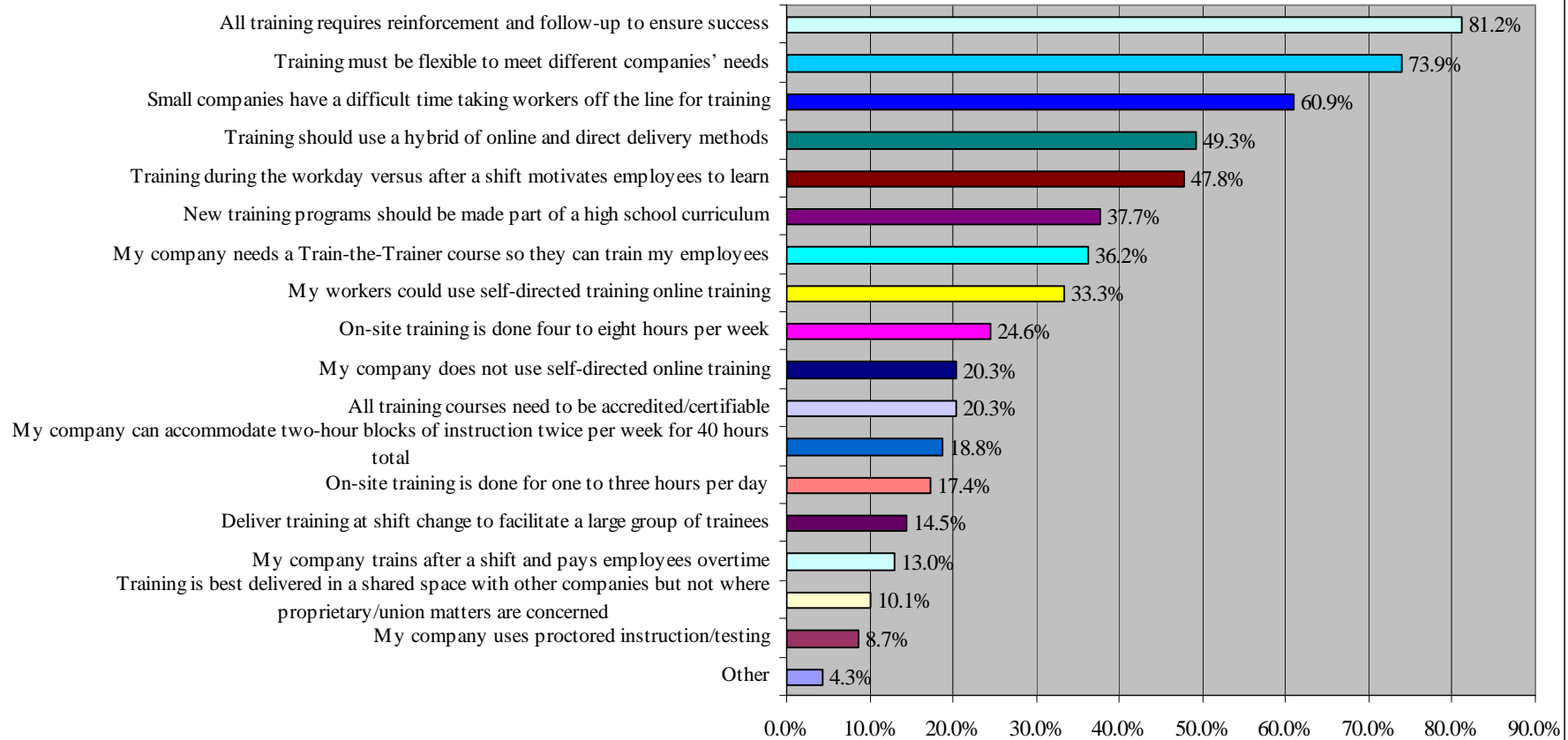
**Other (open response choices not ranked):** 1)Teaching the unique art of boat building and 2)Total productive maintenance.

**Figure 18. Of the following statements about industry-recognized production workforce certification, which statements reflect your view(s) about certification? Please check all that apply.**



**Other (open response choices not ranked):** 1)Would like to know more about the MSSC certification; 2)FAA Certified Aircraft Modifiers; 3)Welding Electrical; 4)IPC J-STD; 5)Internal processes, fork lift, etc.; 6)Soldering certification; 7)NIMS certification; 8)A&P certification; 9)Welding certification; 10)Certification needs to be proven to effectively link to operating environment personnel needs, since we do not have experience with certified people fitting this environment.

**Figure 19. Of the following statements about providing training to your production workforce, which reflects your view(s) about and/or need(s) for training format and delivery? Please check all that apply.**



**Other (open response choices not ranked):** 1)Concentrated training for a full day for four days. Allow workers to begin using new skills immediately; 2)Training should be completely online; and 3)On-the-job training from knowledgeable peers within the daily work environment is a core method of training at our company.