Advanced Manufacturing
COMPETENCY MAP

#Prepared4PA

Pennsylvania's
STATE SYSTEM
of Higher Education

TABLE OF CONTENTS

OVERVIEW

Pennsylvania's State System of Higher Education (PASSHE) is building industry-education-workforce collaboratives to foster stronger connections in our state's workforce ecosystem. This report on high-demand occupations is designed to articulate the competencies, skills, and credentials required by employers to inform quality, robust, industry-validated training and education programs.

WHY COMPETENCIES MATTER

Competencies represent sets of skills, knowledge, and attitudes necessary for broad job functions. These competencies are linked to successful performance and are desirable regardless of an individual's area of expertise or role. Competencies provide a framework to help focus individuals' behavior on things that matter most to an organization and help drive success. They can provide a common way to harmonize, select, and develop talent. Competencies help define how a person should perform a role, and they are often determined in the context of workplace demands - the knowledge, and skills needed to do a specific job or task.

HOW TO USE THESE COMPETENCY MAPS AND CAREER PATHWAYS

The competency maps are meant to serve as a tool for the State System and other education and training providers to develop curricula for pilot programs that meet employer needs for identified in-demand occupations. An important note about these competency maps and career pathways is that they are not an exact science – these competency maps are meant to serve as tools for what is generally required for each occupation. Requirements for competencies vary based on many factors such as employer size, preference, location, and specific need.

CAEL collaborated with the State System to develop the following Competency Maps in Key Industries across the Commonwealth. Recognizing that adult learners are the backbone of the U.S. economy, CAEL helps forge a clear, viable connection between education and career success, providing solutions that promote sustainable and equitable economic growth. CAEL opens doors to opportunity in collaboration with workforce and economic developers, postsecondary educators, and employers, industry groups, foundations, and other mission-aligned organizations. By engaging with these stakeholders, we foster a culture of innovative, lifelong learning that helps individuals and their communities thrive. Established in 1974, CAEL, a Strada Education Network affiliate, is a nonprofit 501(c)(3) membership organization.

PENNSYLVANIA'S ADVANCED MANUFACTURING INDUSTRY

Advanced Manufacturing has a rich history in Pennsylvania, with the building of well-known American landmarks such as the Golden Gate Bridge. In modern times, the industry in Pennsylvania is increasingly focused on high-tech, additive, and digital strategies to meet demands. For the 2020-21 budget, Governor Tom Wolf included a $2.5 million increase for the Industrial Resource Center (IRC) across the state to expand capacities to deliver services to manufacturers in areas such as talent pipeline development, robotics utilization, 3D printing, and other technologies.

At the statewide level, the following occupations within these competency maps are primarily employed within Wholesale Trade Agents and Brokers, Machine Shops, and Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance sub-industries. Digging further at the regional level, Machine Shops and Wholesale Trade Agents and Brokers are among the most prevalent sub-industry across all regions. The Northern region has a focus on Plastics Product and Powder Metallurgy Manufacturing, while the Western region focuses on Iron and Steel Mills and Ferroalloy Manufacturing. Below is an example of some regional specific sub-industries within which these occupations are primarily employed:

HIGH LEVEL REGIONAL SUB-INDUSTRY COMPARISONS WITHIN ADVANCED MANUFACTURING

NORTHERN

- Machine Shops
- All Other Plastics Product Manufacturing
- Powder Metallurgy Part Manufacturing

SOUTHERN

- Machine Shops
- Wholesale Trade Agents and Brokers
- Commercial and Industrial Machinery Equipment Repair and Maintenance

EASTERN

- Wholesale Trade Agents and Brokers
- Machine Shops
- Primary Battery Manufacturing

WESTERN

- Machine Shops
- Iron and Steel Mills and Ferroalloy Manufacturing
- Industrial Machinery and Equipment Merchant Wholesalers

The occupations included in these competency maps are the most demand advanced manufacturing occupations across the state, with varying degrees of demand at regional levels. Across all regions, Heavy and Tractor-Trailer Truck Drivers are most in demand, followed by First-Line Supervisors of Production and Operating Workers in the Northern and Southern region, but Industrial Engineers in the Eastern and Western regions.

REGIONAL IN-DEMAND OCCUPATIONS WITHIN ADVANCED MANUFACTURING

NORTHERN

- Heavy and Tractor-Trailer Truck Drivers
- First-Line Supervisors of Production and Operating Workers
- Maintenance and Repair Workers
- Industrial Engineers
- Packaging and Filling Machine Operators and Tenders

SOUTHERN

- Heavy and Tractor-Trailer Truck Drivers
- First-Line Supervisors of Production and Operating Workers
- Industrial Engineers
- Maintenance & Repair Workers
- Retail Salespersons

EASTERN

- Heavy and Tractor-Trailer Truck Drivers
- Industrial Engineers
- First-Line Supervisors of Production and Operating Workers
- Retail Salespersons
- Maintenance & Repair Workers

WESTERN

- Heavy and Tractor-Trailer Truck Drivers
- Industrial Engineers
- Maintenance and Repair Workers
- First-Line Supervisors of Production & Operating Workers,
- Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products

INDUSTRY-WIDE FOUNDATIONAL SKILLS

Below please find a list of top foundational skills within the Advanced Manufacturing industry. Foundational skills are defined as core skills that provide a foundation for success in school and in the world of work. Nationally, employers have identified a link between foundational skills and job performance and foundational skills are often a prerequisite for workers to learn new industry-specific skills. Foundational skills are broken down into three categories as defined below:

ADVANCED MANUFACTURING: INDUSTRY-WIDE FOUNDATIONAL SKILLS

PERSONAL EFFECTIVENESS COMPETENCIES

These competencies are essential for all life roles - roles as a member of a family, a community, and a larger society. These "soft skills" are increasingly valued in the labor market.

- **Interpersonal Skills:** Displaying skills to work effectively with others from diverse backgrounds.
- **Integrity:** Displaying strong moral principles and work ethic.
- **Professionalism:** Maintaining a professional presence.
- **Initiative:** Demonstrating a commitment to effective job performance by taking action on one's own and following through to get the job done.
- **Dependability:** Displaying responsible behaviors at work.
- **Adaptability:** Displaying the capability to adapt to new, different, or changing requirements.
- **Lifelong Learning:** Demonstrating a commitment to self-development and improvement of knowledge and skills.

ACADEMIC COMPETENCIES

These are critical competencies primarily learned in an academic setting, as well as cognitive functions and thinking styles. These competencies are likely to apply to all organizations in a single industry or be represented by an industry association nationwide.

- **Communication:** Listening, speaking, and signaling so others can understand using a variety of methods, including hearing, speech, American Sign Language, instant messaging, text-to-speech devices, etc.
- **Basic Computer Skills:** Using information technology and related applications, including adaptive devices and software, to convey and retrieve information.
- **Critical & Analytical Thinking:** Using logical thought processes to analyze information and draw conclusions.
- **Reading:** Understanding written sentences, paragraphs, and figures in work-related documents on paper, on computers, or adaptive devices.
- **Writing:** Using standard business English to compile information and prepare written documents on paper, computers, or adaptive devices.
- **Mathematics:** Using mathematics to express ideas and solve problems.
- **Science & Technology:** Using scientific rules and methods to express ideas and solve problems on paper, on computers, or on adaptive devices.

WORKPLACE COMPETENCIES

These competencies represent those skills and abilities that allow individuals to function in an organizational setting.

- **Leadership:** Managing and leading team members to successful outcomes in the workplace.
- **Scheduling/Coordinating:** Making arrangements that fulfill all requirements as efficiently and economically as possible.
- **Problem Solving/Decision Making:** Generating, evaluating, and implementing solutions to problems.
- **Customer Focus:** Efficiently and effectively addressing the needs of clients/customers.
- **Instruction/Teaching:** Teaching others how to do something.
- **Detail Orientation:** Being accurate and thorough in review and development of work materials/ content.
- **Teamwork/Teambuilding:** Working cooperatively with others to complete work assignments.
- **Creative Thinking:** Generating innovative and creative solutions.

ADVANCED MANUFACTURING

FIRST-LINE SUPERVISORS OF PRODUCTION & OPERATING WORKERS

JOB DESCRIPTION	Directly supervise and coordinate the activities of production and operating workers, such as inspectors, precision workers, machine setters and operators, assemblers, fabricators, and plant and system operators.
KEY FOUNDATIONAL SKILLS	Communications, Leadership, Problem Solving/Decision Making, Scheduling/Coordinating, Basic Computer Skills
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Process Guidance:** Inform workers of workplace process by interpreting specifications, blueprints, job orders, and company policies and procedures. **Product Development:** Improve upon and create new products and processes by developing and planning.
OPERATIONS MANAGEMENT	**Employee Management:** Direct and coordinate the activities of employees engaged in the production or processing of goods, such as inspectors, machine setters, and fabricators by recommending or executing personnel actions, such as hirings, evaluations, and promotions. Monitor employees time by keeping records of employees' attendance and hours worked. Resolve worker problems, complaints, or grievances by conferring with management or subordinates. Improve production methods, equipment performance, product quality, or efficiency by motivating employees to improve production. **Training & Mentoring:** Ensure employees are well informed by conducting employee training in equipment operations or work and safety procedures or assigning employee training to experienced workers. **Strategic Planning:** Meet production goals by planning and establishing work schedules, assignments, and production sequences. Determine standards, budgets, production goals, and rates by reviewing company policies, equipment and labor availability, and workloads.
PRODUCTION IN THE SUPPLY CHAIN / SUPPLY CHAIN LOGISTICS	**Systems Analysis & Evaluation:** Determine production requirements to evaluate current production estimates and outputs by reading and analyzing charts, work orders, production schedules, and other records and reports.
QUALITY ASSURANCE AND CONTINUOUS IMPROVEMENT	**Operation Monitoring:** Detect defects or malfunctions by setting up and inspecting materials, products, or equipment. **Data Analysis:** Analyze and create production reports by maintaining operations data, such as time, production, and cost records. Calculate labor and equipment requirements and production specifications by using standard formulas. **Quality Control & Analysis:** Ensure that operators conform to production or processing standards by observing work and monitoring gauges, dials, and other indicators.
PROCESS & EQUIPMENT HEALTH, SAFETY, AND ENVIRONMENT	Monitor & Enforce Regulations: Ensure a high level of safety by enforcing sanitation and safety regulations.
KNOWLEDGE	Good Manufacturing Practices (GMP), Lean Manufacturing, Corrective and Preventive Action (CAPA), Warehousing, Ability to Use Tape Measure

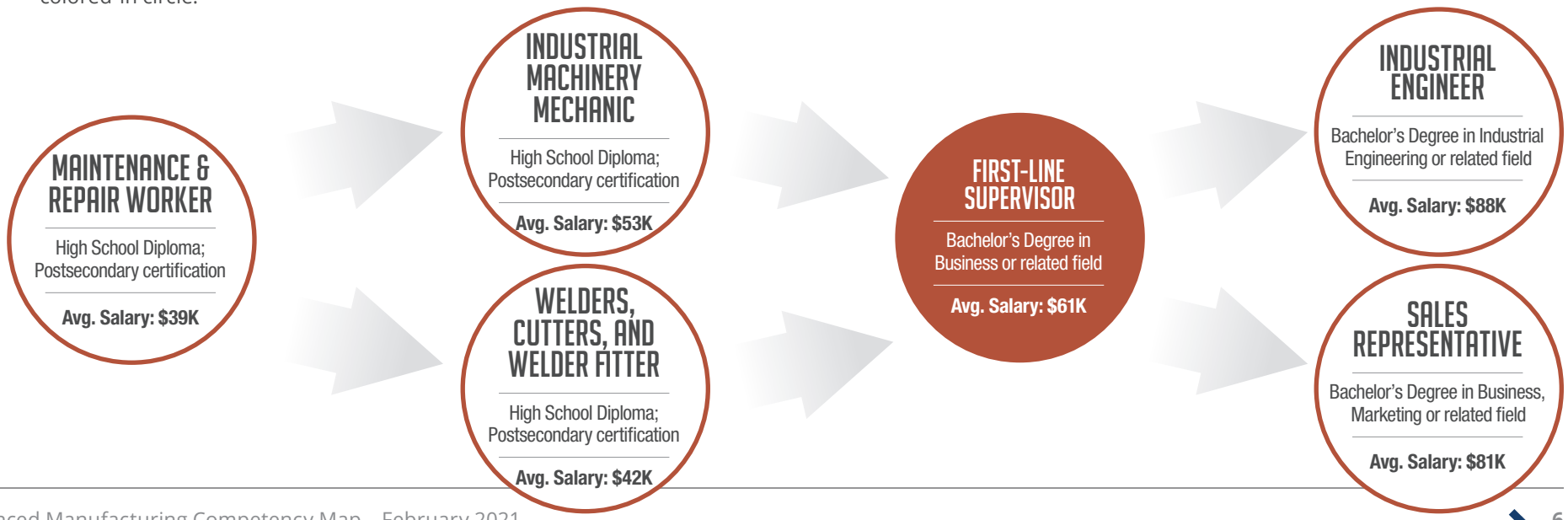
ADVANCED MANUFACTURING

FIRST-LINE SUPERVISORS OF PRODUCTION & OPERATING WORKERS

SALARY RANGE	**Entry Level:** $35,000 - $60,000 (depending on region and employer)	**Advanced Level:** $60,000 - $90,000
TECHNOLOGIES	⦿ Analytical or scientific software (Minitab) ⦿ Computer aided design CAD software ⦿ Database user interface and query software ⦿ Electronic mail software ⦿ Enterprise application integration software ⦿ Enterprise resource planning (ERP) software ⦿ Financial analysis software	⦿ Human resources software ⦿ Industrial control software ⦿ Internet browser software ⦿ Inventory management software ⦿ Materials requirement, planning, logistics, and supply chain software ⦿ Office suite software
CREDENTIALS	**Required:** High school diploma; 3-5 years of work experience for advanced level **Preferred:** OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS)	**Optional/Dependent on Specialty (for both levels):** Bachelor's Degree in Business or related field; Forklift Operator Certification, Six Sigma Green Belt Certification, ServSafe Certification; Lean Six Sigma Certification; Project Management Institute (PMI) or PMP Certification; TQM, ASME, ASQ, NISE,etc. Prior military experience is beneficial.
WORK EXPERIENCE	**Entry Level:** 8 - 10 years	**Advanced Level:** 10+ years
OTHER JOB TITLES/ROLES	Assembly Supervisor, Department Manager, Line Supervisor, Manufacturing Supervisor, Molding Supervisor, Plant Supervisor, Production Manager, Production Supervisor, Quality Assurance Supervisor (QA Supervisor), Shift Supervisor	

FIRST-LINE SUPERVISORS OF PRODUCTION & OPERATING WORKERS PATHWAY

The pathway below represents a typical career pathway in the ever-changing industry of Advanced Manufacturing. The key occupation is represented by the colored-in circle.



ADVANCED MANUFACTURING

MACHINISTS

JOB DESCRIPTION	Set up and operate a variety of machine tools to produce precision parts and instruments. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures.
KEY FOUNDATIONAL SKILLS	Mathematics, Problem Solving/Decision Making, Detail Orientation, Basic Computer Skills, Teamwork
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Design:** Outline design plans by creating working sketches for the illustration of product appearance. Meet special engineering needs by designing fixtures, tooling, or experimental parts. Display the placement of cuts by laying out, measuring, and marking metal stock. Determine methods or sequences of operations needed to fabricate products by studying sample parts, blueprints, drawings, or engineering information. Calculate dimensions or tolerances by using instruments such as micrometers or vernier calipers. Establish work procedures for fabricating new structural products by using a variety of metalworking machines. **Blueprinting and Programming Machinery:** Comprehend, read, and translate blueprint specifications for specific parts and machinery as well as programming machinery to those blueprint specifications. **Machining:** Machine parts to specifications by using machine tools, such as lathes, milling machines, shapers, or grinders. **Team Support:** Check and ensure that new programs or machinery will function properly and that output will meet specifications by conferring with numerical control programmers. Support metalworking projects from planning and fabrication by assembling, testing, inspecting machinery, and using knowledge of machine functions, metal properties and mathematics. Exchange technical information by conferring with engineering, supervisory, or manufacturing personnel. Keep clients informed by advising them about the materials being used for finished products. Coordination of scheduling.
OPERATIONS MANAGEMENT	**Equipment Set Up, Operation & Maintenance:** Verify operational efficiency by setting up or operating metalworking, brazing, heat-treating, welding, or cutting equipment. Ensure equipment is in proper operating condition by maintaining and monitoring equipment. Further monitor efficiency by observing the feed and speed of machines during the machining process. Perform precision machining operations by align and secure holding fixtures, cutting tools, attachments, accessories, or materials onto machines and setting up, adjusting, or operating basic or specialized machine tools.
PRODUCTION IN THE SUPPLY CHAIN/ SUPPLY CHAIN LOGISTICS	**Installation:** Improve or repair machinery by installing experimental parts or assemblies, such as hydraulic systems, lubricants, or batteries into machines or mechanisms. **Diagnose & Repair:** Determine need for adjustments or repairs by diagnosing machine tool malfunctions.
QUALITY ASSURANCE AND CONTINUOUS IMPROVEMENT	**Testing:** Be involved in development, standardization, or feasibility of design by testing experimental models under simulated operating conditions. **Examination:** Examine parts for defects and replace defective parts where needed by dismantling machines or equipment, using hand tools or power tools. Check work pieces by ensuring that they are properly lubricated or cooled. Measure, examine, or test completed units to check for defects and ensure conformance to specifications, by using precision instruments, such as micrometers. **Evaluation Procedures:** Ensure continued and improved efficiency or adaptability by evaluating machining procedures and recommend changes or modifications.
PROCESS & EQUIPMENT HEALTH, SAFETY, AND ENVIRONMENT	**Waste Management:** Be in accordance with company policies and environmental regulations by disposing of scrap or waste material in separate scrap waste and related materials for reuse, recycling, or disposal.
KNOWLEDGE	Micrometers and Calipers, Mechatronics, Programming, Lathes, Mills, Tooling, Computer Numerical Control (CNC), Grinding, Cutting Tool, Drilling, Drill Press, Welding, Sawing, Geometry, Trigonometry, Deburring, Ability to Use Tape Measure

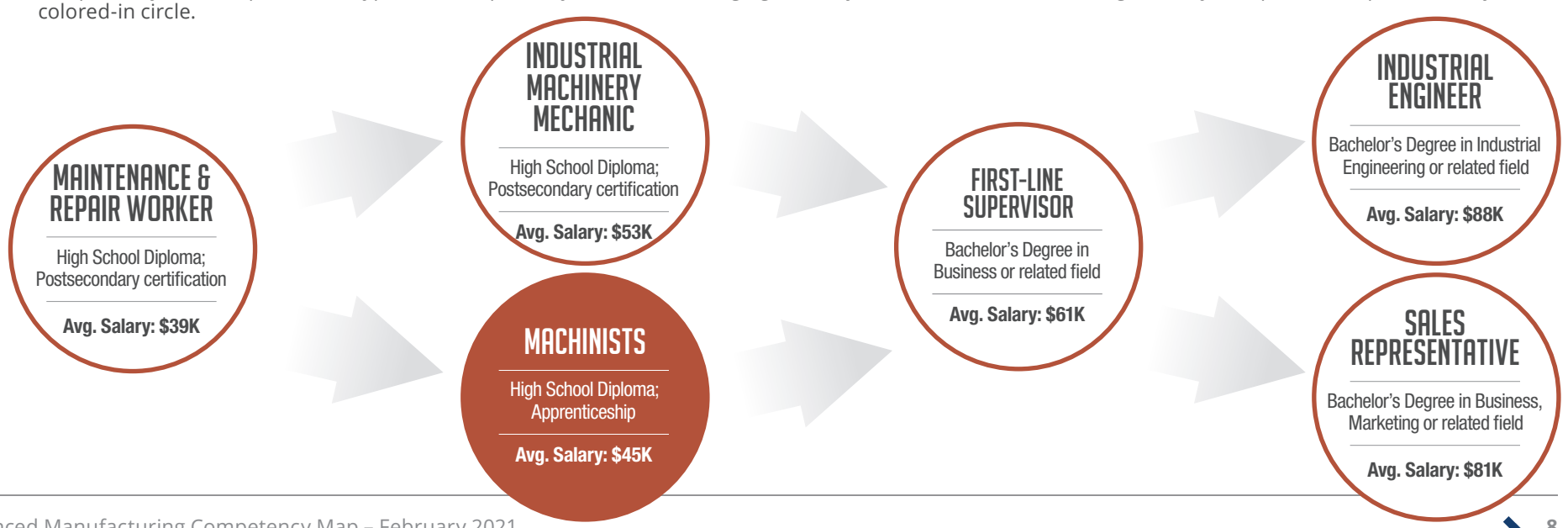
ADVANCED MANUFACTURING

MACHINISTS

SALARY RANGE	**Entry Level:** $28,000 - $45,000 (depending on region and employer)	**Advanced Level:** $45,000 - $65,000
TECHNOLOGIES	⊙ Industrial control software ⊙ Office suite software ⊙ Presentation software ⊙ Procedure management software ⊙ Spreadsheet software ⊙ Word processing software	⊙ Analytical or scientific software ⊙ Computer aided design CAD software ⊙ Computer aided manufacturing CAM software ⊙ Electronic mail software ⊙ Enterprise resource planning ERP software
CREDENTIALS	**Required:** High school diploma **Preferred:** NIMS Certification (CNC Machining, or other specialties); Apprenticeships; OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS)	**Optional/Dependent on Specialty (both levels):** ⊙ Certified Forklift Operator Certification ⊙ National Apprenticeship Certification ⊙ Associates Degree in Tool Technology, CNC Applied Technology, Manufacturing, Electronics, Machining, or Mechatronics ⊙ Forklift Operating Certificate ⊙ Journeyperson Machinist Certification ⊙ OSHA30
WORK EXPERIENCE	**Entry Level:** 0 - 2 years	**Advanced Level:** 3 -5+ years
OTHER JOB TITLES/ROLES	CNC Machinist (Computer Numeric Controlled Machinist), CNC Machinist (Computer Numerically Controlled Machinist), Gear Machinist, Machine Repair Person, Machinist, Maintenance Machinist, Manual Lathe, Machinist, Production Machinist, Set-Up Operator, Tool Room Machinist	

MACHINISTS PATHWAY

The pathway below represents a typical career pathway in the ever-changing industry of Advanced Manufacturing. The key occupation is represented by the colored-in circle.



ADVANCED MANUFACTURING

MAINTENANCE & REPAIR WORKERS

JOB DESCRIPTION	Perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of an establishment in repair. Duties may involve pipe fitting; boiler making; insulating; welding; machining; carpentry; repairing electrical or mechanical equipment; installing, aligning, and balancing new equipment; and repairing buildings, floors, or stairs.
KEY FOUNDATIONAL SKILLS	Problem Solving/Decision Making, Communications, Customer Focus, Detail Oriented, Basic Computer Skills
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Design:** Plan and lay out repair work by using diagrams, drawings, blueprints, maintenance manuals, or schematic diagrams. Aid in the repair or maintenance of machines, mechanical equipment, or building structure by designing new equipment. **Weld and Grind:** Cut or join metal parts by operating cutting torches or welding equipment. Grind and reseat valves by operating valve-grinding machines.
OPERATIONS MANAGEMENT	**Personnel Management:** Train or manage maintenance personnel or subcontractors by following up on employee progress and/or training on various skills. **Building Management (if specialty):** Perform general cleaning duties of buildings, or properties by providing groundskeeping services, such as landscaping or snow removal. **Building Maintenance (if specialty):** Maintain buildings, walls, arches, or other structures by laying brick or painting/repairing roofs, windows, doors, floors, woodwork, plaster, or drywall.
MAINTENANCE, INSTALLATION, AND REPAIR	**Machinery Maintenance:** Perform routine maintenance on boilers by replacing burners or hoses, installing replacement parts, or reinforcing structural weaknesses to ensure optimal boiler efficiency. Maintain or repair specialized equipment or machinery located in cafeterias, laundries, hospitals, stores, offices, or factories. Maintain machinery by lubricating shafts, bearings, gears, or other parts. **Inspection & Testing:** Diagnose machine malfunctions by inspecting, operating, or testing machinery or equipment. Test or treat water supply. Perform routine maintenance, by inspecting drives, motors, or belts, checking fluid levels, replacing filters, or doing other preventive maintenance action. Inspect used parts to determine changes in dimensional requirements by using rules, calipers, micrometers, or other measuring instruments. **Installation:** Assemble boilers at installation sites, using tools such as levels, plumb bobs, hammers, torches, or other hand tools. Assemble, install, or repair wiring, electrical or electronic components, pipe systems, plumbing, machinery, or equipment. Install equipment to improve the energy or operational efficiency of residential or commercial buildings. Position, attach, or blow insulating materials to prevent energy losses from buildings, pipes, or other structures or objects. **Repair:** Diagnose mechanical problems and determine how to correct them by checking blueprints, repair manuals, or parts catalogs, as necessary. Repair machines, equipment, or structures by using tools such as hammers, hoists, saws, drills, wrenches, or equipment such as precision measuring instruments or electrical or electronic testing devices. repair or fabricate machine parts, jigs, fixtures, or tools by operating machine tools. **Device/Machinery Adjustment:** Adjust functional parts of devices or control instruments by using hand tools, levels, plumb bobs, or straightedges. Align and balance new equipment after installation. Dismantle machines, equipment, or devices to access and remove defective parts by using hoists, cranes, hand tools, or power tools.
KNOWLEDGE	Preventive Maintenance & Repair, Mechatronics, Electrical Knowledge, Pumps, Plumbing, HVAC, Welding, Carpentry, Painting, Mechanics, Power Tool Operation, Ability to Use Tape Measure

ADVANCED MANUFACTURING

MAINTENANCE & REPAIR WORKERS

SALARY RANGE	**Entry Level:** $20,000 - $40,000 (depending on region and employer)	**Advanced Level:** $40,000 - $60,000
TECHNOLOGIES	◯ Calendar and scheduling software ◯ Computer aided design CAD software ◯ Database user interface and query software ◯ Development environment software ◯ Electronic mail software ◯ Enterprise resource planning software	◯ Facilities management software ◯ Industrial control software ◯ Internet browser software ◯ Office suite software ◯ Operating system software ◯ Project management software
CREDENTIALS	**Required:** High school diploma; **Preferred:** Journeyperson Maintenance/Repair Apprenticeship and Certification by State DOL; National Institute of Metalworking Skills (NIMS) Certification in specialty area; OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS)	**Optional/Dependent on Specialty:** ◯ Postsecondary certificate in chosen specialty (such as Advanced Manufacturing Systems Technology, Industrial Maintenance, etc.) ◯ Associate degree in Electro-Mechanical, Electronic Technology, Mechatronics ◯ Maintenance and Reliability Technology Certification from the Society for Maintenance and Reliability Professionals ◯ MSSC Certification ◯ OSHA10, OSHA30
WORK EXPERIENCE	0-5+ years	
OTHER JOB TITLES/ROLES	Equipment Engineering Technician, Facilities Manager, Maintenance Engineer, Maintenance Man, Maintenance Mechanic, Maintenance Supervisor, Maintenance Technician, Maintenance Worker, Building Maintenance Mechanic, Building Mechanic	

MAINTENANCE & REPAIR WORKERS PATHWAY

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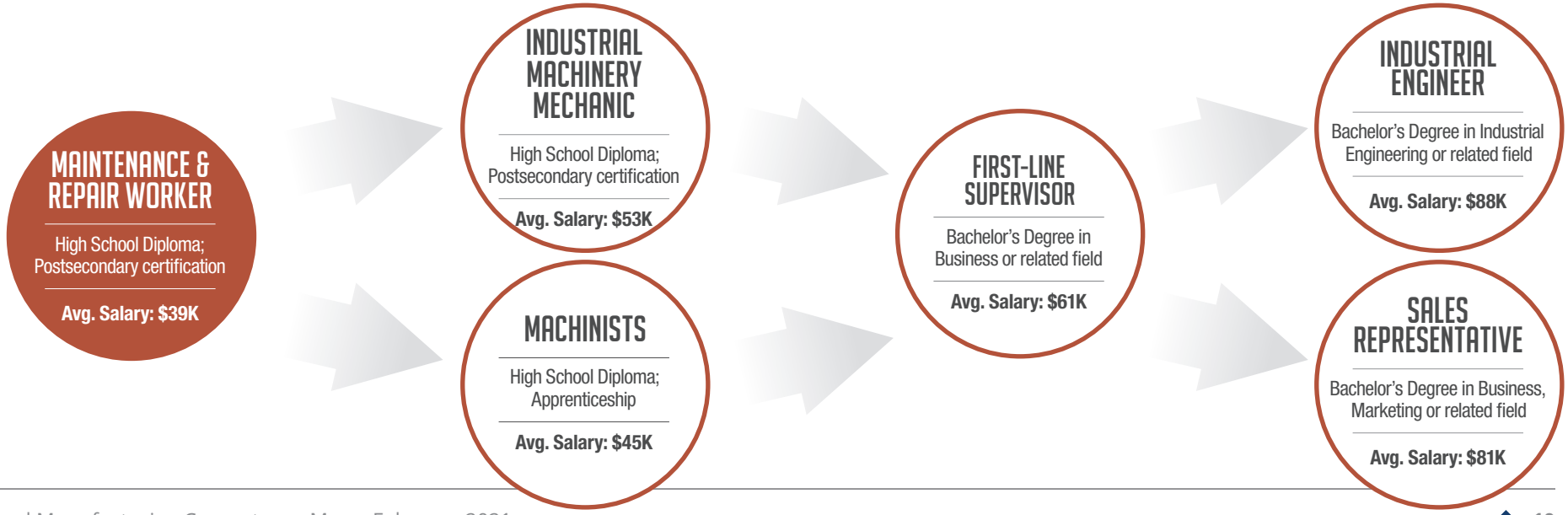

ADVANCED MANUFACTURING

INDUSTRIAL MACHINERY MECHANICS

JOB DESCRIPTION	Repair, install, adjust, or maintain industrial production and processing machinery.
KEY FOUNDATIONAL SKILLS	Problem Solving/Decision Making, Communication, Mathematics, Customer Focus, Basic Computer Skills
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Review & Examine:** Determine correct installation or operation of machinery by studying and reviewing blueprints or manufacturers' manuals. Inspect parts for defects by examining for issues such as breakage or excessive wear.
OPERATIONS MANAGEMENT	**Machinery Operation:** Verify the adequacy of repairs by operating newly repaired machinery or equipment to. Enter codes and instructions to program computer-controlled machinery.
MAINTENANCE, INSTALLATION & REPAIR	**Troubleshooting & Repair:** Repair or maintain the operating condition of industrial production or processing machinery or equipment, broken metal parts and fabricate new parts, or assemble new equipment by cutting and welding metal. **Test & Analyze:** Observe and test the operation of machinery or equipment to diagnose malfunctions by using voltmeters or other testing devices. Ensure quality by reassembling equipment after completion of inspections, testing, or repairs. Diagnose equipment problems by analyzing test results, machine error messages, or information obtained from operators. **Clean & Adjust:** Maintain machinery by cleaning, lubricating, or adjusting parts or equipment as necessary.
PRODUCTION IN THE SUPPLY CHAIN/ SUPPLY CHAIN LOGISTICS	**Recordkeeping:** Determine ordering and requisition needs by recording parts or materials used, as well as repairs and maintenance performed.
QUALITY ASSURANCE & CONTINUOUS IMPROVEMENT	**Training:** Ensure quality by demonstrating equipment functions and features to machine operators.
KNOWLEDGE	Mechanics, Engineering and Technology, Product and Processing, Mathematics, Computers and Electronics, Design, Building and Construction, Public Safety and Security, Preventive Maintenance, Programmable Logic Controllers, Power Tool Operation, Blueprinting/Schematics, Welding, Production Equipment, Machining, Pneumatics, Personal Protective Equipment, Fabrication, Lathes, Mechatronics, Pumps, Ability to Use Tape Measure PLC Troubleshooting, Welding, Fabrication

ADVANCED MANUFACTURING

INDUSTRIAL MACHINERY MECHANICS

SALARY RANGE	**Entry Level:** $30,000 - $50,000 (depending on region and employer)	**Advanced Level:** $50,000 - $75,000
TECHNOLOGIES	⦿ Computer aided design CAD software ⦿ Computer aided manufacturing CAM software ⦿ Database user interface and query software ⦿ Electronic mail software ⦿ Enterprise resource planning ERP software ⦿ Facilities management software	⦿ Industrial control software ⦿ Internet browser software ⦿ Inventory management software
CREDENTIALS	**Required:** High school diploma; Certificate in Industrial Mechanics, Maintenance Technology, Mechatronics or related field; Apprenticeship in Industrial Manufacturing Technology or related field. **Preferred:** National Institute of Metalworking Skills (NIMS) Certification in specialty area, such as Machine Repair; OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS)	**Optional/Dependent on Specialty:** Associates Degree in Industrial Maintenance; Arc/Flash Training ⦿ Associate's Degree in Electro-Mechanical, Electronic Technology, Mechatronics ⦿ Industrial Maintenance Certification from the Society for Maintenance and Reliability Professionals ⦿ MSSC Certification
WORK EXPERIENCE	**Entry Level:** 0-2 years	**Advanced Level:** 3 -5+ years
OTHER JOB TITLES/ROLES	Fixer, Industrial Machinery Mechanic, Industrial Mechanic, Loom Fixer, Machine Adjuster, Maintenance Mechanic, Maintenance Technician, Master Mechanic, Mechanic, Overhauler	

INDUSTRIAL MACHINERY MECHANICS PATHWAY

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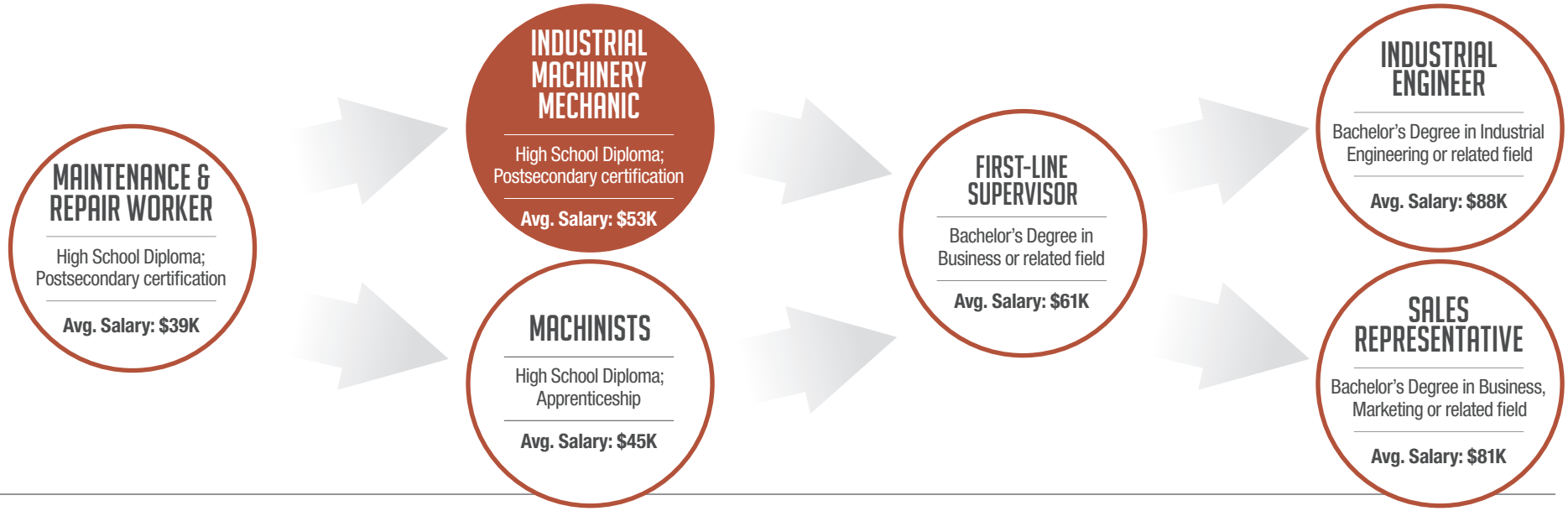


ADVANCED MANUFACTURING

SALES REPRESENTATIVES, WHOLESALE AND MANUFACTURING, EXCEPT TECHNICAL AND SCIENTIFIC PRODUCTS

JOB DESCRIPTION	Sell goods for wholesalers or manufacturers to businesses or groups of individuals. Work requires substantial knowledge of items sold.
KEY FOUNDATIONAL SKILLS	Communication, Customer Focus, Detail Orientation, Leadership, Initiative
OPERATIONS MANAGEMENT	**Client Consultation:** Contact regular and prospective customers to demonstrate products, explain product features, and solicit orders. Recommend products to customers, based on customers' needs and interests. Answer customers' questions about products, prices, availability, product uses, and credit terms. Consult with clients after sales or contract signings to resolve problems and to provide ongoing support. Provide customers with product samples and catalogs. **Business Development:** Identify prospective customers by using business directories, following leads from existing clients, participating in organizations and clubs, and attending trade shows and conferences. Obtain credit information about prospective customers. **Cost Estimation:** Estimate or quote prices, credit or contract terms, warranties, and delivery dates. Prepare drawings, estimates, and bids that meet specific customer needs.
QUALITY ASSURANCE & CONTINUOUS IMPROVEMENT	**Training:** Train customers' employees to operate and maintain new equipment. **Professional Development & Research:** Monitor market conditions, product innovations, and competitors' products, prices, and sales. **Administrative Duties:** Perform administrative duties by preparing sales budgets and reports, keeping sales records, filing expense account reports, checking stock levels and reordering merchandise as necessary. **Contract Negotiation:** Prepare sales contracts and order forms by negotiating the details of contracts and payments. ***(Advanced Level Competency)*** **Vendor Negotiation:** Improve product exposure, such as shelf positioning and advertising by negotiating with merchants and vendors. Plan, assemble, and stock product displays in wholesale stores, by making recommendations to vendors regarding product displays, promotional programs, and advertising. ***(Advanced Level Competency)***
KNOWLEDGE	Sales and Marketing, Customer and Personal Service, Computer and Electronics, Customer Relationship Management, Business Development, Cold Calling, Sales Management, Sales Territory, Business to Business, Sales Process, Merchandising, Ability to Use Tape Measure

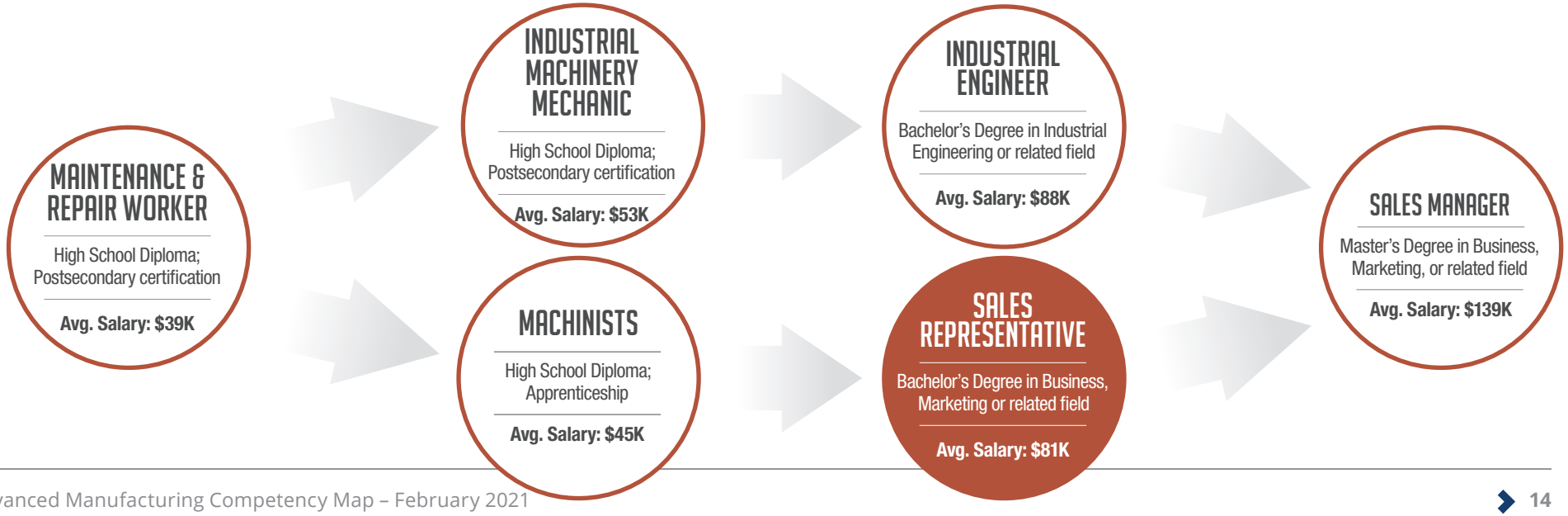
ADVANCED MANUFACTURING

SALES REPRESENTATIVES, WHOLESALE AND MANUFACTURING, EXCEPT TECHNICAL AND SCIENTIFIC PRODUCTS

SALARY RANGE	**Entry Level:** $25,000 - $60,000 (depending on region and employer)	**Advanced Level:** $60,000 - $115,000
TECHNOLOGIES	⦿ Access Software ⦿ Accounting software ⦿ Analytical or scientific software ⦿ Application server software ⦿ Database User Interface and Query Software ⦿ Electronic Mail Software ⦿ Enterprise Resource Planning (ERP) Software ⦿ Business Intelligence and Data Analysis Software	⦿ Calendar and Scheduling Software ⦿ Computer Aided Design (CAD) Software ⦿ Customer Relationship Management CRM Software ⦿ Database management system software ⦿ Database reporting software ⦿ Data mining software ⦿ Desktop publishing software ⦿ Development environment software
CREDENTIALS	**Required: High school diploma;** Certificate in Business or related field or 2-3 years work experience **Preferred:** Some years experience in selected industry	**Optional/Dependent on Specialty:** Customer Service Specialist Certification, Welding Sales Representative Certification; Bachelor's Degree in Business or related field
WORK EXPERIENCE	**Entry Level:** 0-2 years	**Advanced Level:** 3-5+years
OTHER JOB TITLES/ROLES	Account Representative, Customer Account Technician, Inside Salesperson, Outside Sales Representative, Route Sales Representative, Sales Consultant, Sales Professional, Sales Representative (Sales Rep), Salesman, Salesperson	

SALES REPRESENTATIVES, WHOLESALE AND MANUFACTURING PATHWAY

The pathway below represents a typical career pathway in the ever-changing industry of Advanced Manufacturing. The key occupation is represented by the colored-in circle.



ADVANCED MANUFACTURING

INDUSTRIAL ENGINEERS

JOB DESCRIPTION	Design, develop, test, and evaluate integrated systems for managing industrial production processes, including human work factors, quality control, inventory control, logistics and material flow, cost analysis, and production coordination.
KEY FOUNDATIONAL SKILLS	Communication, Problem Solving/Decision Making, Leadership, Scheduling/Coordinating, Science & Technology
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Planning & Review:** Plan and establish a sequence of operations to fabricate and assemble parts or products and to promote efficient utilization. Review production schedules, engineering specifications, orders, and related information to obtain knowledge of manufacturing methods, procedures, and activities. **Design:** Draft and design layout of equipment, materials, and workspace to illustrate maximum efficiency by using drafting tools and computers. **Client Communication:** Confer with clients, vendors, staff, and management personnel regarding purchases, product and production specifications, manufacturing capabilities, or project status. **Data Analysis:** Determine manufacturing processes, staff requirements, and production standards by applying statistical methods and performing mathematical calculations. Determine standards and establish quality and reliability objectives of finished product by analyzing statistical data and product specifications. **Personnel Management:** Study operations sequence, material flow, functional statements, organization charts, and project information to determine worker functions and responsibilities. **Evaluate:** Formulate corrective action plans by evaluating precision and accuracy of production and testing equipment and engineering drawings**.** **Increase Efficiency:** Expedite production operations by regulating and alter workflow schedules according to established manufacturing sequences and lead times. Formulate sampling procedures and designs and develop forms and instructions for recording, evaluating, and reporting quality and reliability data. **Develop Procedures:** Implement methods and procedures for disposition of discrepant material and defective or damaged parts and assess cost and responsibility.
OPERATIONS MANAGEMENT	**Cost Estimation:** Estimate production costs, cost saving methods, and the effects of product design changes on expenditures for management review, action, and control. **Administrative Duties:** Ensure accurate recording of engineering drawings and documentation of production problems by creating production reports, purchase orders, and material, tool, and equipment lists.
PRODUCTION IN THE SUPPLY CHAIN/ SUPPLY CHAIN LOGISTICS	**Manage and Forecast:** Schedule deliveries based on production forecasts, material substitutions, storage and handling facilities, and maintenance requirements.
QUALITY ASSURANCE & CONTINUOUS IMPROVEMENT	**Develop Quality Control Procedures:** resolve production problems, maximize product reliability, or minimize costs by coordinating and implementing quality control objectives, activities, or procedures. Further, develop production and design standards by communicating with management and user personnel. Ensure quality control and reliability by directing workers engaged in product measurement, inspection, and testing activities. **Recommend & Direct:** Improve utilization of personnel, material, and utilities by recommending and directing personnel on methods to do so.
KNOWLEDGE	Engineering Technology, Production and Processing, Design, Mathematics, Computers and Electronics, Administration and Management, Process and/ or Mechanical Engineering, New Product Development, Corrective and Preventive Action (CAPA), Manufacturing Processes, Auditing, Continuous Improvement Process, Lean Manufacturing, Automation, Quality Management Systems

ADVANCED MANUFACTURING

INDUSTRIAL ENGINEERS

SALARY RANGE	**Entry Level:** $50,000 - $80,000 (depending on region and employer)	**Advanced Level:** $80,000 - $130,000
TECHNOLOGIES	ⓘ Analytical or scientific software ⓘ Application server software ⓘ Computer aided design CAD software ⓘ Computer aided manufacturing CAM software ⓘ Database user interface and query software ⓘ Development environment software ⓘ Inventory management software	ⓘ Electronic mail software ⓘ Enterprise application integration software ⓘ Enterprise resource planning ERP software ⓘ Expert system software ⓘ Graphics or photo imaging software ⓘ Human resources software ⓘ Industrial control software
CREDENTIALS	**Required:** Some employers require Bachelor's or Associate's Degree in Industrial Engineering, General Engineering, Mechanical Engineering, Electrical Engineering, Supply Chain Management, or related field. **Preferred:** OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS) **Note:** Some smaller organizations will accept years or experience/ certifications in lieu of bachelor's degree	**Optional/Dependent on Specialty:** Master's Degree in Industrial Engineering; Fundamentals of Engineering (FE) or Professional Engineer (PE) Licensing; APIC Certification, Lean Manufacturing, Six Sigma Green/Black Certification; Inventory Management, CPIM, Project Management Certification (PMP)
WORK EXPERIENCE	5+ years	
OTHER JOB TITLES/ROLES	Continuous Improvement Engineer, Engineer, Facilities Engineer, Industrial Engineer, Operations Engineer, Plant Engineer, Process Engineer, Project Engineer, Quality Engineer	

INDUSTRIAL ENGINEERS PATHWAY

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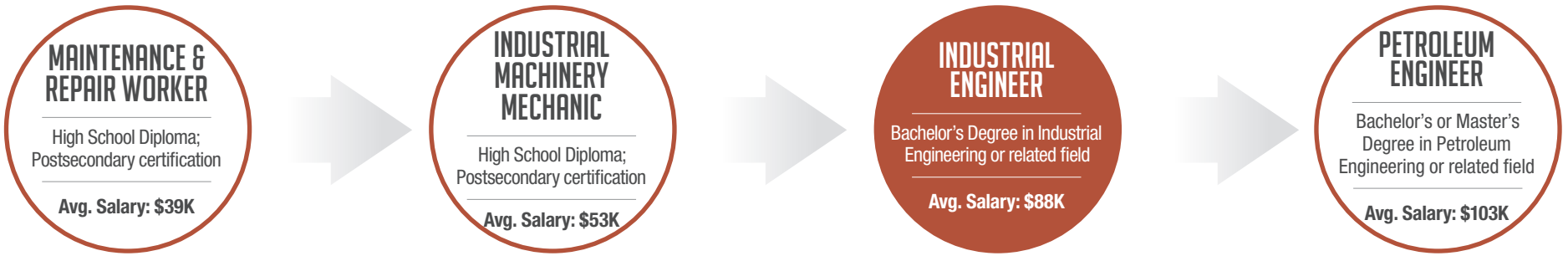

ADVANCED MANUFACTURING

WELDERS, CUTTERS, AND WELDER FITTERS

JOB DESCRIPTION	Use hand-welding or flame-cutting equipment to weld or join metal components or to fill holes, indentations, or seams of fabricated metal products.
KEY FOUNDATIONAL SKILLS	Mathematics, Detail Orientation, Communication, Initiative, Problem Solving/Decision Making
MANUFACTURING PROCESS DESIGN/ DEVELOPMENT	**Design & Assess:** Develop templates and models for welding projects by using mathematical calculations based on blueprint information. Determine required equipment and welding methods by applying knowledge of metallurgy, geometry, and welding techniques. **Analyze:** Plan layout, assembly, and welding operations by analyzing engineering drawings, blueprints, specifications, sketches, work orders, and material safety data sheets. **Weld:** Weld components in flat, vertical, or overhead positions by using aluminum, stainless steel, cast iron, and other alloys. Join parts such as beams and steel reinforcing rods in buildings, bridges, and highways by bolting and riveting, as necessary. Clamp, hold, tack-weld, heat-bend, grind, or bolt component parts to obtain required configurations and positions for welding. Ignite torches or start power supplies and strike arcs by touching electrodes to metals being welded, completing electrical circuits. Connect and turn regulator valves by activating and adjusting gas flow and pressure so that desired flames are obtained. Guide and direct flames or electrodes on or across workpieces to straighten, bend, melt, or build up metal. Fill holes and increase the size of metal parts. Melt lead bars, wire, or scrap to add lead to joints or to extrude melted scrap into reusable form. Gouge metals, using the air-arc gouging process. Mix and apply protective coatings to products. **Grind:** Chip or grind off excess weld, slag, or spatter by using hand scrapers or power chippers, portable grinders, or arc-cutting equipment. Remove rough spots from workpieces by using portable grinders, hand files, or scrapers. Cut, contour, and bevel metal plates and structural shapes to dimensions as specified by blueprints, layouts, work orders, and templates by using powered saws, hand shears, or chipping knives. Hammer out bulges or bends in metal workpieces. Dismantle metal assemblies or cut scrap metal by using thermal-cutting equipment, such as flame-cutting torches or plasma-arc equipment. **Prepare:** Lay out, position, align, and secure parts and assemblies prior to assembly by using straightedges, combination squares, calipers, and rules. Prepare all material surfaces to be welded by ensuring that there is no loose or thick scale, slag, rust, moisture, grease, or other foreign matter. Preheat workpieces prior to welding or bending by using torches or heating furnaces. Position and secure workpieces by using hoists, cranes, wire, and banding machines or hand tools. **Monitor:** Avoid overheating of parts or warping, shrinking, distortion, or expansion of material by monitoring the fitting, burning, and welding processes.
OPERATIONS MANAGEMENT	**Equipment Operation:** Operate brazing and soldering equipment. Operate metal shaping, straightening, and bending machines, such as brakes and shears. Set up and use ladders and scaffolding as necessary to complete work. Operate manual or semi-automatic welding equipment to fuse metal segments, using processes such as gas tungsten arc, gas metal arc, flux-cored arc, plasma arc, shielded metal arc, resistance welding, and submerged arc welding. Recognize, set up, and operate hand and power tools common to the welding trade, such as shielded metal arc and gas metal arc welding equipment.
MAINTENANCE, INSTALLATION, & REPAIR	**Install:** Select and install torches, torch tips, filler rods, and flux, by referring to welding chart specifications or types and thicknesses of metal**s.** **Repair:** Repair products by dismantling, straightening, reshaping, and reassembling parts, using cutting torches, straightening presses, and hand tools.
PRODUCTION IN THE SUPPLY CHAIN/SUPPLY CHAIN LOGISTICS	**Estimate:** Estimate materials needed for production and manufacturing by maintaining required stocks of materials**.**
QUALITY ASSURANCE & CONTINUOUS IMPROVEMENT	**Quality Assurance & Monitoring:** Check grooves, angles, or gap allowances, using micrometers, calipers, and precision measuring instruments. Detect faulty operation of equipment or defective materials and notify supervisors. Examine workpieces for defects and measure workpieces with straightedges or templates by ensuring conformance with specifications. Mark or tag material with proper job number, piece marks, and other identifying marks as required. **Clean:** Clean or degrease parts by using wire brushes, portable grinders, or chemical baths.
PROCESS & EQUIPMENT HEALTH, SAFETY AND ENVIRONMENT	**Ensure Safety:** Operate safety equipment by using fire suppression methods in industrial emergencies and other safe work habits
KNOWLEDGE	Production and Processing, Design, Administration and Management, Engineering and Management, Metal Inert Gas (MIG) Welding,Gas Tungsten Arc Welding (TIG), Fabrication, Grinding, Blueprinting, Ability to Use Tape Measure

ADVANCED MANUFACTURING

WELDERS, CUTTERS, AND WELDER FITTERS

SALARY RANGE	**Entry Level:** $28,000 - $40,000 (depending on region and employer)	**Advanced Level:** $40,000 - $60,000
TECHNOLOGIES	⦿ Analytical or scientific software ⦿ Calendar and scheduling software ⦿ Computer aided design CAD software ⦿ Database user interface query software	⦿ Electronic mail software ⦿ Office suite software ⦿ Spreadsheet software
CREDENTIALS	**Required:** High school diploma **Some Employers Require:** ASME Certification or AWS Welding Certification; OSHA 10 or 30 hour certification, Environmental Health & Safety Professional Certificate (EHS)	**Optional/Dependent on Specialty:** Associate degree in Welding or Welding Technology; Robotic Welding Certifications
WORK EXPERIENCE	3 - 5 years	
OTHER JOB TITLES/ROLES	Aluminum Welder, Fabrication Welder, Fabricator, Fitter/Welder, Maintenance Welder, MIG Welder (Metal Inert Gas Welder), Sub Arc Operator, Welder, Welder-Fitter, Welder/Fabricator	

WELDERS, CUTTERS, AND WELDER FITTERS PATHWAY

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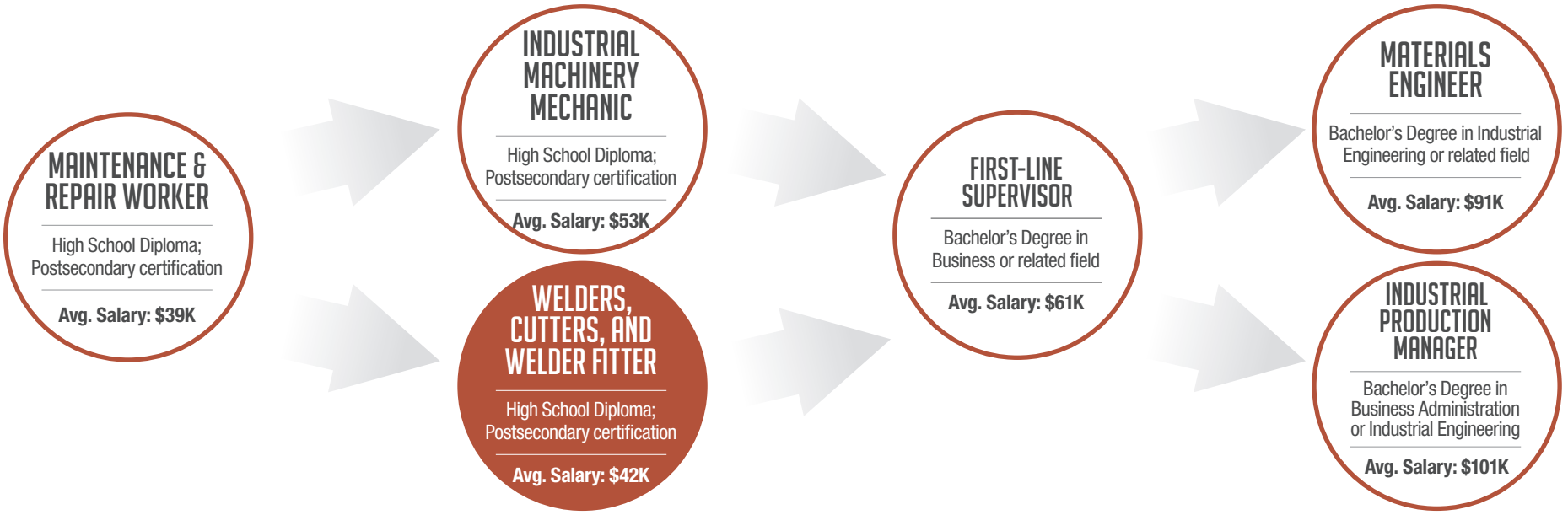

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