# Minnesota Dual-Training Pipeline
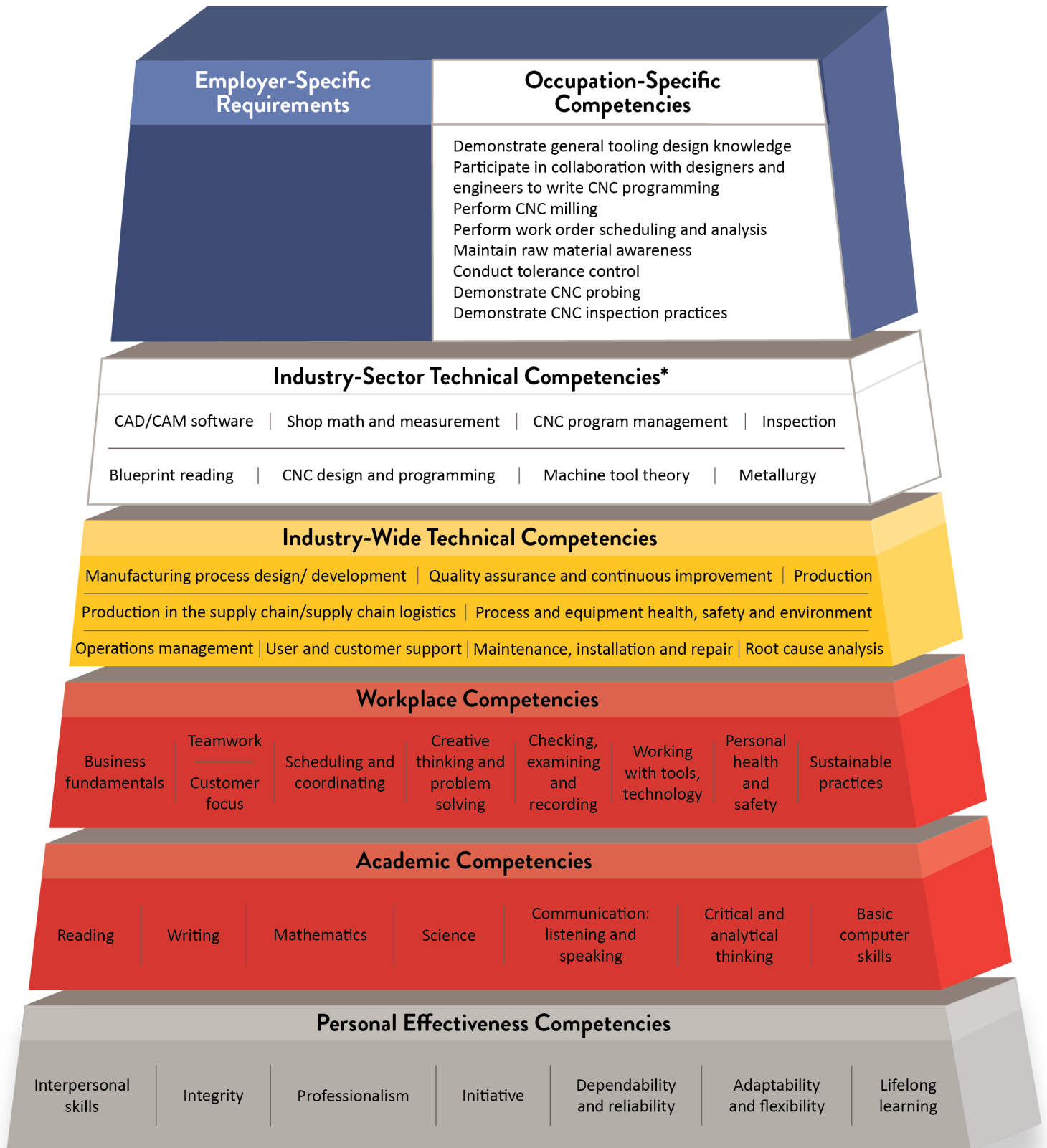# Competency Model for Advanced Manufacturing
# Occupation: Computer Numerical Control (CNC) Programmer

## Employer-Specific Requirements

## Occupation-Specific Competencies

Demonstrate general tooling design knowledge
Participate in collaboration with designers and engineers to write CNC programming
Perform CNC milling
Perform work order scheduling and analysis
Maintain raw material awareness
Conduct tolerance control
Demonstrate CNC probing
Demonstrate CNC inspection practices

## Industry-Sector Technical Competencies*

CAD/CAM software | Shop math and measurement | CNC program management | Inspection

Blueprint reading | CNC design and programming | Machine tool theory | Metallurgy

## Industry-Wide Technical Competencies

Manufacturing process design/ development | Quality assurance and continuous improvement | Production

Production in the supply chain/supply chain logistics | Process and equipment health, safety and environment

Operations management | User and customer support | Maintenance, installation and repair | Root cause analysis

## Workplace Competencies

Business fundamentals | Teamwork / Customer focus | Scheduling and coordinating | Creative thinking and problem solving | Checking, examining and recording | Working with tools, technology | Personal health and safety | Sustainable practices

## Academic Competencies

Reading | Writing | Mathematics | Science | Communication: listening and speaking | Critical and analytical thinking | Basic computer skills

## Personal Effectiveness Competencies

Interpersonal skills | Integrity | Professionalism | Initiative | Dependability and reliability | Adaptability and flexibility | Lifelong learning

# Competency Model for Computer Numerical Control (CNC) Programmer

**Computer Numerical Control (CNC) Programmer** – An individual who assists in the design and production on CNC machines that shape parts from metal or plastic. They must create designs and interpret blueprints, manuals, and other work instructions. They also study sample parts to determine dimensions of finished work pieces and equipment setup requirements. They help determine which tools will be the right ones for the CNC machine to use to ensure product reliability and machine shop efficiency. These professionals detect malfunctions using precision measuring instruments such as micrometers, dial calipers, depth gages, indicators, and scales.

*Pipeline recommends the Industry-Sector Technical Competencies as formal training opportunities (provided through related instruction) and the Occupation-Specific Competencies as on-the-job (OJT) training opportunities.

## Industry-Sector Technical Competencies

**Related Instruction** for dual training means the organized and systematic form of education resulting in the enhancement of skills and competencies related to the dual trainee's current or intended occupation.

- **CAD/CAM software** – Use the models and assemblies created in CAD software to develop toolpaths that drive machine tools to turn designs into physical parts.

- **Shop math and measurement** – Training in basic math, including linear measurement, metrics and beginning algebra.

- **CNC program management** – Knowledge of how to ensure that current software is up to date and aligns with shop needs. Able to also manage time and prioritize programming so that it meets company deadlines and order scheduling goals.

- **Inspection** – Knowledgeable of the proper methods and instruments used to effectively inspect parts in the shop, including using instruments such as the caliper, micrometer, and of course CNC machine.

- **Blueprint reading** – Knowledge in reading and understanding industrial prints.

- **CNC design and programming** – Knowledge of manual programming of Computer Numerical Control (CNC) machine tools. Learn types of CNC controls, machinery, programming formats and basic terminology. The ability to hide G-code and/or have ways to bypass it to speed up the process of part design is also useful knowledge to have for this role as well.

- **Machine tool theory** – Learn to complete the processes required for manufacturing a precision part, use standard shop safety practices, set-up and operate standard manufacturing machines, complete accurate layouts, explain applications of hand tools and use correctly and use basic measuring tools.

- **Metallurgy** – Know the basic principles of metals, the behavior of metals and the processes which affect them, as well as the most common metals used in industrial processes.

# Occupation-Specific Competencies

**On-the-Job Training** is hands-on instruction completed at work to learn the core competencies necessary to succeed in an occupation. Common types of OJT include job shadowing, mentorship, cohort-based training, assignment-based project evaluation and discussion-based training.

- **Demonstrate general tooling design knowledge** – Demonstrate knowledge of methods, and procedures for common machine shop benchwork and hand tool work as well as ability to do basic design and development of fixtures to support CNC machines.

- **Participate in collaboration with designers and engineers to write programming** - Demonstrates ability to write programs using CAD/ CAM software and the skill to collaborate with engineers and peers to develop CNC programming.

- **Perform CNC milling** – Demonstrates the fundamentals of CNC machining processes with skills in work holding, speeds and feeds for various materials and functions and capabilities of CNC machining tools.

- **Perform work order scheduling and analysis** – Demonstrates ability to prioritize certain work orders over others to strive for efficiency to maximize CNC programming and machine output potential.

- **Maintain raw material awareness** – Demonstrates knowledge of steel, aluminum, etc. and how they interact with the CNC and occasionally CMM machines.

- **Conduct tolerance control** – Demonstrates knowledge of raw materials and how CMM and CNC machine use could potentially damage the materials. Takes steps to avoid damage to materials.

- **Demonstrate CNC probing** - Ability to program software for probing tools to be able to maximize the efficiency, quality, and accuracy of CNC machine tools.

- **Demonstrate CNC inspection practices** – Demonstrate the proper methods and instruments used to effectively inspect parts in the shop, including using instruments such as the caliper, micrometer, and CNC.

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