Minnesota Dual-Training Pipeline
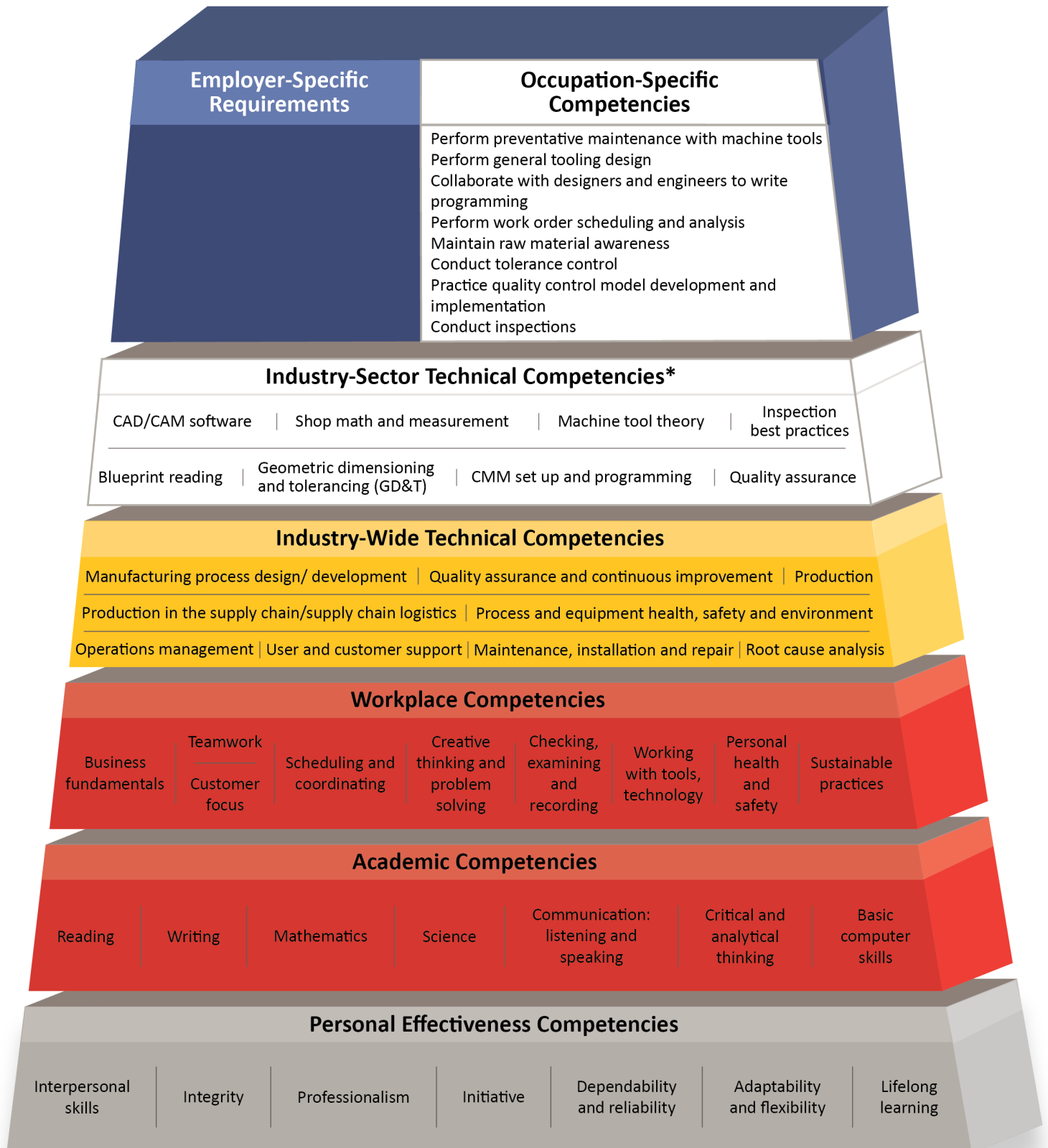## Competency Model for Advanced Manufacturing
Occupation: Coordinate Measuring Machine (CMM) Programmer

Employer-Specific Requirements

Occupation-Specific Competencies

Perform preventative maintenance with machine tools
Perform general tooling design
Collaborate with designers and engineers to write programming
Perform work order scheduling and analysis
Maintain raw material awareness
Conduct tolerance control
Practice quality control model development and implementation
Conduct inspections

Industry-Sector Technical Competencies*

CAD/CAM software	Shop math and measurement	Machine tool theory	Inspection best practices
Blueprint reading	Geometric dimensioning and tolerancing (GD&T)	CMM set up and programming	Quality assurance

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 Coordinate Measuring Machine (CMM) Programmer

Coordinate Measuring Machine (CMM) Programmer – An individual who assists in the design and production of inspection equipment programming to ensure the highest quality possible for each product. They must be able to operate the CMM and also 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 work closely with engineers to note areas for improvement or to make corrections to help determine which tools will be the right ones for the CNC machine to use to ensure product reliability and machine shop efficiency. CMM Programmers inspect work pieces throughout a production run. These professionals additionally 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 such as PC-DMIS, Calypso, etc. to develop toolpaths that drive machine tools to turn designs into physical parts that meet quality standards.

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

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

- **CMM set up and programming** – Knowledge of manual programming of Coordinate Measuring Machine tools. Learn types of CMM controls, machinery, programming formats and basic terminology.

- **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 lay-outs, explain applications of hand tools and use correctly and use basic measuring tools.

- **Geometric dimensioning and tolerancing (GD & T)** – Understand the system for defining and communicating engineering tolerances through symbolic language on engineering drawings and blueprints as well as computer generated models to assist in utilizing CMM operations.

- **Quality assurance** – Understands basic principles of precise measurement and attention to detail to ensure product meets exact standards as laid out in production plans.

- **Inspection best practices** – 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 CMM machine.

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.

- **Perform preventative maintenance with machine tools** – Practice industry approved procedures for preventative maintenance on CMM machines and any related machines too.

- **Perform general tooling design** – 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 CMM machines.

- **Collaborate 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 CMM programming.

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

- **Maintain raw material awareness** – Demonstrates knowledge of steel, aluminum, and other metals, and how they interact with the CMM and occasionally a CNC machine.

- **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 and machines.

- **Practice quality control model development and implementation** – Demonstrate ability to create models via files, drawing, blueprints, etc. to ensure product quality.

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

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