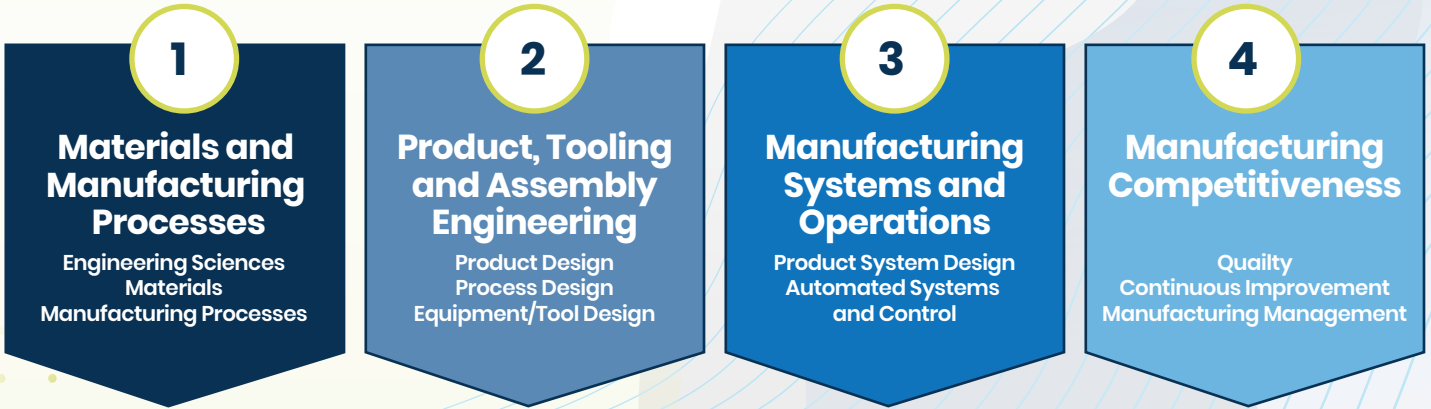


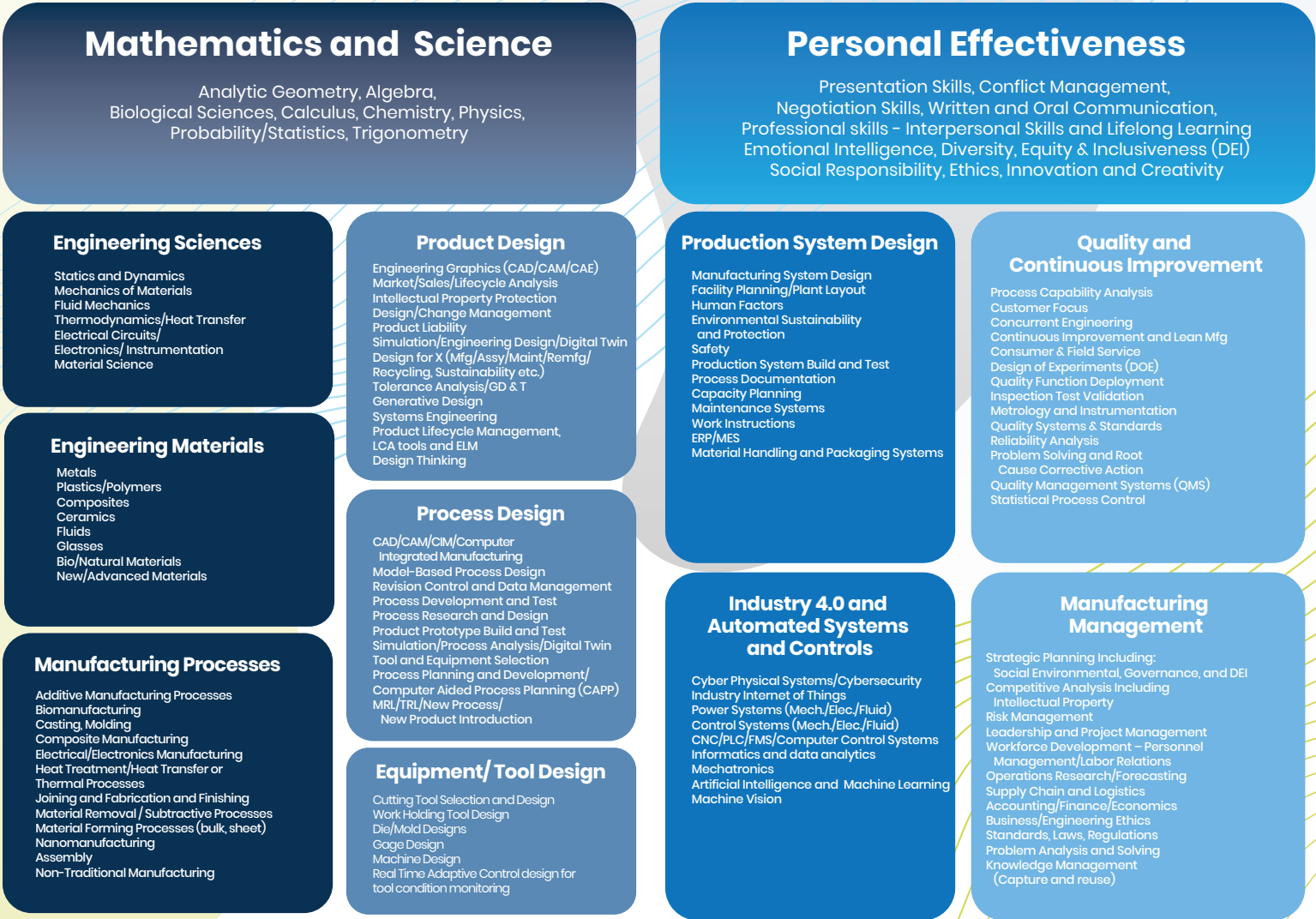
The 4 PILLARS of MANUFACTURING KNOWLEDGE

PRODUCT PRODUCING ENTERPRISE

Customer focus – Quality & Continuous Improvement – Metrology – SPC – Problem Analysis (FMEA, DOE, ect.)
 Capability Analysis – Reliability System Thinking – Product Design – Manufacturing Processes
 Production System Design – Measurement of Process Variables – Process Improvement



FOUNDATION



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1

Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Engineering Sciences

Statics and Dynamics
Mechanics of Materials
Fluid Mechanics
Thermodynamics/Heat Transfer
Electrical Circuits/
Electronics/ Instrumentation
Material Science

Engineering Materials

Metals
Plastics/Polymers
Composites
Ceramics
Fluids
Glasses
Bio/Natural Materials
New/Advanced Materials

Manufacturing Processes

Additive Manufacturing Processes
Biomufacturing
Casting, Molding
Composite Manufacturing
Electrical/Electronics Manufacturing
Heat Treatment/Heat Transfer or
Thermal Processes
Joining and Fabrication and Finishing
Material Removal / Subtractive Processes
Material Forming Processes (bulk, sheet)
Nanomanufacturing
Assembly
Non-Traditional Manufacturing

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2

Product, Tooling and Assembly Engineering

**Product Design
Process Design
Equipment/Tool Design**

Product Design

Engineering Graphics (CAD/CAM/CAE)
Market/Sales/Lifecycle Analysis
Intellectual Property Protection
Design/Change Management
Product Liability
Simulation/Engineering Design/Digital Twin
Design for X (Mfg/Assy/Maint/Remfg/
Recycling, Sustainability etc.)
Tolerance Analysis/GD & T
Generative Design
Systems Engineering
Product Lifecycle Management,
LCA tools and ELM
Design Thinking

Process Design

CAD/CAM/CIM/Computer
Integrated Manufacturing
Model-Based Process Design
Revision Control and Data Management
Process Development and Test
Process Research and Design
Product Prototype Build and Test
Simulation/Process Analysis/Digital Twin
Tool and Equipment Selection
Process Planning and Development/
Computer Aided Process Planning (CAPP)
MRL/TRL/New Process/
New Product Introduction

Equipment/Tool Design

Cutting Tool Selection and Design
Work Holding Tool Design
Die/Mold Designs
Gage Design
Machine Design
Real Time Adaptive Control design for
tool condition monitoring

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3

Manufacturing Systems and Operations

**Product System Design
Automated Systems
and Control**

Production System Design

Manufacturing System Design
Facility Planning/Plant Layout
Human Factors
Environmental Sustainability
and Protection
Safety
Production System Build and Test
Process Documentation
Capacity Planning
Maintenance Systems
Work Instructions
ERP/MES
Material Handling and Packaging Systems

Industry 4.0 and Automated Systems and Controls

Cyber Physical Systems/Cybersecurity
Industry Internet of Things
Power Systems (Mech./Elec./Fluid)
Control Systems (Mech./Elec./Fluid)
CNC/PLC/FMS/Computer Control Systems
Informatics and data analytics
Mechatronics
Artificial Intelligence and Machine Learning
Machine Vision



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4

Manufacturing Competitiveness

Quality
Continuous Improvement
Manufacturing Management

Quality and Continuous Improvement

- Process Capability Analysis
- Customer Focus
- Concurrent Engineering
- Continuous Improvement and Lean Mfg
- Consumer & Field Service
- Design of Experiments (DOE)
- Quality Function Deployment
- Inspection Test Validation
- Metrology and Instrumentation
- Quality Systems & Standards
- Reliability Analysis
- Problem Solving and Root Cause Corrective Action
- Quality Management Systems (QMS)
- Statistical Process Control

Manufacturing Management

- Strategic Planning Including:
 - Social Environmental, Governance, and DEI
- Competitive Analysis Including
 - Intellectual Property
- Risk Management
- Leadership and Project Management
- Workforce Development - Personnel Management/Labor Relations
- Operations Research/Forecasting
- Supply Chain and Logistics
- Accounting/Finance/Economics
- Business/Engineering Ethics
- Standards, Laws, Regulations
- Problem Analysis and Solving
- Knowledge Management (Capture and reuse)