sme technical COMMUNITY

Four Pillars of Manufacturing Knowledge Revision

Four Pillars of Manufacturing Knowledge Revision

Speakers

Suzanne G Marzano, Sr. Manager of Industry Development and Technical Activities at SME

Dr. John L. Irwin, Michigan Technological University
Chair, Manufacturing and Mechanical Engineering Technology

Dr. Neil Littell, Ohio University
Associate Professor and Kraft Family Scholar

Please fill out the form to receive updates on the Mfg 4 Pillars

Manufacturing Education & Accreditation Committee

- https://www.sme.org/education/educators/manufacturing-education-accreditation-committee/

Ongoing agenda item in support of the SME Strategic Plan:

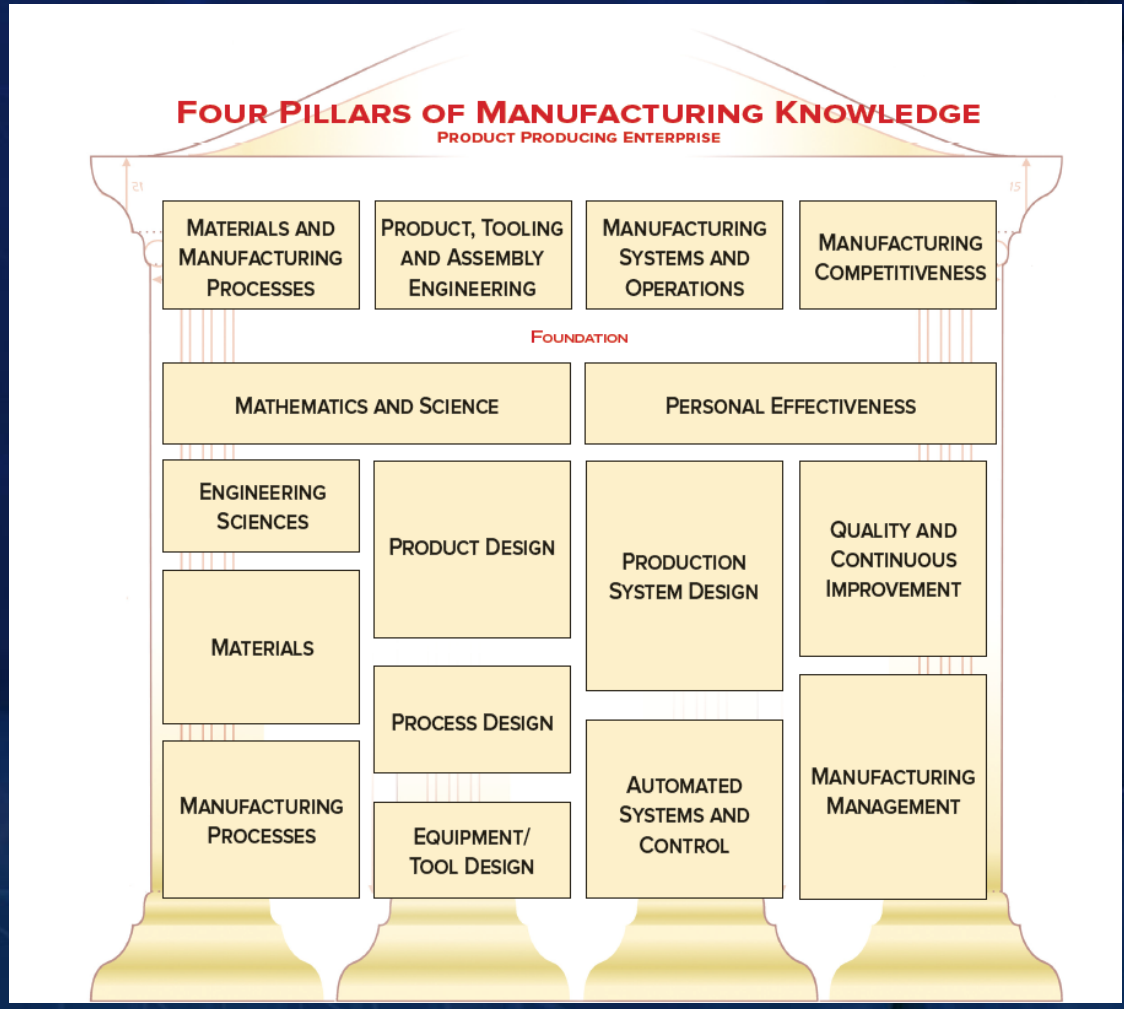
- Promote the benefits of postsecondary manufacturing education programs based on the Four Pillars of Manufacturing Knowledge and accreditation of these manufacturing education programs globally through engagement of academia and employers.

What is the Four Pillars of Manufacturing Knowledge

- Developed in 2011, and first appeared in SME publication in 2012

SME (2012). "A Strategy for Manufacturing Education." Dearborn, MI: Society of Manufacturing Engineers. Accessed from https://www.abet.org/wp-content/uploads/2015/04/workforce-imperative-manufacturing-education-strategy.pdf

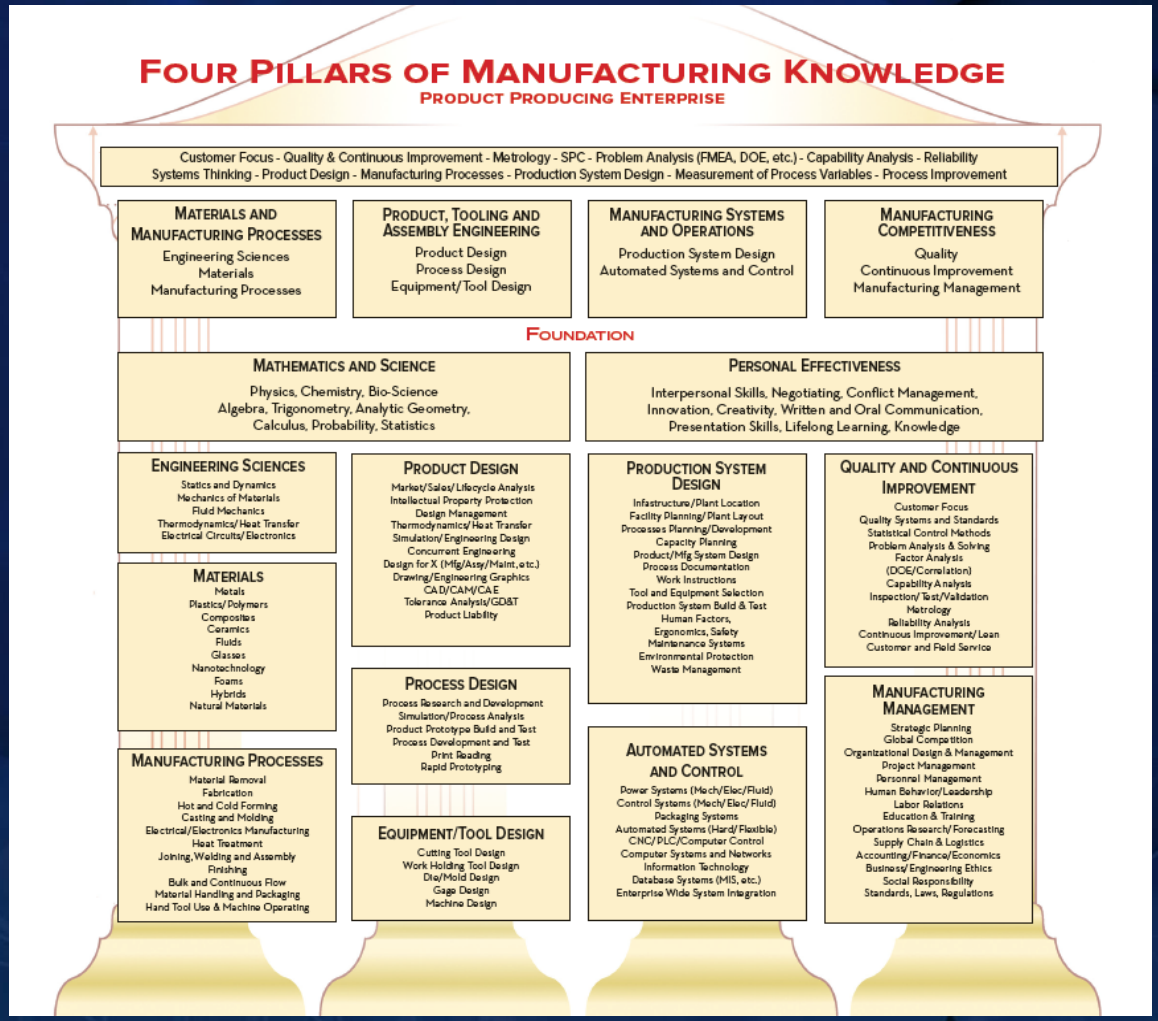
- Update process was initiated in 2021
- Each of the original 12 blocks of knowledge have been surveyed, revised and validated
- Seeking expert comment and input for revision process



Who uses the Four Pillars

- Industry professionals
- Manufacturing education program leaders and faculty

- Visually presents breadth and scope of manufacturing engineering based on accreditation criteria and SME Certification Body of Knowledge



Revision Process

- 350 manufacturing experts from industry, government, and the academia were surveyed, with 75 responses yielding a response rate of approximately 21%.
- The results were presented in a 90-page PowerPoint slide deck provided by SME Technical Activities.
- SME subject matter experts refined the topics in each knowledge block.
- Topics were validated by SME Manufacturing Education and Accreditation Committee.
- Annually the topics in each knowledge block will be reviewed and input collected from the public will be evaluated for future revisions.

Manufacturing Four Pillars on sme.org

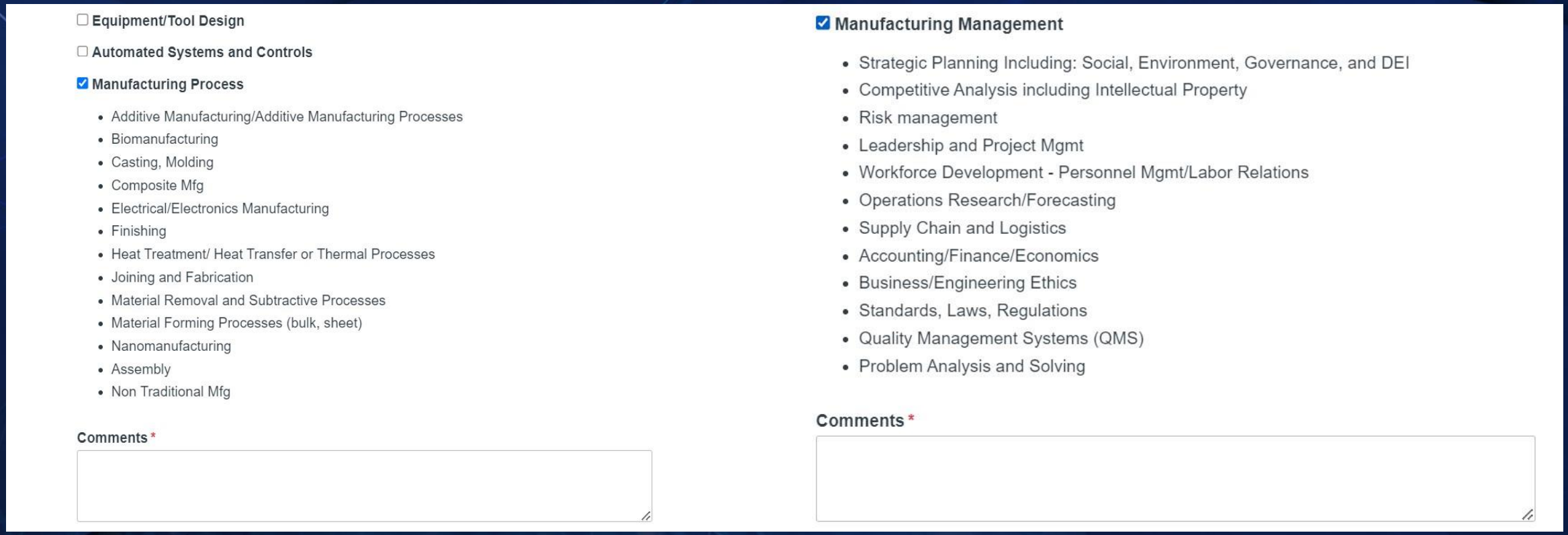
Please use the webform below to comment, suggest edits and provide updates to the interest areas of **SME's Four Pillars of Manufacturing Knowledge**. We look forward to your feedback.

Please select one or more Pillar Categories to expand and comment:

- ☐ Mathematics and Science
- ☐ Engineering Sciences
- ☐ Engineering Materials
- ☐ Personal Effectiveness
- ☐ Production System Design
- ☐ Manufacturing Management
- ☐ Equipment/Tool Design
- ☐ Automated Systems and Controls
- ☐ Manufacturing Process
- ☐ Product Design
- ☐ Quality and Continuous Improvement
- ☐ Process Design

https://www.sme.org/education/educators/sme-four-pillars-of-manufacturing-knowledge/sme-four-pillars-comment-form/

Manufacturing Four Pillars on sme.org



☐ **Equipment/Tool Design**

☐ **Automated Systems and Controls**

☑ **Manufacturing Process**

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

Comments *

☑ **Manufacturing Management**

- Strategic Planning Including: Social, Environment, Governance, and DEI
- Competitive Analysis including Intellectual Property
- Risk management
- Leadership and Project Mgmt
- Workforce Development - Personnel Mgmt/Labor Relations
- Operations Research/Forecasting
- Supply Chain and Logistics
- Accounting/Finance/Economics
- Business/Engineering Ethics
- Standards, Laws, Regulations
- Quality Management Systems (QMS)
- Problem Analysis and Solving

Comments *

https://www.sme.org/education/educators/sme-four-pillars-of-manufacturing-knowledge/sme-four-pillars-comment-form/

Four Pillars of Manufacturing Knowledge

Product Producing Enterprise

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

Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Product, Tooling and Assembly Engineering

Product Design
Process Design
Equipment/Tool Design

Manufacturing Systems and Operations

Production System Design
Automated Systems and Control

Manufacturing Competitiveness

Quality
Continuous Improvement
Manufacturing Management

Foundation

Mathematics and Science

Physics, Chemistry, Bio-Science
Algebra, Trigonometry, Analytic Geometry,
Calculus, Probability, Statistics

Personal Effectiveness

Interpersonal Skills, Negotiating, Conflict Management,
Innovation, Creativity, Written and Oral Communication,
Presentation Skills, Lifelong Learning, Knowledge

Engineering Sciences

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

Materials

Metals
Plastics/Polymers
Composites
Ceramics
Fluids
Glasses
Nanotechnology
Foams
Hybrids
Natural Materials

Manufacturing Processes

Material Removal
Fabrication
Hot and Cold Forming
Casting and Molding
Electrical/Electronics Manufacturing
Heat Treatment
Joining, Welding and Assembly
Finishing
Bulk and Continuous Flow
Material Handling and Packaging
Hand Tool Use & Machine Operating

Product Design

Market/Sales/Lifecycle Analysis
Intellectual Property Protection
Design Management
Thermodynamics/Heat Transfer
Simulation/Engineering Design
Concurrent Engineering
Design for X (Mfg/Assy/Maint, etc.)
Drawing/Engineering Graphics
CAD/CAM/CAE
Tolerance Analysis/GD&T
Product Liability

Process Design

Process Research and Development
Simulation/Process Analysis
Product Prototype Build and Test
Process Development and Test
Print Reading
Rapid Prototyping

Equipment/Tool Design

Cutting Tool Design
Work Holding Tool Design
Die/Mold Design
Gage Design
Machine Design

Production System Design

Infastructure/Plant Location
Facility Planning/Plant Layout
Processes Planning/Development
Capacity Planning
Product/Mfg System Design
Process Documentation
Work Instructions
Tool and Equipment Selection
Production System Build & Test
Human Factors,
Ergonomics, Safety
Maintenance Systems
Environmental Protection
Waste Management

Automated Systems and Control

Power Systems (Mech/Elec/Fluid)
Control Systems (Mech/Elec/Fluid)
Packaging Systems
Automated Systems (Hard/Flexible)
CNC/PLC/Computer Control
Computer Systems and Networks
Information Technology
Database Systems (MIS, etc.)
Enterprise Wide System Integration

Quality and Continuous Improvement

Customer Focus
Quality Systems and Standards
Statistical Control Methods
Problem Analysis & Solving
Factor Analysis
(DOE/Correlation)
Capability Analysis
Inspection/Test/Validation
Metrology
Reliability Analysis
Continuous Improvement/Lean
Customer and Field Service

Manufacturing Management

Strategic Planning
Global Competition
Organizational Design & Management
Project Management
Personnel Management
Human Behavior/Leadership
Labor Relations
Education & Training
Operations Research/Forecasting
Supply Chain & Logistics
Accounting/Finance/Economics
Business/Engineering Ethics
Social Responsibility
Standards, Laws, Regulations

Four Pillars of Manufacturing Knowledge

Product Producing Enterprise

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Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Product, Tooling and Assembly Engineering

Product Design
Process Design
Equipment/Tool Design

Manufacturing Systems and Operations

Production System Design
Automated Systems and Control

Manufacturing Competitiveness

Quality
Continuous Improvement
Manufacturing Management

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Personal Effectiveness

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Presentation Skills, Lifelong Learning, Knowledge

Engineering Sciences

Statics and Dynamics
Mechanics of Materials

Product Design

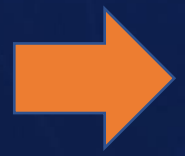
Market/Sales/Lifecycle Analysis

Production System Design

Quality and Continuous Improvement

Mathematics and Science

- Analytic Geometry
- Algebra
- Biological Sciences
- Calculus
- Chemistry
- Physics
- Probability/Statistics
- Trigonometry



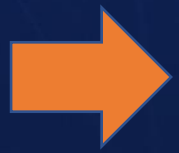
No Change

Mathematics and Science

- Analytic Geometry
- Algebra
- Biological Sciences
- Calculus
- Chemistry
- Physics
- Probability/Statistics
- Trigonometry

Personal Effectiveness

- ~~Interpersonal Skills~~
- ~~Negotiating~~
- Conflict Management
- ~~Innovation~~
- ~~Creativity~~
- Written and Oral Communication
- Presentation Skills
- ~~Lifelong Learning~~
- ~~Knowledge~~



Personal Effectiveness

- Presentation Skills
- Conflict Management
- Negotiation Skills
- Written and Oral Communication
- Professional skills - Interpersonal Skills and Lifelong Learning
- Emotional Intelligence
- Diversity, Equity & Inclusiveness (DEI)
- Social Responsibility
- Ethics
- Innovation and Creativity

Systems Thinking - Product Design - Manufacturing Processes - Production System Design - Measurement of Process Variables - Process Improvement

Materials and Manufacturing Processes

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Electrical Circuits/Electronics

Materials

Metals
Plastics/Polymers
Composites
Ceramics
Fluids
Glasses
Nanotechnology
Foams
Hybrids
Natural Materials

Manufacturing Processes

Material Removal
Fabrication
Hot and Cold Forming
Casting and Molding
Electrical/Electronics Manufacturing
Heat Treatment
Joining, Welding and Assembly
Finishing
Bulk and Continuous Flow
Material Handling and Packaging

Product Design

Market/Sales/Lifecycle Analysis
Intellectual Property Protection
Design Management
Thermodynamics/Heat Transfer
Simulation/Engineering Design
Concurrent Engineering
Design for X (Mfg/Assy/Maint, etc.)
Drawing/Engineering Graphics
CAD/CAM/CAE
Tolerance Analysis/GD&T
Product Liability

Process Design

Process Research and Development
Simulation/Process Analysis
Product Prototype Build and Test
Process Development and Test
Print Reading
Rapid Prototyping

Equipment/Tool Design

Cutting Tool Design
Work Holding Tool Design
Die/Mold Design
Gage Design

Production System Design

Infastructure/Plant Location
Facility Planning/Plant Layout
Processes Planning/Development
Capacity Planning
Product/Mfg System Design
Process Documentation
Work Instructions
Tool and Equipment Selection
Production System Build & Test
Human Factors,
Ergonomics, Safety
Maintenance Systems
Environmental Protection
Waste Management

Automated Systems and Control

Power Systems (Mech/Elec/Fluid)
Control Systems (Mech/Elec/Fluid)
Packaging Systems
Automated Systems (Hard/Flexible)
CNC/PLC/Computer Control
Computer Systems and Networks
Information Technology
Database Systems (MIS, etc.)
Enterprise Wide System Integration

Quality and Continuous Improvement

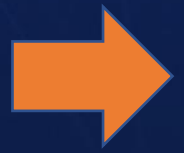
Customer Focus
Quality Systems and Standards
Statistical Control Methods
Problem Analysis & Solving
Factor Analysis
(DOE/Correlation)
Capability Analysis
Inspection/Test/Validation
Metrology
Reliability Analysis
Continuous Improvement/Lean
Customer and Field Service

Manufacturing Management

Strategic Planning
Global Competition
Organizational Design & Management
Project Management
Personnel Management
Human Behavior/Leadership
Labor Relations
Education & Training
Operations Research/Forecasting
Supply Chain & Logistics
Accounting/Finance/Economics
Business/Engineering Ethics
Social Responsibility
Standards, Laws, Regulations

Engineering Sciences

- Statics and Dynamics
- Mechanics of Materials
- Fluid Mechanics
- Thermodynamics/Heat Transfer
- Electrical Circuits/ Electronics

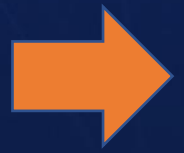


Engineering Sciences

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

Materials

- Metals
- Plastics/Polymers
- Composites
- Ceramics
- Fluids
- Glasses
- ~~Nanotechnology~~
- ~~Foams~~
- ~~Hybrids~~
- Natural Materials

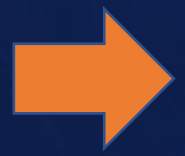


Engineering Materials

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

Manufacturing Processes

- Material Removal
- Fabrication
- Hot and Cold Forming Processes
- Casting, Molding
- Electrical/Electronics Manufacturing
- Heat Treatment
- Joining, Welding, and Assembly
- Finishing
- ~~Bulk and Continuous Flow~~
- ~~Material Handling and Packaging~~
- ~~Hand Tool Use and Machine Operation~~



Manufacturing Processes

- Additive Manufacturing Processes
- Biomanufacturing
- 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

Systems Thinking - Product Design - Manufacturing Processes - Production System Design - Measurement of Process Variables - Process Improvement

Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Product, Tooling and Assembly Engineering

Product Design
Process Design
Equipment/Tool Design

Manufacturing Systems and Operations

Production System Design
Automated Systems and Control

Manufacturing Competitiveness

Quality
Continuous Improvement
Manufacturing Management

Foundation

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Manufacturing Processes

Material Removal
Fabrication
Hot and Cold Forming
Casting and Molding
Electrical/Electronics Manufacturing
Heat Treatment
Joining, Welding and Assembly
Finishing
Bulk and Continuous Flow

Product Design

Market/Sales/Lifecycle Analysis
Intellectual Property Protection
Design Management
Thermodynamics/Heat Transfer
Simulation/Engineering Design
Concurrent Engineering
Design for X (Mfg/Assy/Maint, etc.)
Drawing/Engineering Graphics
CAD/CAM/CAE
Tolerance Analysis/GD&T
Product Liability

Process Design

Process Research and Development
Simulation/Process Analysis
Product Prototype Build and Test
Process Development and Test
Print Reading
Rapid Prototyping

Equipment/Tool Design

Cutting Tool Design
Work Holding Tool Design
Die/Mold Design
Gage Design

Production System Design

Infastructure/Plant Location
Facility Planning/Plant Layout
Processes Planning/Development
Capacity Planning
Product/Mfg System Design
Process Documentation
Work Instructions
Tool and Equipment Selection
Production System Build & Test
Human Factors,
Ergonomics, Safety
Maintenance Systems
Environmental Protection
Waste Management

Automated Systems and Control

Power Systems (Mech/Elec/Fluid)
Control Systems (Mech/Elec/Fluid)
Packaging Systems
Automated Systems (Hard/Flexible)
CNC/PLC/Computer Control
Computer Systems and Networks
Information Technology
Database Systems (MIS, etc.)
Enterprise Wide System Integration

Quality and Continuous Improvement

Customer Focus
Quality Systems and Standards
Statistical Control Methods
Problem Analysis & Solving
Factor Analysis
(DOE/Correlation)
Capability Analysis
Inspection/Test/Validation
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Continuous Improvement/Lean
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Manufacturing Management

Strategic Planning
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Project Management
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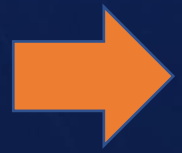
Human Behavior/Leadership
Labor Relations
Education & Training
Operations Research/Forecasting
Supply Chain & Logistics
Accounting/Finance/Economics
Business/Engineering Ethics
Social Responsibility
Standards, Laws, Regulations

2011

Product Design

- Market/Sales/Lifecycle Analysis
- Intellectual Property Protection
- Design/Change Management
- ~~Thermodynamics/Heat Transfer~~
- Simulation/Engineering Design
- ~~Concurrent Engineering~~
- Design for X (Mfg/Assy/Maint)
- Drawing/Engineering Graphics
- CAD/CAM/CAE
- Tolerance Analysis/GD & T
- Product Liability

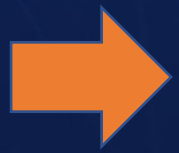


Product Design

- 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

- Process Research ~~and Development~~
- Simulation/Process Analysis
- Product Prototype Build and Test
- Process Development and Test
- ~~Print Reading~~
- ~~Rapid Prototyping~~



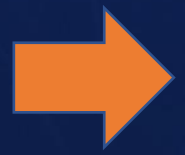
Process Design

- 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

2011

Equipment/ Tool Design

- Cutting Tool Design
- Work Holding Tool Design
- Die/Mold Designs
- Gage Design
- Machine Design



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

Systems Thinking - Product Design - Manufacturing Processes - Production System Design - Measurement of Process Variables - Process Improvement

Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Product, Tooling and Assembly Engineering

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Fabrication
Hot and Cold Forming
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Heat Treatment
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Finishing
Bulk and Continuous Flow

Product Design

Market/Sales/Lifecycle Analysis
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Product Liability

Process Design

Process Research and Development
Simulation/Process Analysis
Product Prototype Build and Test
Process Development and Test
Print Reading
Rapid Prototyping

Equipment/Tool Design

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Die/Mold Design
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Facility Planning/Plant Layout
Processes Planning/Development
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Product/Mfg System Design
Process Documentation
Work Instructions
Tool and Equipment Selection
Production System Build & Test
Human Factors,
Ergonomics, Safety
Maintenance Systems
Environmental Protection
Waste Management

Automated Systems and Control

Power Systems (Mech/Elec/Fluid)
Control Systems (Mech/Elec/Fluid)
Packaging Systems
Automated Systems (Hard/Flexible)
CNC/PLC/Computer Control
Computer Systems and Networks
Information Technology
Database Systems (MIS, etc.)
Enterprise Wide System Integration

Quality and Continuous Improvement

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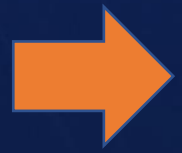
2011

Production System Design

- ~~Infrastructure/Plant Location~~
- Facility Planning/Plant Layout
- ~~Process Planning/Development~~
- Capacity Planning
- Manufacturing System Design
- Process Documentation
- Work Instructions
- ~~Tool and Equipment Selection~~
- Production System Build and Test
- Human Factors
- Safety
- Maintenance Systems
- Environmental protection
- ~~Waste Management~~

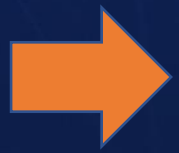


Production System Design

- 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

Automated Systems and Controls

- Power Systems (Mech./Elec./Fluid)
- Control Systems (Mech./Elec./Fluid)
- ~~Packaging Systems~~
- ~~CNC/PLC/Computer Control~~
- Computer Systems and Networks
- ~~Information Technology~~
- ~~Database Systems (MIS. etc.)~~
- ~~Enterprise Wide System Integration~~



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

Systems Thinking - Product Design - Manufacturing Processes - Production System Design - Measurement of Process Variables - Process Improvement

Materials and Manufacturing Processes

Engineering Sciences
Materials
Manufacturing Processes

Product, Tooling and Assembly Engineering

Product Design
Process Design
Equipment/Tool Design

Manufacturing Systems and Operations

Production System Design
Automated Systems and Control

Manufacturing Competitiveness

Quality
Continuous Improvement
Manufacturing Management

Foundation

Mathematics and Science

Physics, Chemistry, Bio-Science
Algebra, Trigonometry, Analytic Geometry,
Calculus, Probability, Statistics

Personal Effectiveness

Interpersonal Skills, Negotiating, Conflict Management,
Innovation, Creativity, Written and Oral Communication,
Presentation Skills, Lifelong Learning, Knowledge

Engineering Sciences

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

Materials

Metals
Plastics/Polymers
Composites
Ceramics
Fluids
Glasses
Nanotechnology
Foams
Hybrids
Natural Materials

Manufacturing Processes

Material Removal
Fabrication
Hot and Cold Forming
Casting and Molding
Electrical/Electronics Manufacturing
Heat Treatment
Joining, Welding and Assembly
Finishing
Bulk and Continuous Flow

Product Design

Market/Sales/Lifecycle Analysis
Intellectual Property Protection
Design Management
Thermodynamics/Heat Transfer
Simulation/Engineering Design
Concurrent Engineering
Design for X (Mfg/Assy/Maint, etc.)
Drawing/Engineering Graphics
CAD/CAM/CAE
Tolerance Analysis/GD&T
Product Liability

Process Design

Process Research and Development
Simulation/Process Analysis
Product Prototype Build and Test
Process Development and Test
Print Reading
Rapid Prototyping

Equipment/Tool Design

Cutting Tool Design
Work Holding Tool Design
Die/Mold Design
Gage Design

Production System Design

Infastructure/Plant Location
Facility Planning/Plant Layout
Processes Planning/Development
Capacity Planning
Product/Mfg System Design
Process Documentation
Work Instructions
Tool and Equipment Selection
Production System Build & Test
Human Factors,
Ergonomics, Safety
Maintenance Systems
Environmental Protection
Waste Management

Automated Systems and Control

Power Systems (Mech/Elec/Fluid)
Control Systems (Mech/Elec/Fluid)
Packaging Systems
Automated Systems (Hard/Flexible)
CNC/PLC/Computer Control
Computer Systems and Networks
Information Technology
Database Systems (MIS, etc.)
Enterprise Wide System Integration

Quality and Continuous Improvement

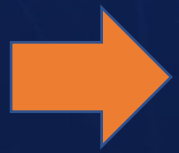
Customer Focus
Quality Systems and Standards
Statistical Control Methods
Problem Analysis & Solving
Factor Analysis
(DOE/Correlation)
Capability Analysis
Inspection/Test/Validation
Metrology
Reliability Analysis
Continuous Improvement/Lean
Customer and Field Service

Manufacturing Management

Strategic Planning
Global Competition
Organizational Design & Management
Project Management
Personnel Management
Human Behavior/Leadership
Labor Relations
Education & Training
Operations Research/Forecasting
Supply Chain & Logistics
Accounting/Finance/Economics
Business/Engineering Ethics
Social Responsibility
Standards, Laws, Regulations

Quality and Continuous Improvement

- Customer focus
- Quality Systems and Standards
- ~~Statistical Control Methods~~
- ~~Problem Analysis & Solving~~
- ~~Factor Analysis (DOE/Correlation)~~
- ~~Capability Analysis~~
- Inspection/Test/Validation
- Metrology
- Reliability Analysis
- Continuous Improvement /Lean
- Customer and Field Service

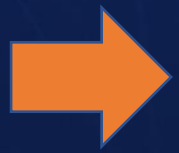


Quality and Continuous Improvement

- 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
- ~~Global Competition~~
- ~~Organizational Design and Management~~
- Project Management
- Personnel Management
- Human Behavior/Leadership
- ~~Labor Relations~~
- ~~Education & Training~~
- Operations Research/Forecasting
- Supply Chain & Logistics
- Accounting/Finance/Economics
- Business/Engineering Ethics
- ~~Social Responsibility~~
- Standards, Laws, Regulations



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)

Manufacturing Four Pillars on sme.org

https://www.sme.org/education/educators/sme-four-pillars-of-manufacturing-knowledge/sme-four-pillars-comment-form/

Thank you

Questions?

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