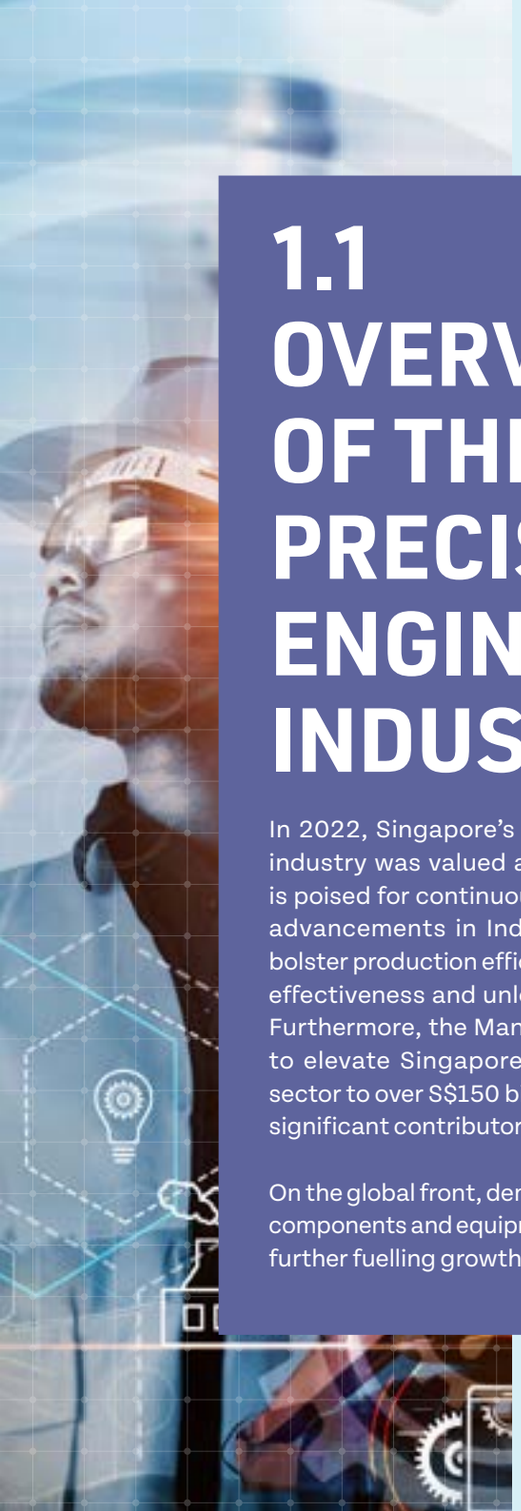
Advanced Manufacturing Training Academy
先进制造技能策略及规划中心

SKILLSFuture SG

# WORKFORCE UPSKILLING PLAYBOOK FOR THE MACHINING AND MOLDING INDUSTRY SECTORS 2024

# GLOBAL TRENDS IMPACTING THE PRECISION ENGINEERING INDUSTRY



# 1.1 OVERVIEW OF THE PRECISION ENGINEERING INDUSTRY

In 2022, Singapore's precision engineering (PE) industry was valued at SG 55 billion. The sector is poised for continuous growth, propelled by the advancements in Industry 4.0 technologies to bolster production efficiency, foster organisational effectiveness and unlock new business avenues. Furthermore, the Manufacturing 2030 plan aims to elevate Singapore's broader manufacturing sector to over S$150 billion, with the PE sector as a significant contributor.

On the global front, demand for advanced precision components and equipment also continues to surge, further fuelling growth in the PE sector.

## Global Trends Impacting the Precision Engineering Industry

### Increasing Adoption of Industry 4.0 (I4.0) Technologies

- I4.0 technologies are driving a shift from traditional to more value-added and efficient production processes that encompass robotics, the Internet of Things (IoT), big data analytics, and artificial intelligence (AI).
- Real-time data analysis and advanced machining techniques are driving precision engineering to become more innovative and competitive, evolving into a modern industrial landscape marked by digitalisation and interconnectedness.

### Sustainable Manufacturing

- Sustainable manufacturing is emerging as a pivotal trend in precision engineering. The sector is adopting green manufacturing practices and sustainable precision manufacturing techniques to meet rising regulatory and societal sustainability demands. These eco-friendly initiatives also offer economic benefits by optimising resource efficiency and reducing costs.

### Mass Production and Customisation

- Utilising modularisation and additive manufacturing technologies, the sector can produce unique, customer-specific products at scale without compromising on production efficiency.
- This integration of mass production and customisation enhances customer satisfaction, creates new market opportunities, and fosters a more responsive and versatile manufacturing ecosystem.

### Changes in Global Trade Patterns

- Structural changes in the evolving global trade landscape are reshaping international cooperation, business integration, and global value chains. Adapting to these changing trade patterns is crucial for precision engineering entities to sustain growth, enhance global competitiveness, and navigate the complex international market dynamics in a rapidly evolving trade environment.

# 1.2 SINGAPORE'S PE INDUSTRY AND ITS MACHINING AND MOLDING SUB-SECTORS

PE stands as a cornerstone in Singapore's vibrant manufacturing landscape. Predominantly sustained by Small and Medium Enterprises (SMEs), it forms the backbone of several pivotal sectors, including electronics, aerospace, medtech, and marine. PE employs nearly a quarter of Singapore's manufacturing workforce and contributes about 12.5 % of the total manufacturing output.

## Precision Engineering

### 2022 Statistics

**Output:** S$ 55,007 million

**Value added:** S$ 16,774.80 million; 12.5% of total manufacturing value-add

**Employment:** 90,134

## Complementary Sectors

- Additive Manufacturing
- Advanced Materials
- Lasers and Optics
- Robotics
- Sensors

## End User Sectors

- Aerospace
- Automotive
- Electronics
- Medical Technology
- Semiconductors

Approximately 50% of precision engineering companies in Singapore engage in machining and molding operations. They produce a variety of metal, plastic, and rubber parts and components, alongside dies, molds, and tools. These firms are navigating a tide of transformative shifts, confronted by a gamut of challenges such as escalating business costs, fierce regional competition, a shortage of skilled operators, and the looming risk of supply chain disruptions amidst geopolitical unrest. The inherent rigidity of traditional manufacturing processes further complicates the fulfillment of growing customer demands for individual order customization.

Source(s): **Singapore Accreditation Council;** Department of Statistics Singapore; **Institute for Adult Learning Singapore; Ministry of Trade & Industry Singapore**

# 1.3 TRANSFORMATIVE TRENDS IN SINGAPORE'S MACHINING AND MOLDING SUB-SECTORS

## Data-Driven Decision-Making

Companies are leveraging the exponential growth in data collection, analysis, and modelling to make informed and strategic decisions while building a rich repository of manufacturing and operation data.

## Digital Twins

The adoption of digital twins, especially design and simulation models, is becoming a staple in the industry. This technology facilitates a virtual representation of physical systems, paving the way for more precise and efficient processes.

## Integration of IT and OT Technologies

The convergence of Information Technology (IT) and Operational Technology (OT) is expanding the horizons of traditional IT departments, a transition facilitated by the advent of cloud and edge computing technologies.

## Robotics and Automation

The sector is leaning heavily on robotics and industry automation to manage repetitive tasks, thereby freeing human resources to focus on higher-value activities and enhancing efficiency on the shop floor.

## Sustainability

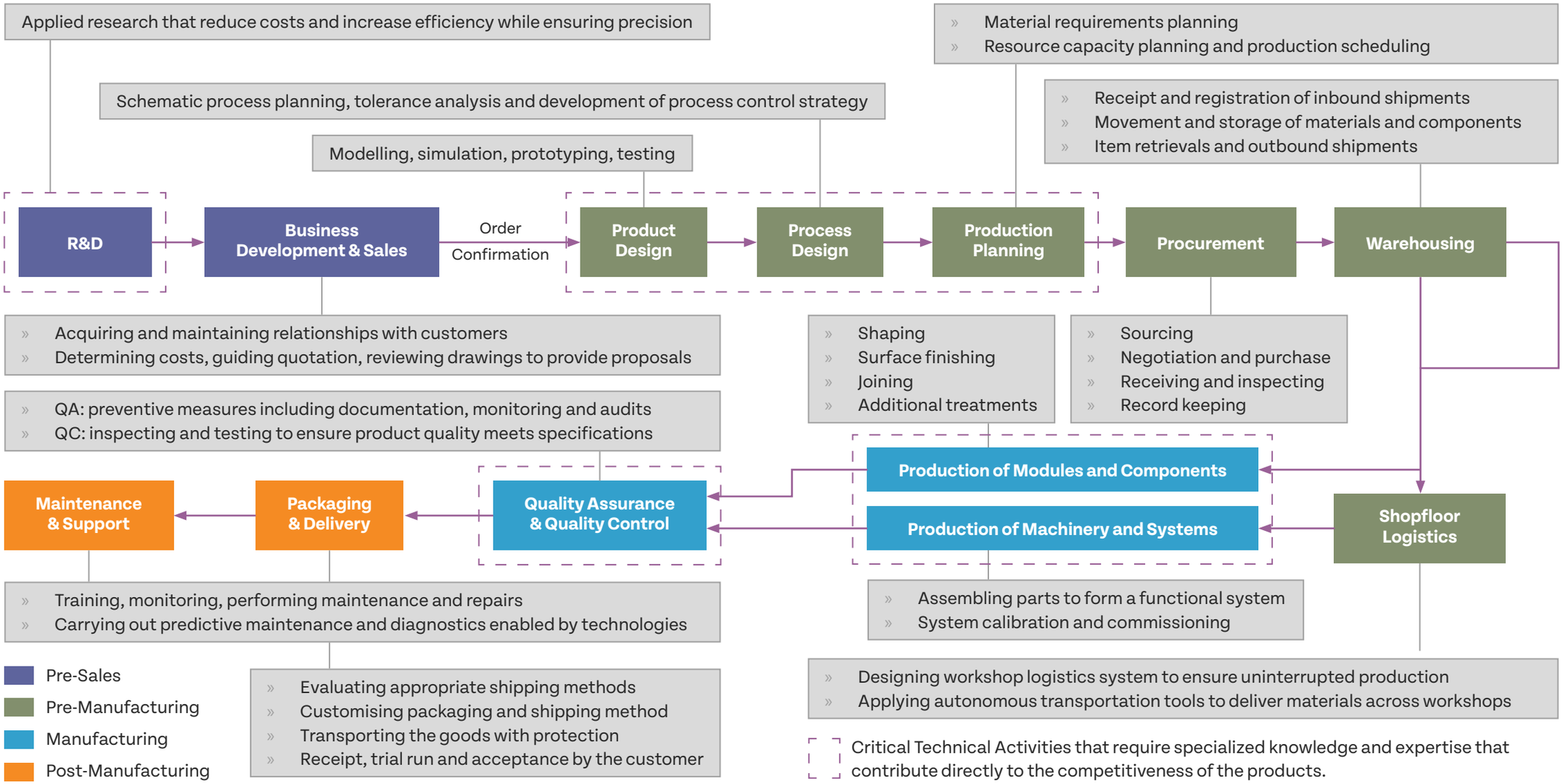
With a renewed focus on sustainability, companies are ramping up efforts to minimize energy consumption and reduce the carbon footprint in tooling and production operations.

## Transition of Equipment Operators

A significant shift is underway in the industry with a gradual phasing out of traditional roles of operators. The automation of current job scopes is not just a change but a necessity, ushering in opportunities for operators to transition into new specialized positions in automation and IoT monitoring and maintenance.

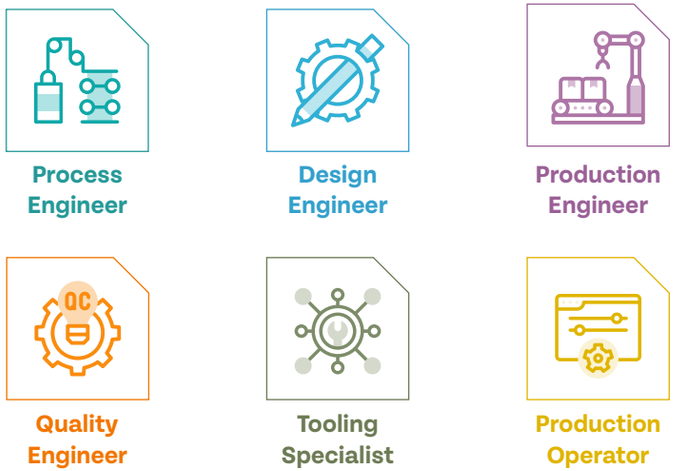
# 1.4 VALUE CHAIN AND BUSINESS LINE ACTIVITIES WITHIN THE PE INDUSTRY

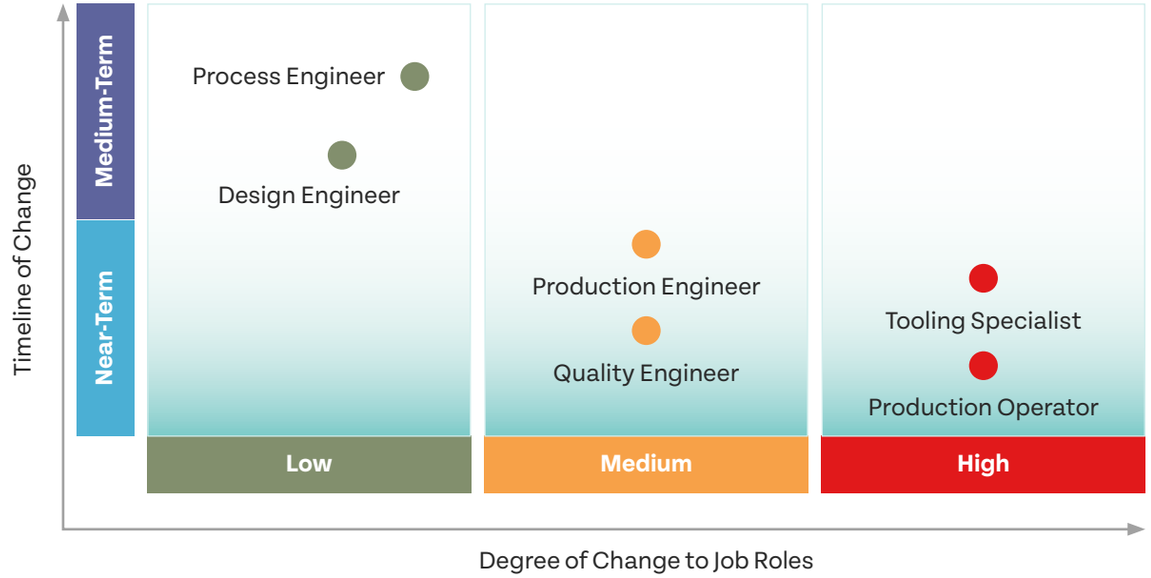
The industry generally adopts a made-to-order business model, with high-value add activities found in the R&D, design, and testing phases.



# 1.5 TRANSFORMATION OF CRITICAL ROLES IN MACHINING AND MOLDING SUB-SECTORS

As machining and molding companies navigate these emerging trends, the need for job role transformation becomes starkly apparent. Six roles critical to the competitiveness of product and business activities across the value chains have been identified for significant transformation. These roles are facing different urgency and degrees of transformation in terms of key tasks and skills required, as summarised below.



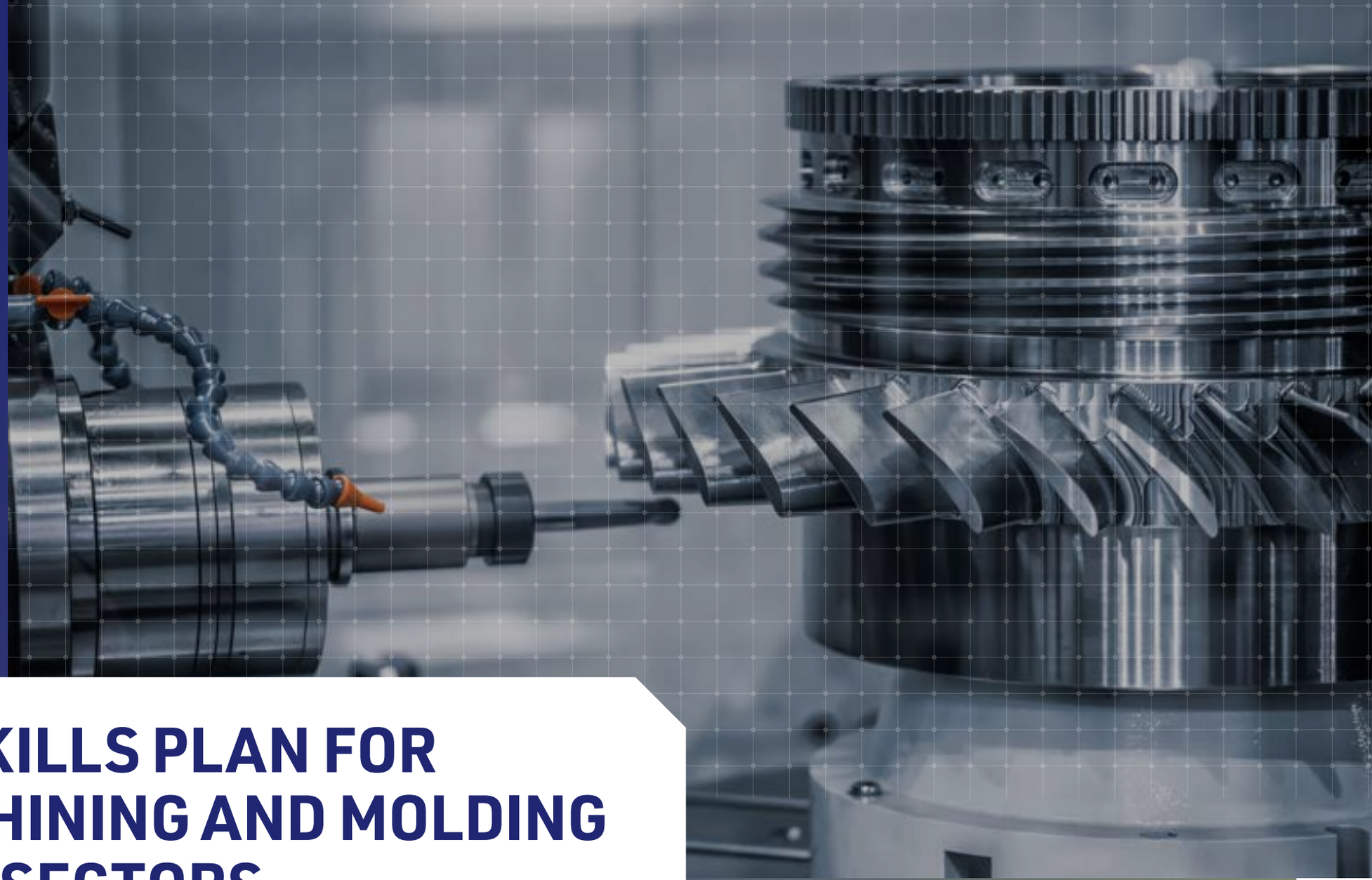




**New considerations, knowledge, and regulations are required to perform the duties.** For example, carbon tax, energy consumption, ESG regulations.

**New tools, technology, and skills are available to enhance the effectiveness and efficiency of the role.** For example, simulation and digital twin for product design and process improvement.

**Shift in the focus of the role as automation and AI take over repetitive and low-value-added activities.** For example, with the adoption of automated metrology equipment and machine vision, the QA/QC engineers will shift focus from performing measurement and characterisation to performing data analytics for failure analysis.

**Disruption of the role as a significant part of the existing job scope becomes deprioritised, necessitating a transformation of the role with extended responsibilities.**

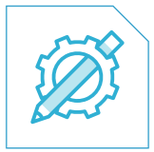


# PE SKILLS PLAN FOR MACHINING AND MOLDING SUB-SECTORS

# Change in Tasks and Job Scopes (Design Engineer)

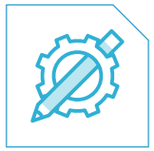
| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
| Design Engineer | **Product/Tooling Design and Development:**<br>» Choose appropriate materials for the mold and components to achieve desired product properties.<br>» Create detailed 2D and 3D models of molds and components.<br>» Design/develop molds and components based on product specifications. | |
| | **Design Optimization:**<br>» Conduct mechanical and kinematic simulations of components for performance optimization.<br>» Conduct mold flow and DfM/A analyses to predict potential issues, such as air traps, weld lines, short shots, and wrappage, and propose design rectification. | **New Tasks:**<br>» Leverage AI to improve mold and component design to achieve optimised product quality and mold cost.<br>» Use digital twin models to simulate the mold and component performance for different materials and at different process parameters. |
| | **Prototyping:**<br>» Analyze the prototype's performance and make necessary adjustments to the final design.<br>» Create prototype molds and components to test and validate the design. | **New Tasks:**<br>» Adopt digital twin models to reduce physical prototyping activities<br>» Adopt additive manufacturing for rapid prototyping |
| | **Cross-Department Collaboration:**<br>» Work with production teams to ensure the manufacturability of the molds and components.<br>» Work with quality assurance teams to ensure the final products meet quality standards.<br>» Work with sales and procurement teams to estimate project cost and source for materials and components. | |
| | **Safety and Compliance:**<br>» Ensure mold and component designs comply with industry safety standards and regulations. | **New Task:**<br>» Conduct life cycle assessment and carbon footprint analysis to ensure compliance with sustainable manufacturing practices |

# Skills Requirements for Design Engineers

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  **Design Engineer** | **Product/Tooling Design and Development**<br>» Computer-aided Design<br>» Computer-aided Manufacturing<br>» Design for Manufacturing and Assembly<br>» Injection Mould Design*<br>» New Product Introduction<br>» Polymeric/Metallic Material Characterisation<br>» Research and Development<br>• *Including product design and development*<br><br>**Manufacturing Technology and Processes**<br>» Cutting and Machining<br>• *Including knowledge of post-processing*<br>» Geometric Dimensioning and Tolerancing<br>» Plastic Injection Moulding*<br>• *Including knowledge of thermal dynamics and fluid mechanics in moulding operations**<br>» Surface Preparation and Protection<br>• *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Lean Manufacturing<br>» Quality Assurance and Quality Control<br>» Value Analysis<br>» Workplace Safety and Health Practice | » Artificial Intelligence Application<br>» Additive Manufacturing<br>» Carbon Footprint Management<br>» Digital Twin for Simulation and Optimisation<br>» Product Life-cycle Assessment<br>» Sustainable Manufacturing | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» ANSYS<br>» AutoCAD, UG, Solidworks, etc.<br>» MoldFlow, Modex3D |

* For roles associated with tooling and molding companies

# Recommended Training Intervention for Design Engineers

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Design Engineer** | Additive Manufacturing | » High-Speed Additive Manufacturing Processes for Metallic Components (SIMTech/ARTC)<br>» Qualification of Parts Printed by Metal Additive Manufacturing (NTU)<br>» Smart Additive Manufacturing System (SIMTech) |
| | Artificial Intelligence Application | » GoML (Machine Learning) (RP)<br>» Introduction To Artificial Intelligence (SUTD)<br>» Managing and Leading Artificial Intelligence Projects (SIT)<br>» Practical AI In Manufacturing (TP) |
| | Carbon Footprint Management Analysis & Life Cycle Assessment | » Carbon Footprinting through Lifecycle Assessment (SIMTech)<br>» Standards Adoption in Manufacturing Sustainability and Carbon Footprint Measurement (TP) |
| | Digital Twin for Simulation and Optimisation | » Virtual & Augmented Reality in Manufacturing (NTU) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | I4.0 Transformation | » Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Advanced Manufacturing Learning Journey (SP)<br>» Industry 4.0 in Action (RP) |
| | Lean Manufacturing | » Go Lean Transformation (RP)<br>» Implement Lean Manufacturing (SIMTech)<br>» Industry 4.0 meets Lean (Siemens) |
| | Research and Development: Product Design | » Design for Sustainable Products and Services (HP)<br>» Product Design, Innovation and Fabrication (SIMTech) |
| | Sustainable Manufacturing | » Smart Energy Management for Sustainability (SIMTech)<br>» Sustainability Lead (SP)<br>» Sustainability Transformation through Green Compass (SIMTech) |

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# Change in Tasks and Job Scopes (Process Engineer)

| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
|  **Process Engineer** | **Manufacturing Process Development and Optimization:**<br>» Analyze process and production data to identify process improvement opportunities.<br>» Validate the manufacturing processes and ensure they meet production and quality requirements.<br>» Work with the design engineers, equipment engineers and equipment suppliers to develop and optimize injection machining and/or molding processes for efficient production, high-quality products, and reduced cycle times. | **New Tasks:**<br>» Use digital twin and process simulation tools to identify the process parameters for optimal product quality, production efficiency, and cost-effectiveness<br>» Leverage machine learning and data mining to identify process improvement opportunities. |
| | **Materials Selection:**<br>» Validate material behaviours during the machining and molding process and the properties of the final product.<br>» Work with customers and suppliers to identify and select appropriate materials to meet product specifications. | |
| | **Quality Assurance:**<br>» Implement process control measures to ensure product quality consistency.<br>» Conduct failure analysis of rejected products and implement process rectifications.<br>» Work with the quality control team to ensure that the final products meet their specifications and quality standards. | **New Task:**<br>» Leverage AI and data mining to predict equipment failures and process variations to enable predictive process interventions. |
| | **Cost Analysis and Optimization:**<br>» Implement lean manufacturing practices to improve process efficiency.<br>» Reduce production costs through process improvement, materials selection or equipment upgrades. | |
| | **Safety and Compliance:**<br>» Ensure machining and molding processes comply with industry safety standards and regulation. | **New Task:**<br>» Conduct carbon footprint analysis to ensure compliance with sustainable manufacturing practices |

# Skills Requirements for Process Engineers

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  **Process Engineer** | **Manufacturing Technology and Processes**<br>» Cutting and Machining<br>  • *Including knowledge of post-processing*<br>» Geometric Dimensioning and Tolerancing<br>» Manufacturing Process Design<br>» Manufacturing Technology<br>» Plastic Injection Moulding*<br>  • *Including knowledge of thermal dynamics and fluid mechanics in moulding operations**<br>» Surface Preparation and Protection<br>  • *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Failure Analysis<br>» Lean Manufacturing<br>» Manufacturing Process Management<br>  • *Including statistical process control*<br>» Project Management<br>» Quality Process Control<br>» Workplace Safety and Health System Management | » Artificial Intelligence Application<br>» Carbon Footprint Management<br>» Data Analytics and Visualisation<br>» Data Synthesis<br>  • *Including data mining*<br>» Digital Twins<br>» Manufacturing Process Simulation<br>» Predictive Maintenance<br>» Product Life-cycle Assessment<br>» Sustainable Manufacturing | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» Manufacturing process simulation software:<br>  • Fanuc CNC simulation<br>  • Autodesk Smart Manufacturing<br>» MES<br>» MoldFlow, Modex3D |

* For roles associated with tooling and molding companies

# Recommended Training Intervention for Process Engineers

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Process Engineer** | Additive Manufacturing | » High-Speed Additive Manufacturing Processes for Metallic Components (SIMTech/ARTC)<br>» Qualification of Parts Printed by Metal Additive Manufacturing (NTU)<br>» Smart Additive Manufacturing System (SIMTech) |
| | Artificial Intelligence Application | » GoML (Machine Learning) (RP)<br>» Introduction To Artificial Intelligence (SUTD)<br>» Managing and Leading Artificial Intelligence Projects (SIT)<br>» Practical AI In Manufacturing (TP) |
| | Carbon Footprint Management Analysis & Life Cycle Assessment | » Carbon Footprinting through Lifecycle Assessment (SIMTech)<br>» Standards Adoption in Manufacturing Sustainability and Carbon Footprint Measurement (TP) |
| | Data Analytics and Visualisation | » Data Analytics for Industrial Applications (SP)<br>» Data Wrangling and Preparation with Programming (SUTD)<br>» Go Data Visualization (RP)<br>» Visual Analytics Using Power BI (SP) |
| | Data Mining | » Data Mining for Correlation Analysis (SIMTech)<br>» Implement Manufacturing Data Mining Techniques (SIMTech) |
| | Digital Twin and Process Simulation | » Automation Design and Simulation (SIMTech)<br>» Virtual & Augmented Reality in Manufacturing (NTU) |
| | I4.0 Transformation | » Advanced Manufacturing Learning Journey (SP)<br>» Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Industry 4.0 in Action (RP) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | Lean Manufacturing | » Go Lean Transformation (RP)<br>» Implement Lean Manufacturing (SIMTech)<br>» Industry 4.0 meets Lean (Siemens) |
| | Predictive Maintenance | » Data Driven Predictive Maintenance and Optimal Plan (SIMTech)<br>» Introduction to Predictive Analytics for Maintenance (SP) |
| | Sustainable Manufacturing | » Smart Energy Management for Sustainability (SIMTech)<br>» Sustainability Lead (SP)<br>» Sustainability Transformation through Green Compass (SIMTech) |

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# Change in Tasks and Job Scopes (Production Engineer)

| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
|  **Production Engineer** | **Production/Project Planning and Execution:**<br>» Ensure optimal resource allocation, such as manpower, machines and materials, to meet production plans.<br>» Manage multiple projects concurrently through the phases from definition, scoping, delivery and successful completion.<br>» Plan, schedule and execute production runs based on demand forecasts, machine availability, and material supply.<br>» Work with logistics and supply chain team to ensure availability of raw materials . | **New Task:**<br>» Train and implement AI/ML models to optimise production plan and execution. |
| | **Equipment Maintenance and Upgrades:**<br>» Evaluate the need for equipment or technology upgrades for productivity and quality enhancement.<br>» Plan and coordinate maintenance, calibration and troubleshooting of production equipment. | **New Tasks:**<br>» Assess, design and implement shop floor automation technologies to enhance productivity<br>» Develop and implement predictive maintenance models based on real-time production data enabled by IIoT to reduce equipment downtime. |
| | **Quality Assurance:**<br>» Implement quality control measures during production to reduce defects and rejections.<br>» Work with the quality control team to set and ensure the quality standards of the products. | |
| | **Production Cost Management:**<br>» Implement lean manufacturing practices to reduce waste, improve productivity, and cut production costs.<br>» Monitor production costs in terms of labour, machine time, materials, and overheads. | **New Task:**<br>» Design real-time dashboards to capture, monitor and visualise production and cost data. |
| | **Documentation and Reporting:**<br>» Prepare regular reports on production metrics. | **Task Deprioritised Following I4.0 Adoption:**<br>» Regular production reporting to be automated by MES and intelligent process automation. |
| | **Safety and Compliance:**<br>» Ensure production activities comply with industry safety standards and regulations. | **New Task:**<br>» Conduct carbon footprint analysis to ensure compliance with sustainable manufacturing practices |

# Skills Requirements for Production Engineers

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  **Production Engineer** | **Manufacturing Technology and Processes**<br>» Automation Systems Maintenance<br>» Cutting and Machining<br>• *Including knowledge of post-processing*<br>» Geometric Dimensioning and Tolerancing<br>» Manufacturing Technology<br>» Plastic Injection Moulding*<br>» Statistical Analysis<br>» Surface Preparation and Protection<br>• *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Failure Analysis<br>» Lean Manufacturing<br>» Production Planning<br>» Project Management<br>» Quality Process Control<br>» Workplace Safety and Health System Management | » Artificial Intelligence Application<br>» Automated Operation Monitoring<br>» Automation Systems Maintenance<br>» Carbon Footprint Management<br>» Cyber Risk Management<br>• *Including OT Cybersecurity*<br>» Data Analytics and Visualisation<br>» Data Synthesis<br>• *Including data mining*<br>» Embedded Systems Integration<br>» Internet of Things Management<br>» Predictive Maintenance<br>» Robotics and Automation Application<br>» Robotic Process Automation<br>» Sustainable Manufacturing | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» ERP<br>» JMP<br>» MES<br>» PowerBI, Tableau<br>» RPA: PowerAutomate, UiPath |

* For roles associated with tooling and molding companies

# Recommended Training Intervention for Production Engineers

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Production Engineer** | Artificial Intelligence Application | » GoML (Machine Learning) (RP)<br>» Introduction To Artificial Intelligence (SUTD)<br>» Managing and Leading Artificial Intelligence Projects (SIT)<br>» Practical AI In Manufacturing (TP) |
| | Carbon Footprint Management | » Carbon Footprinting through Lifecycle Assessment (SIMTech)<br>» Standards Adoption in Manufacturing Sustainability and Carbon Footprint Measurement (TP) |
| | Data Analytics and Visualisation | » Data Analytics for Industrial Applications (SP)<br>» Data Wrangling and Preparation with Programming (SUTD)<br>» Go Data Visualisation (RP)<br>» Visual Analytics Using Power BI (SP) |
| | Data Mining | » Data Mining for Correlation Analysis (SIMTech)<br>» Implement Manufacturing Data Mining Techniques (SIMTech) |
| | Digital Twin and Process Simulation | » Automation Design and Simulation (SIMTech)<br>» Virtual & Augmented Reality in Manufacturing (NTU) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | I4.0 Transformation | » Advanced Manufacturing Learning Journey (SP)<br>» Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Industry 4.0 in Action (RP) |
| | IIoT and Shopfloor Connectivity | » Connectivity for Visibility and Decision-Making in Smart Factories (SIMTech)<br>» Practical Applications of Condition Monitoring for Industry 4.0 (SP)<br>» Sensing and Digitalization for Advanced Manufacturing (TP) |
| | Industrial Automation | » Implementing Automation Technologies in Smart Factory (SP)<br>» Industrial Automation in Practice (TP)<br>» Understanding Automation Assessment and Adoption Methodologies (SIMTech) |

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# Recommended Training Intervention for Production Engineers (cont'd)

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Production Engineer** | Industrial Robotics | » Application of Industry Robotics Technology (NYP)<br>» Autonomous Robotics in Advanced Manufacturing (TP)<br>» Robot Operating System Industrial (ROS-I) (SIMTech)<br>» The Right Robot for the Right Job (SIT) |
| | Lean Manufacturing | » Go Lean Transformation (RP)<br>» Implement Lean Manufacturing (SIMTech)<br>» Industry 4.0 meets Lean (Siemens) |
| | Cyber Risk Management | » Fundamentals of Operational Technology (OT) Cybersecurity (RP)<br>» Industrial Control Systems (ICS) Cybersecurity (SP)<br>» Industry 4.0 Cybersecurity Management (SIMTech) |
| | Predictive Maintenance | » Data Driven Predictive Maintenance and Optimal Plan (SIMTech)<br>» Introduction to Predictive Analytics for Maintenance (SP) |
| | Robotic Process Automation | » Go Power Automate (RP)<br>» GoRPA - UiPath (RP)<br>» Robotic Process Automation (SP)<br>» Robotic Process Automation for Beginners (TP) |
| | Sustainable Manufacturing | » Smart Energy Management for Sustainability (SIMTech)<br>» Sustainability Lead (SP)<br>» Sustainability Transformation through Green Compass (SIMTech) |

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# Change in Tasks and Job Scopes (Quality Engineer)

| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
|  <br>**Quality Engineer** | **Product Inspection and Testing:**<br>» Determine and establish appropriate quality standards and checks to manage quality assurance.<br>» Manage and operate various measurement and testing tools.<br>» Perform regular inspection and testing of raw materials, work-in-process parts and completed products against quality standards. | **Task Deprioritised Following I4.0 Adoption:**<br>» Manual quality inspection, measurement and testing activities to be automated by automated quality monitoring and real-time quality assessment and feedback systems.<br>**New Task:**<br>» Design, implement and calibrate automated quality inspection and monitoring systems |
| | **Failure and Defect Analysis:**<br>» Analyze rejected products to identify root causes of the failures, defects, and non-conformities.<br>» Work with design, process and production teams to recommend and implement corrective and/or preventive actions. | **New Task:**<br>» Train computer vision and machine learning models to facilitate failure and root cause analysis. |
| | **Documentation and Reporting:**<br>» Document and report inspection and testing results.<br>» Maintain records of quality tests, inspections, and corrective actions for traceability and analysis. | **New Task:**<br>» Use process automation technologies to automate data collection and record keeping and enable real-time reporting. |
| | **Continuous Improvement:**<br>» Analyze product quality data sets using statistical techniques to identify or predict trends or problems.<br>» Develop and implement new methodologies or tools to enhance quality monitoring and analysis.<br>» Develop and implement quality enhancement practices based on feedback from suppliers and customers. | **New Task:**<br>» Build data analytics models using AI and machine learning tools to predict quality issues and recommend preemptive measures. |
| | | **Data Management and Analytics (New Tasks):**<br>» Manage large amounts of test and quality data generated from the automated inspection and measurement systems.<br>» Develop and implement data analytic and visualisation methods to interpret and present quality data to facilitate data-driven decision-making. |

# Skills Requirements for Quality Engineers

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  <br>**Quality Engineer** | **Manufacturing Technology and Processes**<br>» Continuous Process Improvement<br>» Cutting and Machining<br>  • *Including knowledge of post-processing*<br>» Geometric Dimensioning and Tolerancing<br>» Manufacturing Technology<br>» Metrology Management<br>» Non-Destructive Testing<br>» Plastic Injection Moulding*<br>» Precision Measurement<br>» Surface Preparation and Protection<br>  • *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Failure Analysis<br>» Manufacturing Process Management<br>  • *Including statistical process control*<br>» Quality System Management<br>» Including conduct of quality Inspections and testing | » Additive Manufacturing<br>» Artificial Intelligence Application<br>» Cloud Computing<br>» Cyber Risk Management<br>  • *Including OT Cybersecurity*<br>» Data Analytics and Visualisation<br>» Data Analytics System Design<br>» Data Management<br>» Data Synthesis<br>  • *Including data mining*<br>» Robotic Process Automation | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» 8D Problem Solving Process<br>» MES<br>» PowerBI, Tableau<br>» Quality inspection technologies:<br>  • Computer vision<br>  • Intelligent inspection<br>» RPA: PowerAutomate, UiPath |

* For roles associated with tooling and molding companies

# Recommended Training Intervention for Quality Engineers

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Quality Engineer** | Additive Manufacturing | » High-Speed Additive Manufacturing Processes for Metallic Components (SIMTech/ARTC)<br>» Qualification of Parts Printed by Metal Additive Manufacturing (NTU)<br>» Smart Additive Manufacturing System (SIMTech) |
| | Artificial Intelligence Application | » GoML (Machine Learning) (RP)<br>» Introduction To Artificial Intelligence (SUTD)<br>» Practical AI In Manufacturing (TP) |
| | Computer Vision | » Introduction to Machine Vision (NYP) |
| | Cyber Risk Management | » Fundamentals of Operational Technology (OT) Cybersecurity (RP)<br>» Industrial Control Systems (ICS) Cybersecurity (SP)<br>» Industry 4.0 Cybersecurity Management (SIMTech) |
| | Data Analytics and Visualisation | » Data Analytics for Industrial Applications (SP)<br>» Data Wrangling and Preparation with Programming (SUTD)<br>» Go Data Visualisation (RP)<br>» Visual Analytics Using Power BI (SP) |
| | Data Mining | » Data Mining for Correlation Analysis (SIMTech)<br>» Implement Manufacturing Data Mining Techniques (SIMTech) |
| | Failure Analysis | » 8 Disciplines (8D) and Failure Mode Effect Analysis (FMEA) in High Volume Manufacturing (TP) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | I4.0 Transformation | » Advanced Manufacturing Learning Journey (SP)<br>» Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Industry 4.0 in Action (RP) |
| | Intelligent Inspection | » AI Visual Inspection System (TP)<br>» Intelligent Inspection for Digital Manufacturing (SIMTech) |
| | Quality Inspection and Metrology | » Advanced Inspection Methods In Manufacturing (NTU)<br>» Dimensional Measurement and Metrology (SIMTech)<br>» Materials Characterization (SIMTech) |
| | Robotic Process Automation | » Go Power Automate (RP), GoRPA - UiPath (RP)<br>» Robotic Process Automation (SP)<br>» Robotic Process Automation for Beginners (TP) |

* Visit AMTA website at **https://amta.sg/training-courses/** for more details and register your interest in receiving support.

# Change in Tasks and Job Scopes (Tooling Specialist)

| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
|  **Tooling Specialist** | **Equipment Set-Up and Operation:**<br>» Monitor equipment performance during operation to ensure smooth and accurate production.<br>» Perform equipment alignment and calibration prior to the machining process.<br>» Set up, program, and operate precision machining equipment, such as CNC, EDM, wire-cut, turning, milling and grinding machines, to produce or modify molds and components. | **Tasks Deprioritised Following I4.0 Adoption:**<br>» Setting, programming and operating precision machining equipment and equipment alignment and calibration to become automated.<br>» Equipment monitoring to become automated with the implementation of IIoT devices such as sensors and connected instrumentations.<br>**New Task:**<br>» Use MES to identify intervention required on the shopfloor |
| | **Materials Handling:**<br>» Load and unload materials and finished parts from the machinery. | **Task Deprioritised Following I4.0 Adoption:**<br>» Materials handling to be taken over by industrial robots and automated materials handling systems. |
| | **Basic Quality Screening:**<br>» Use basic measuring tools like callipers, micrometres, and gauges to inspect machining accuracy.<br>» Visual check of finished products for machining defects. | **Task Deprioritised Following I4.0 Adoption:**<br>» Visual and dimensional inspection to be performed by machine vision and automated CMM. |
| | **Basic Equipment Maintenance and Troubleshooting:**<br>» Identify and escalate major equipment malfunctions.<br>» Identify and resolve minor machine malfunctions.<br>» Perform routine machining equipment maintenance. | **New Tasks:**<br>» Operate, maintain and improve the performance of the predictive maintenance system<br>» Perform routine automation equipment maintenance |
| | **House Keeping:**<br>» Dispose waste and/or hazardous materials from the machining processes.<br>» Ensure that the machining area is always clean and organized. | |
| | | **Robotics and Automation (New Task):**<br>» Basic programming and operation of robotic and automation applications, such as PLC, MES, SCADA, and robotic manipulators. |

# Skills Requirements for Tooling Specialists

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  **Tooling Specialist** | **Manufacturing Technology and Processes**<br>» Computer-aided Manufacturing<br>» Cutting and Machining<br>  • *Including knowledge of post-processing*<br>» Geometric Dimensioning and Tolerancing<br>» Manufacturing Technology<br>» Precision Measurement<br>» Surface Preparation and Protection<br>  • *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Condition-based Assets Monitoring Management<br>» Equipment Maintenance<br>» Workplace Safety and Health Practice | » Additive Manufacturing<br>» Automated System Design<br>  • *Including PLC programming, sensors, actuators, and safety standards*<br>» Automation System Maintenance<br>» Internet of Things Management<br>  • *Including Industrial communication protocols*<br>» Robotics and Automation Application | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» MES |

# Recommended Training Intervention for Tooling Specialists

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  **Tooling Specialist** | Additive Manufacturing | » High-Speed Additive Manufacturing Processes for Metallic Components (SIMTech/ARTC)<br>» Qualification of Parts Printed by Metal Additive Manufacturing (NTU)<br>» Smart Additive Manufacturing System (SIMTech) |
| | Automated System Design | » Advanced Manufacturing Learning Journey (SP)<br>» Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Industry 4.0 in Action (RP) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | IIoT and Shopfloor Connectivity | » Connectivity for Visibility and Decision-Making in Smart Factories (SIMTech)<br>» Practical Applications of Condition Monitoring for Industry 4.0 (SP)<br>» Sensing and Digitalization for Advanced Manufacturing (TP) |
| | Industrial Automation | » Implementing Automation Technologies in Smart Factory (SP)<br>» Industrial Automation in Practice (TP) |
| | Industrial Robotics | » Application of Industry Robotics Technology (NYP)<br>» Autonomous Robotics in Advanced Manufacturing (TP)<br>» Robot Operating System Industrial (ROS-I) (SIMTech)<br>» The Right Robot for the Right Job (SIT) |
| | PLC Programming | » Controlling Automated System using PLC IEC61131-3 (NP)<br>» Programmable Logic Controller (PLC) Level 1 (Siemens) |
| | Safety with Robotic and Automation Systems | » Functional Safety Machinery in Advanced Manufacturing Certification Programme (TP) |

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# Change in Tasks and Job Scopes (Production Operator)

| Job Role | Key Tasks Today | Changes in Key Tasks in 3-5 years |
|---|---|---|
|  Production Operator | **MachineSet-Up and Operation:**<br>» Monitor machine status, such as raw materials levels, process parameter deviations, and process disruptions, to ensure efficient and smooth operation.<br>» Operate manufacturing equipment (injection molding, die casting, stamping, etc.) according to the production schedule.<br>» Set up and adjust machine parameters according to the product and process requirements, such as temperature, pressure, cycle time, etc. | **Tasks Deprioritised Following I4.0 Adoption:**<br>» Equipment set-up, adjustment and operation to be automated by MES<br>» Real-time equipment status monitoring and operator instructions enabled by IIoT devices and smart manufacturing platforms<br>**New Task:**<br>» Use MES for equipment set-up, operation, and monitoring |
| | **Materials Handling:**<br>» Load the correct raw materials to the machines.<br>» Transport finished parts to designated areas. | **Task Deprioritised Following I4.0 Adoption:**<br>» Materials handling to be automated by industrial robots and AMRs |
| | **Basic Quality Screening:**<br>» Visual check of finished products for defects, such as warping, discoloration, flash, burs, etc. | **Task Deprioritised Following I4.0 Adoption:**<br>» Visual and dimensional inspection to be performed by machine-vision-enabled automated inspection systems |
| | **Basic Equipment Maintenance and Troubleshooting:**<br>» Identify and escalate major equipment malfunctions.<br>» Identify and resolve minor machine malfunctions.<br>» Perform routine machining equipment maintenance. | **New Task:**<br>» Operate, maintain and improve the performance of the predictive maintenance system |
| | **Documentation and Labeling:**<br>» Label products with relevant information.<br>» Maintain logs of production history, such as production quantity and equipment downtime. | **Task Deprioritised Following I4.0 Adoption:**<br>» Production history to be automatically recorded by MES |
| | **House Keeping:**<br>» Dispose waste and/or hazardous materials.<br>» Ensure that the machining area is always clean and organized. | |
| | | **IIoT Management (New Task):**<br>» Maintain and troubleshoot IIoT devices and IIoT network<br>» Configure IIoT dashboards based on evolving operation needs<br>» Ensure compliance with OT cybersecurity protocols and monitor IIoT network for unusual activities |

# Skills Requirements for Production Operators

| Job Role | Core Technical Skills | I4.0-Related and Green-Related Skills | Critical Core Skills/Apps & Tools |
|---|---|---|---|
|  **Production Operator** | **Manufacturing Technology and Processes**<br>» Automation Systems Maintenance<br>» Cutting and Machining<br>• *Including knowledge of post-processing*<br>» Equipment Maintenance<br>» Geometric Dimensioning and Tolerancing<br>» Manufacturing Technology<br>» Plastic Injection Moulding*<br>» Statistical Analysis<br>» Surface Preparation and Protection<br>• *Including surface finishing and treatment*<br><br>**Production Processes and Systems Management**<br>» Emergency Response Management<br>» Failure Analysis<br>» Lean Manufacturing<br>» Workplace Safety and Health Practice | » Automated Operation Monitoring<br>» Automation Process Control<br>• *Including sensors and instrumentation*<br>» Cyber Risk Management<br>• *Including OT Cybersecurity*<br>» Data Analytics and Visualisation<br>» Data Management<br>» Internet of Things Management<br>• *Including IOT system and hardware maintenance*<br>» Predictive Maintenance<br>» Robotic Process Automation<br>» Sustainable Manufacturing | **Critical Core Skills**<br>» Adaptability<br>» Collaboration<br>» Communication<br>» Digital Fluency<br>» Problem Solving<br><br>**Apps and Tools**<br>» ERP<br>» MES<br>» PowerBI, Tableau<br>» RPA: PowerAutomate, UiPath |

* For roles associated with tooling and molding companies

# Recommended Training Intervention for Production Operators

| Job Role | Training Topics | Training Programme/Course* |
|---|---|---|
|  | Cyber Risk Management: OT Cybersecurity | » Fundamentals of Operational Technology (OT) Cybersecurity (RP)<br>» Industrial Control Systems (ICS) Cybersecurity (SP)<br>» Industry 4.0 Cybersecurity Management (SIMTech) |
| | Data Analytics and Visualisation | » Data Analytics for Industrial Applications (SP)<br>» Data Wrangling and Preparation with Programming (SUTD)<br>» Go Data Visualisation (RP)<br>» Visual Analytics Using Power BI (SP) |
| | Geometric Dimensioning and Tolerancing | » Geometric Dimensioning & Tolerancing (NTU)<br>» Geometric Dimensioning & Tolerancing (SIMTech) |
| | I4.0 Transformation | » Advanced Manufacturing Learning Journey (SP)<br>» Advanced Manufacturing Learning Journey and Workshop (TP)<br>» Industry 4.0 in Action (RP) |
| | IIoT and Shopfloor Connectivity | » Connectivity for Visibility and Decision-Making in Smart Factories (SIMTech)<br>» Practical Applications of Condition Monitoring for Industry 4.0 (SP)<br>» Sensing and Digitalization for Advanced Manufacturing (TP)<br>» Smart IoT Basics (NYP) |
| | Lean Manufacturing | » Go Lean Transformation (RP)<br>» Implement Lean Manufacturing (SIMTech)<br>» Industry 4.0 meets Lean (Siemens) |
| | Predictive Maintenance | » Data Driven Predictive Maintenance and Optimal Plan (SIMTech)<br>» Introduction to Predictive Analytics for Maintenance (SP) |
| | Robotic Process Automation | » Go Power Automate (RP)<br>» GoRPA - UiPath (RP)<br>» Robotic Process Automation (SP)<br>» Robotic Process Automation for Beginners (TP) |
| | Sustainable Manufacturing | » Smart Energy Management for Sustainability (SIMTech)<br>» Sustainability Transformation through Green Compass (SIMTech) |

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# TRAINING INTERVENTION APPROACHES

## AMTA's Implementation-Oriented Approaches

AMTA champions an outcome-driven training approach that transforms manufacturing companies' challenges into learning projects, facilitating the discovery and application of technological and skills solutions. The process commences with a thorough understanding of the company's problem statement, which is then translated into prioritized training topics relevant to addressing these issues. Subsequently, contextualized training courses are recommended or developed to enhance the workforce's skill set. Under the guidance of AMTA, industry experts from our training partners will mentor and handhold the trainees in developing and implementing proof of concept projects post-training to validate potential solutions to the companies' challenges.

**Problem Statements** > **Priority Training Topics** > **Training Courses** > **Mentorship and Handholding** > **Proof of Concept**

SMF | Advanced Manufacturing Training Academy 先进制造技能策略及规划中心

AMTA spearheads the initiative to curate and develop tailored training & implementation programs for manufacturing companies in partnership with training providers within the training ecosystem. Visit AMTA website at **https://amta.sg/training-courses/** for more details and register your interest in receiving support.

Nanyang Technological University Singapore | NUS National University of Singapore | SIT Singapore Institute of Technology | SUTD Singapore University of Technology and Design | Ngee Ann Polytechnic | NYP Nanyang The Innovative Polytechnic | Republic Polytechnic

Temasek Polytechnic | Singapore Polytechnic SP | ITE Institute of Technical Education | ARTC Advanced Remanufacturing and Technology Centre | SIMTech Singapore Institute of Manufacturing Technology | ntuc LearningHub

# APPENDIX

# List of Skills and Skill Descriptions

| | |
|---|---|
| **Additive Manufacturing** | Design and apply additive manufacturing workflows to create three-dimensional objects |
| **Artificial Intelligence Application** | Apply algorithmic, statistical and engineering knowledge to integrate artificial intelligence into engineering processes |
| **Automated Operation Monitoring** | Monitor automated equipment and control systems to ensure quality execution of the manufacturing process flow |
| **Automated System Design** | Monitor automated equipment and control systems to ensure quality execution of the manufacturing process flow |
| **Automation Process Control** | Apply automation process control to monitor performance metrics and quality of manufacturing outputs to determine the optimal settings as well as productivity improvement strategies |
| **Automation Systems Maintenance** | Maintain automation systems to meet operation requirements as well as propose strategies for improvement of automation systems' performance |
| **Carbon Footprint Management** | Quantify and reduce the organisational carbon footprint |
| **Cloud Computing** | Implement cloud solutions to enhance business performance and security of IT systems |
| **Computer-aided Design** | Use computer-aided design software and tools to design products, components and machine parts for manufacture |
| **Computer-aided Manufacturing** | Manage computer-aided manufacturing systems and perform computer numerical control part programming to manufacture components and products. |
| **Condition-based Assets Monitoring Management** | Formulate and implement condition-based maintenance procedures to enhance organisation maintenance regimes and operational reliability. |
| **Continuous Process Improvement** | Apply continuous improvement processes to improve products, services or processes seeking incremental improvement over time or breakthrough improvement all at once |
| **Cutting** | Manage and implement material removal processes and activities to manufacture components and products |
| **Cyber Risk Management** | Develop cyber risk assessment and treatment techniques that can effectively pre-empt and identify significant security loopholes and weaknesses, demonstration of the business risks associated with these loopholes and provision of risk treatment and prioritisation strategies to effectively address the cyber-related risks, threats and vulnerabilities identified to ensure appropriate levels of protection, confidentiality, integrity and privacy in alignment with the security framework |
| **Data Visualisation** | Implement contemporary techniques, dynamic visual displays with illustrative and interactive graphics to present patterns, trends, analytical insights from data or new concepts in a strategic manner for the intended audience |
| **Data Analytics System Design** | Integrate the use of data analytics in the production environment for the identification of bottlenecks and system improvements |
| **Data Management** | Implement data management systems to meet organisational requirements |
| **Data Synthesis** | Analyse factory automation and manufacturing data to monitor the manufacturing processes for operations and product or process flow optimisation |
| **Design for Manufacturing and Assembly** | Design products in a way that optimizes their ease of manufacturing and assembly, minimizing costs and maximiing efficiency throughout the production process |
| **Digital Twins** | Create digital representations of physical objects and/or processes in a digital version of its environments simulate real situations and outcomes |
| **Embedded Systems Integration** | Implement control systems to perform pre-defined tasks and also real-time monitoring for the real world |
| **Emergency Response Management** | Manage emergency response plans for the range of contingencies affecting work operations such as fire, explosion, power failure, chemical spillage, leakages, collapses, flooding, falling from height and other types of emergencies |
| **Equipment Maintenance** | Maintain tools and equipment to meet operation requirements as well as propose strategies for tools and equipment performance improvement |
| **Failure Analysis** | Examine the electrical and physical defects evidence to verify the causes of failure as well as identify the failure modes |
| **Geometric Dimensioning and Tolerancing** | Define and verify acceptable engineering tolerances of products' and parts' geometry |
| **Injection Mould Design** | Design moulds for manufacturing of products through plastic injection moulding processes |
| **Internet of Things Management** | Interrelate computing devices, equipment and machines' data in a networked environment to provide specific solutions |
| **Lean Manufacturing** | Apply concepts, tools and techniques of 'lean' manufacturing to improve efficiency in a manufacturing organisation |
| **Machining** | Manage and perform machining activities to manufacture components and products, incorporating computer numerical control and computer-aided manufacturing processes |

# List of Skills and Skill Descriptions (cont'd)

| | |
|---|---|
| **Manufacturing Process Design** | Analyse the design of the product to identify potential manufacturing risks and problems for the reduction of manufacturing costs |
| **Manufacturing Process Management** | Perform process engineering and ensure the stability of the manufacturing process as well as troubleshoot process deviations and propose strategies for process performance improvement |
| **Manufacturing Process Simulation** | Apply computer-based modeling of real production systems and processes, including inventory, assembly, transportation and production functions |
| **Manufacturing Technology** | Optimise manufacturing processes, utilising available and applicable technologies |
| **Metrology Management** | Manage metrology techniques for process performance measurement as well as develop metrology recipes for process optimisation |
| **New Product Introduction** | Support new production by validating build plan to achieve cost-effective production and assembly as well as meeting design specifications |
| **Non-Destructive Testing** | Execute non-destructive tests to ensure structural integrity, insulation resistance, continuity and satisfactory performance of electrical equipment and installations against organisational and regulatory standards and requirements |
| **Plastic injection Moulding** | Design and implement injection moulding systems to manufacture polymer-based products |
| **Polymeric/Metallic Material Characterisation** | Conduct tests and measurement taking to evaluate suitability of materials for uses in manufacturing |
| **Precision Measurement** | Perform precision measurements with relevant techniques and equipment to meet requirements for product conformity |
| **Predictive Maintenance** | Develop and implement predictive maintenance strategies and plans to optimise equipment availability and reliability |
| **Product Life-cycle Assessment** | Conduct assessments of environmental impacts associated with all the stages of products' life cycle |
| **Production Planning** | Establish and implement strategic production planning and scheduling to meet production targets and cycle time indices |
| **Project Management** | Execute projects by managing stakeholder engagement, resources, budgets and resolving problems |
| **Quality Assurance and Quality Control** | Establish key indicators and performance measures as well as monitor and maintain quality of finished products |
| **Quality Process Control** | Implement quality process controls to improve and stabilise production in order to avoid or minimise issues leading to defects |
| **Quality System Management** | Coordinate and direct the organisation's activities to meet customer and regulatory requirements as well as identify opportunities for improvement |
| **Research and Development** | Optimising manufacturing processes, material developments and development of new product lines |
| **Robotics and Automation Application** | Apply and integrate evaluated technologies into organisation operations or processes to achieve desired outcomes and reduce reliance on manual tasks |
| **Robotic Process Automation** | Deploy software robots to automate repetitive, rule-based tasks by mimicking human interactions with digital systems |
| **Statistical Analysis** | Interpret and analyse data using statistical techniques to uncover trends and patterns to locate and define new process improvement opportunities |
| **Surface Preparation and Protection** | Apply appropriate surface preparation and protection techniques, based on surface material, operating conditions and maintenance requirements |
| **Sustainable Manufacturing** | Manage efficient use of energy and other utility resources to promote sustainable manufacturing operations |
| **Value Analysis** | Establish the organisational value stream, enhance value-add and reduce costs |
| **Workplace Safety and Health Practice** | Implement workplace safety and health practices in the manufacturing environment |
| **Workplace Safety and Health System Management** | Ensure systematic process in the managing of Workplace Safety and Health-related activities in the workplace |

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# About Advanced Manufacturing Training Academy

The Advanced Manufacturing Training Academy (AMTA) is a national programme operated by the Singapore Manufacturing Federation (SMF) to provide support to local manufacturing by leading foresight on emerging jobs and skills, charting and coordinating training offerings and facilitating the development of new training programmes to address key skill gaps. AMTA is guided by an advisory board with representatives from government agencies, institutes of higher learning, and industry leaders. For more information, visit https://www.amta.sg/.

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# About SkillsFuture Singapore

SkillsFuture Singapore (SSG) drives and coordinates the implementation of the national SkillsFuture movement, promotes a culture of lifelong learning and strengthens the ecosystem of training and adult education in Singapore. Through a holistic suite of national SkillsFuture initiatives, SSG enables Singaporeans to take charge of their learning journey in their pursuit of skills mastery. SSG also works with key stakeholders to ensure that students and adults have access to high-quality and industry-relevant training that meets the demands of different sectors of the economy for an innovative and productive workforce. For more information, visit https://www.skillsfuture.gov.sg/.

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