Product Quality

Strategies	2030 Goals	2025 Targets	2024 Achievements
Enhance Quality Culture Promote CIT programs to strengthen the internal quality culture	Achieve the annual target for the total number of CIT projects Note 1 NEW	Achieve the completion of 2,530 CIT projects NEW	Completed 3,118 CIT projects NEW -
			Generated more than NT$15 billion in value from improvement projects Note 1 Target: NT$15 billion ✓
	Involve outstanding projects in TCIA	Involve at least six outstanding projects in TCIA	Nine outstanding projects in TCIA Target: Six projects ↑
Encourage major local raw material suppliers to participate in TCIA to strengthen quality culture and competitiveness of the local supply chain Note 2	Encourage major local raw materials suppliers to participate in TCIA, with 60% advancing to finals; among them, wafer manufacturing raw materials suppliers have a 100% participation rate, and advanced packaging raw materials suppliers have 75% Note 2	-	18% of major local raw materials suppliers advanced to the finals of TCIA Target: 20% — Note 3
			71% of wafer manufacturing raw materials suppliers participated in TCIA Target: 100% — Note 3
			80% of advanced packaging raw materials suppliers participated in TCIA Target: 60% ↑
Improve Quality Capability Develop innovative testing methods to enhance product, technology and production quality	Develop a cumulative total of 3,000 innovative testing methods for quality and reliability	Develop 305 innovative testing methods for quality and reliability	Developed 292 innovative testing methods for quality and reliability Target: 290 ↑
Require that major raw material suppliers obtain ISO 9001 certification to ensure the implementation of a well-structured quality management system Note 2	100% of major raw material suppliers obtain ISO 9001 certification NEW	100% of major raw material suppliers obtain ISO 9001 certification NEW	100% of major raw material suppliers obtain ISO 9001 certification NEW -

Applicable to all TSMC fabs around the world | Applicable to TSMC fabs in Taiwan and other specific fabs | Only applicable to TSMC fabs in Taiwan | Applicable to TSMC overseas fabs | ↑ Exceeded | ✓ Achieved | — Missed target

Note 1: To better evaluate the effectiveness of promoting of quality culture, starting in 2024, the focus will shift from "generating benefits from improvement projects" to " achieving the annual target for the total number of CIT projects." The annual target for CIT projects were set at 10% of the total number of indirect labor (IDL) personnel in mass production fabs.

Note 2: To strengthen supply chain stability and reliability, TSMC has refined its supplier assistance strategy, shifting focus from cultural advocacy to capability reinforcement. Starting in 2024, the target of "major raw material suppliers obtaining ISO 9001 certification" replaced the previous objective of "participation in TCIA." Major raw material suppliers are those that meet at least one of the following criteria: 1) accounting for 85% of purchasing expenses; 2) being a single-source supplier; 3) maintaining ongoing quarterly trading orders applied to critical processes.

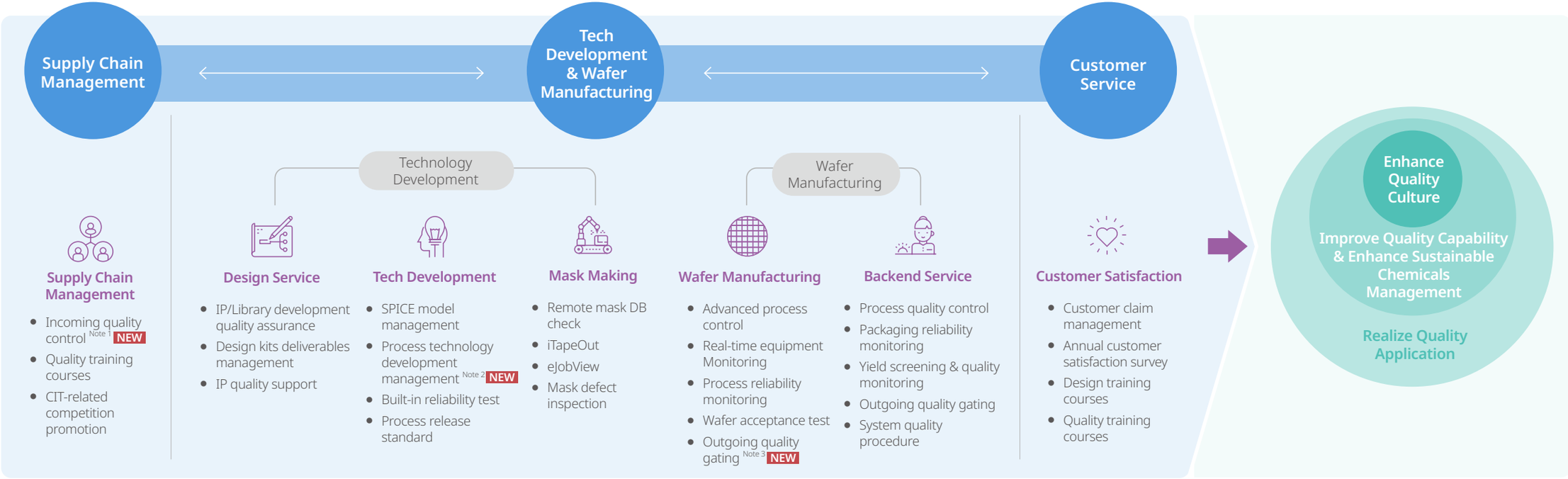
Note 3: Some major local raw material suppliers are unable to participate in TCIA due to insufficient resources.

Strategies	2030 Goals	2025 Targets	2024 Achievements
Enhance Sustainable Chemicals Management Develop hazardous substance analysis capabilities in chemical laboratories to ensure occupational health and safety (OHS) Strengthen management for hazardous substances to improve green manufacturing	Develop the capability to analyze 100% of CMR substances in materials with potential risks, and assist suppliers of such materials in developing the same capability	Develop the capability to identify and analyze 100% of CMR substances in materials with potential risks, and assist suppliers of such materials in developing the same capability	Developed the capability to identify and analyze 100% of CMR substances in materials with potential risks, and assist suppliers of such materials in developing the same capability ✓ Target: 100%
	Replace 100% of NMP used in etching processes (using 2016 as the baseline year)	Achieve 100% replacement of NMP in the Company's etching processes.	100% replacement completed in the etching process in overseas subsidiaries' fabs ✓ Target: 100%
	No processes involving PFASs that contain more than four perfluorinated carbons	Replace 100% of photoresists containing PFHxA-related substances in VisEra	Replaced 64% of photoresists containing PFHxA related substances in VisEra ✓ Target: 64%
Realize Quality Application Complete quality and reliability certification for advanced process technologies, specialty process technologies, and wafer-level packaging technologies in the design and development stage based on the Company's technology roadmap to ensure quality and safety without any concerns	Complete quality and reliability certification for advanced process technologies, specialty process technologies, and wafer-level packaging technologies in the design and development stage based on the Company's technology roadmap	Complete quality and reliability certification for advanced process technologies, specialty process technologies, and wafer-level packaging technologies per the R&D targets	Completed reliability certifications for N3P process technology, CIS 3-wafer stacking technology, and CoWoS® technology featuring larger interposer sizes ✓
	Zero cases of product recalls by customers due to safety concerns	Zero cases of product recalls by customers due to safety concerns	Zero cases of product recalls by customers due to safety concerns ✓

Applicable to all TSMC fabs around the world | Applicable to TSMC fabs in Taiwan and other specific fabs | Only applicable to TSMC fabs in Taiwan | Applicable to TSMC overseas fabs | ↑ Exceeded | ✓ Achieved | — Missed target

TSMC is dedicated to delivering outstanding semiconductor manufacturing services to its global customers. To continuously enhance process control, promptly detect abnormalities, and prevent quality issues that could impact customers, TSMC established a comprehensive quality management system based on four key pillars: supply chain management, technology development, wafer manufacturing, and customer service. To ensure the effectiveness of this system, TSMC established an internal quality audit team, nurtured talent certified as ISO 9001 internal auditors, and conducted annual audits across fabs. In 2024, third-party audits further confirmed the system's compliance with ISO 9001 or IATF 16949 standards. TSMC fosters a strong quality culture throughout the Company, encouraging employees to deepen their understanding of quality responsibilities while continuously advancing their expertise in quality-related practices. Regarding customers, TSMC strengthens relationships through diverse communication channels and integrates advanced tools such as SPC and FMEA to monitor production line performance. These proactive measures help minimize the risk of product defects, ensuring customers receive high-quality solutions. In supply chain management, TSMC extends its quality management practices to partners, leveraging its expertise to guide partners toward continuous improvement and enhance raw material quality. Throughout the year, TSMC collaborated with suppliers to finalize technologies such as Diamond Cutting Wire (DCW) and target purification and reuse. The Company is also pursuing innovative carbon reduction strategies, focusing on improving chemical drum packaging materials and developing chlorine-free chemical mechanical polishing (CMP) pads. These initiatives reflect TSMC's commitment to balancing quality and eco-friendly practices. With a robust quality management system as its foundation, TSMC reported zero product recalls initiated by customers due to safety concerns in 2024.

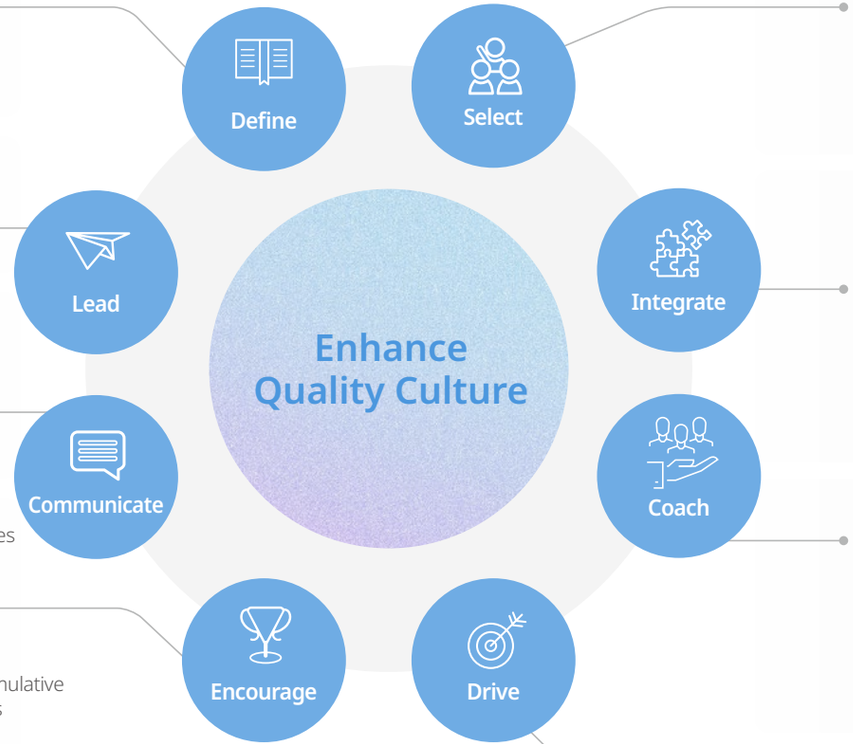
TSMC Quality Management System



Note 1: Reinforce quality control measures for mixed acid raw materials to tackle particulate contamination, stabilize raw material quality, and ensure seamless production line operations
Note 2: Leverage innovative methods to improve data quality in material quality assessments, enabling the R&D team to gain deeper insights into factors affecting process optimization
Note 3: Optimize the outgoing inspection notification system and monitoring mechanisms to place manual operations, reduce error risks, and significantly increase operational effectiveness

Enhance Quality Culture

TSMC integrates eight core principles — "Define, Lead, Communicate, Encourage, Select, Integrate, Coach, and Drive" — into its daily operations, establishing a strong foundation for long-term success and sustainable growth. Through its Suggestion Award program, the Company encourages employees to embrace continuous improvement in their work. It also fosters collaboration by promoting "Continuous Improvement Team (CIT)," empowering employees to tackle complex quality issues through dedicated projects. To further inspire participation in quality initiatives, TSMC holds annual "CIT Competitions" at our fabs, along with the company-wide " Total Quality Excellence and Innovation (TQE) Conference." To deepen its quality culture, TSMC sets an annual target for CIT projects, equivalent to 10% of the total number of IDL personnel in mass production fabs. In 2024, TSMC achieved remarkable results by completing 3,118 CIT projects, exceeding its annual target of 2,385 projects. This achievement reflects employees' relentless efforts to practice quality innovation in their daily work, further enhancing TSMC's competitive edge.



- Develop the Quality Policy to establish three core values
  - Internal/external customer satisfaction
  - Quality is everyone's responsibility
  - Strive for excellence
- ✓ Displayed promotional posters on the online "Quality Academy" platform and offline office spaces to improve employees' understanding

- Host a Quality Forum to encourage employees to engage in quality innovations
- ✓ **1,807** employees participated

- Create the Quality Academy platform to inspire innovative ideas
- Design quality posters to strengthen accurate quality awareness
- ✓ The Quality Academy reached **114,843** views
- ✓ **4,262** employees participated in the quality poster campaign NEW

- Establish a hierarchical structure to promote continuous improvement activities
  - Suggestion Award
  - CIT Competition
  - TQE Conference
  - TCIA
- ✓ Awarded **662** proposals through the Suggestion Award program, with a cumulative total of **8,528** projects rewarded since 2009, totaling **NT$15** million in prizes
- ✓ **18** fabs organized the CIT competition
- ✓ Invited major local raw material suppliers to participate in the TQE Conference for the first time NEW
- ✓ Received **eight** Golden Awards, **one** Silver Awards, and **three** Best Improvement and Innovation Awards

- Launch the CIT Outstanding Engineer program to build a talent pool of improvement experts
- Establish the CIT/DOE judge system to enhance the application of quality tools, statistics, and innovative methods, improving project quality
- ✓ Awarded **104** CIT Outstanding Engineer Awards, with a cumulative total to **1,608** since 2000
- ✓ Trained **128** CIT judges and **22** DOE judges

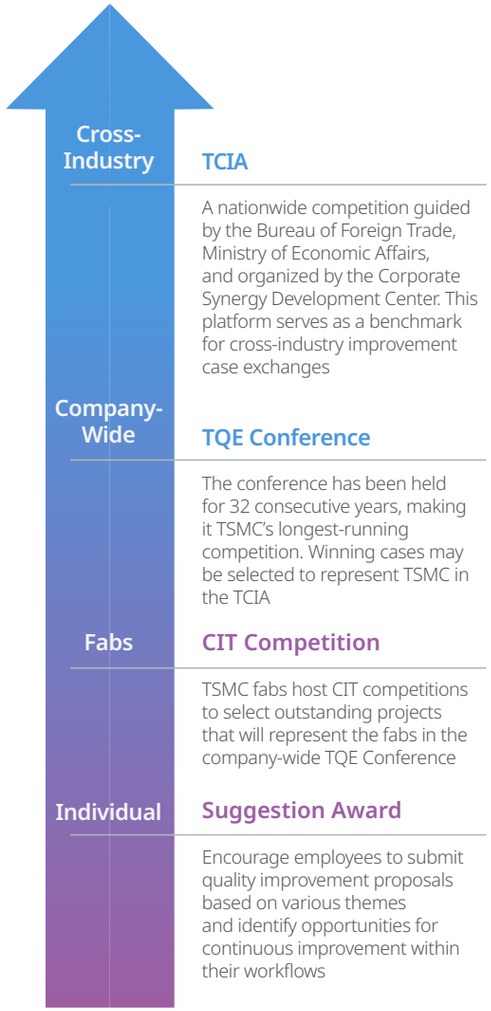
- Incorporate quality culture courses into new employee orientation to raise awareness of quality and corporate core values.
- Introduce multilingual quality courses to strengthen capabilities across international fabs NEW
- ✓ **6,877** employees completed quality culture courses
- ✓ Launched **three** new Japanese quality courses, covering Statistical Process Control, Failure Mode and Effects Analysis, and Lean Manufacturing NEW

- Conduct case studies to guide employees in reflecting and adopting improvement measures.
- CIT/DOE judges assist employees in applying quality tools to solve problems and execute continuous improvement projects.
- ✓ Highlighted **three** quality cases to improve employees' quality awareness and prevent recurrence of mistakes
- ✓ Provided **96** coaching sessions for improving projects

- Advance quality improvement through internal, customer, and third-party audits
- ✓ Quality management system certified annually by a third party

✓ Achievements in 2024

Promotion Structure of Continuous Improvement Activities



2024 TQE Conference-Winning Cases

Quality Improvement
Global Shutter Image Sensor Yield Improvement
- Optimized grinding thickness
- Introduced innovative thin film deposition

38%
Yield improved

Production Capacity Improvement
Equipment Enhancement Leading to Capacity Growth
- Modified thin film chambers
- Developed an AI-driven intelligent tuning system

22%
Capacity increased

Cost and Production Support
Optimization of Automated Material Handling System
- Created an automatic recovery mechanism
- Reinforced stocker safety solutions
- Established a real-time damage inventory platform

34%
Seismic recovery time reduced

Process and Efficiency Improvement
Significant Progress in R&D Asset Management Standards
- Designed independent R&D assets coding
- Built an asset data system
- Implemented automated data updates with physical control measures

$6.36 Billion
Projected annual benefit (NT$)

STOP & FIX
Design Rule Correction and Process Refinement
- Refined design rule syntax and code structure
- Streamlined the deployment process for design rules

$23 Million
Estimated benefit (NT$)

ESH and Green Corporation
Fire Protection Pipeline Operation Safety Management
- Verified risk factors in fire protection pipelines
- Developed systematic safety management procedures

Zero
Accidents in fire protection pipeline operations

Design of Experiment

Cooling Efficiency Advancement

- Identified improvement opportunities through flow and heat transfer simulation
- Optimized cooling nozzle dimensions through DOE

50%
Cooling efficiency improved

Quality Audit

Refined Audit Methods for Overseas Fabs

- Analyzed differences in engineering documentation between domestic and overseas sites
- Proposed improvement recommendations for overseas operations

Improved quality consistency between headquarters and overseas fabs

Talent Cultivation

Development of a TSMC Global Newcomer Training Platform

- Systematically integrated diverse remote teaching techniques
- Upgraded instructor foreign language teaching skills and resources
- Improved the quality of newcomer training courses

18.5%
Global teaching satisfaction increased

Rising Star

Product Yield Increase

- Enhanced equipment structure
- Optimized protective layer thickness

47%
Yield improved

Assistant Engineer and Module Associate Engineer

Equipment Efficiency Boost

- Incorporated heat dissipation technologies
- Modified equipment door panels and optimized exhaust systems

50%
Equipment abnormalities reduced

Outstanding Proposals from Direct Labor

Production Line Feeding Mechanism Refinement

- Established a precise tape-out mechanism
- Repurposed excess and obsolete materials for wafer control use
- Implemented new raw material system control mechanisms

60%
Annual obsolete inventory decreased

Supplier Quality Category NEW

Nano Process Quality Optimization

- Strengthened components in analytical instruments
- Improved the stability of analytical systems

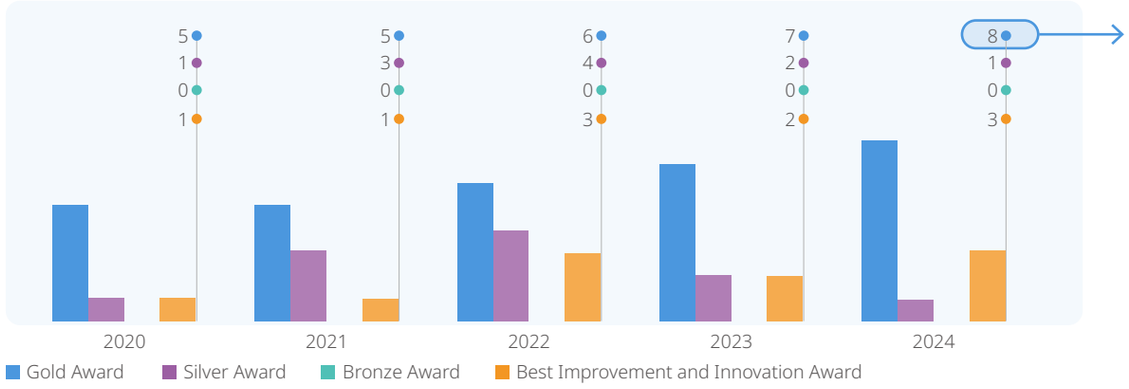
2%
Nitrogen contamination in analytical systems reduced

98%
Overall product yield increased

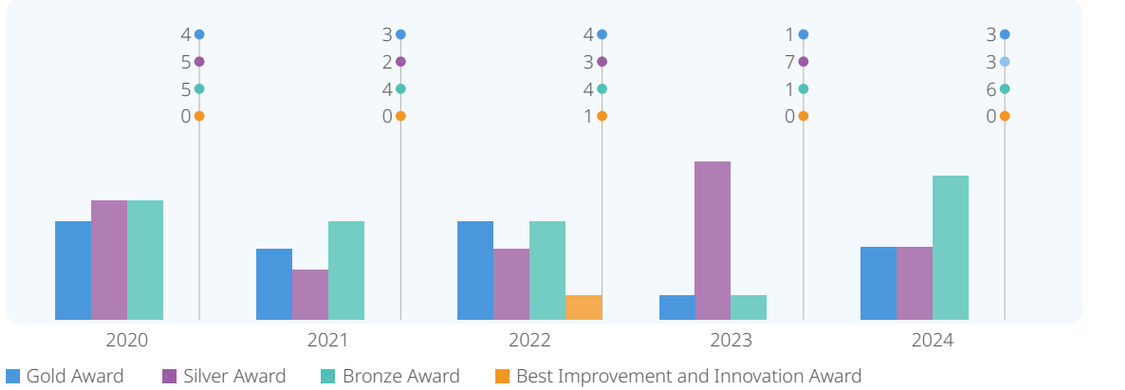
In 2024, TSMC hosts the TQE conference and invites suppliers to participate for the first time, fostering mutual exchange of continuous improvement methods and driving quality innovation.

Beyond its internal quality initiatives, TSMC collaborates with major local raw material suppliers to participate in the TCIA, fostering cross-industry exchanges of improvement techniques and experiences that drive collective progress. In 2024, TSMC achieved a historic milestone, earning eight Gold Awards, one Silver Award, and three Best Improvement and Innovation Awards. Its suppliers also demonstrated excellence, securing three Gold Awards, three Silver Awards, and six Bronze Awards, with the list of recipients publicly available on the TSMC website . Reflecting the spirit of mutual prosperity within the supply chain, TSMC enabled 82% of its major local raw material suppliers to join continuous improvement competitions in 2024. Additionally, the Company introduced a new "Supplier Quality Category" at its internal TQE Conference, actively driving quality innovation across the domestic semiconductor supply network.

TSMC Participation Record in TCIA



Major Local Raw Material Supplier Participation Record in TCIA



2024 TCIA-TSMC Award-Winning Cases

Major Breakthrough in Silicon Photonics Chip Mass Production
(Winner of the Best Improvement and Innovation Award)

430% Process uniformity improved	$900 Million Approximate Silicon photonics chip output valued (NT$)

Significant Quality Advancement in 5G Communication Chips
(Winner of the Best Improvement and Innovation Award)

>79% Yield loss reduced	$130 Million Estimated Improvement benefits (NT$)

Quality Enhancement of Communication Chips in Overseas Fabs

7.3% Yield increased	$130 Million Estimated Improvement benefits (NT$)

Maximization of EUV Photomask and Wafer Throughput
(Winner of the Best Improvement and Innovation Award)

100% Improved Photomask and wafer throughput	$1.21 Billion Improvement benefits totaled approximately (NT$)

Boost in Thin Film Process Capacity

4.9% Capacity expanded	$640 Million Equipment purchase costs reduced approximately (NT$)

Optimization of Advanced Process Manufacturing Cycle

12.2% Production cycle shortened	$180 Million Estimated Improvement benefits (NT$)

Automation of 8-Inch Wafer Logistics

10% People productivity increased	$140 Million Equipment purchase costs reduced approximately (NT$)

Minimization of Personnel Exposure to Chemicals in Operations

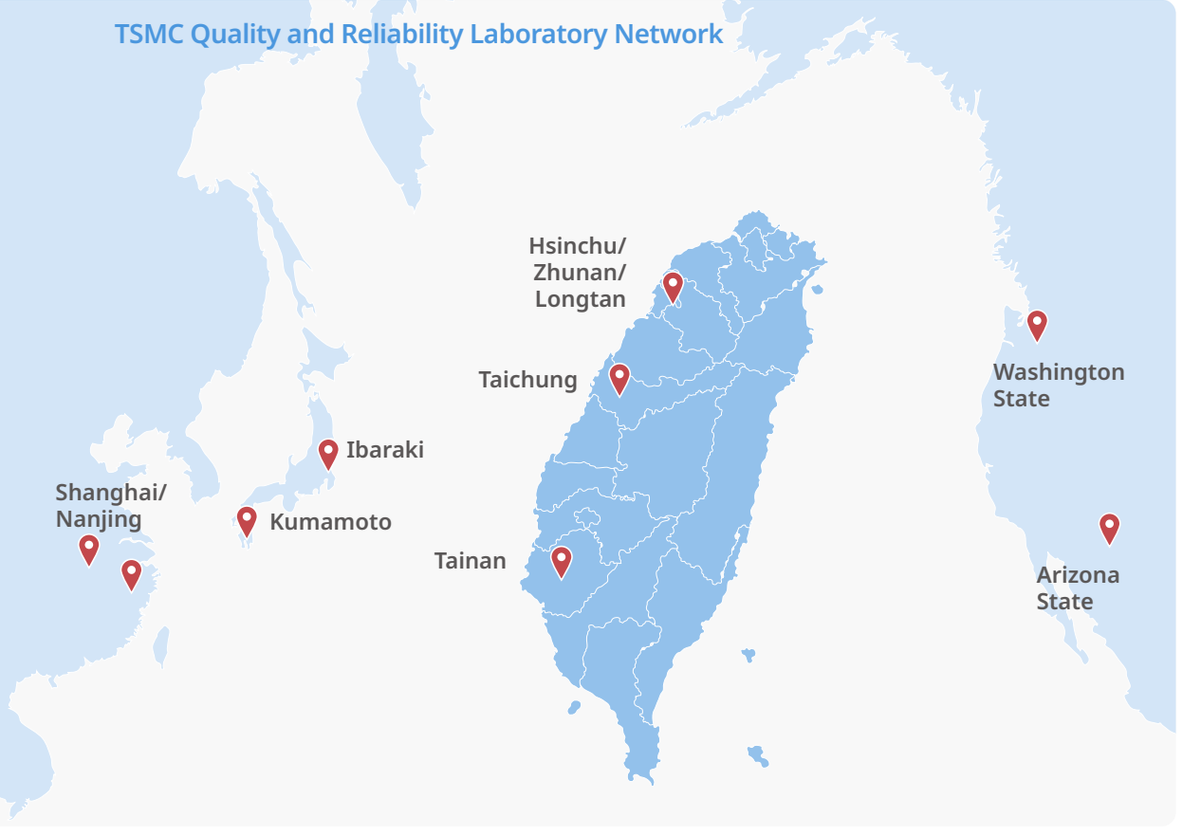
5 chemicals Health risks from five chemicals mitigated	80% Manual labor time reduced

Improve Quality Capability

To reinforce its competitive edge in advanced technology, TSMC continues to invest heavily in the refinement and development of quality-related technologies. In 2024, the Company introduced 292 innovative inspection methods designed to ensure that device characteristics, process yields, and product reliability align with customer expectations. Notably, TSMC unveiled a groundbreaking Time-Dependent Dielectric Breakdown (TDDB) testing, which replaces traditional DC stress with complicate AC stress to more accurately evaluate realistic circuit operation. This approach has been formally verified into JEDEC standards, and as of 2024, the Company has published 10 related articles in international journals, continually leading the industry in advancing testing methods. In addition, in response to the evolution of advanced packaging technologies, TSMC successfully substituted bulk material preparation with thin film deposition techniques for copper — a critical material for advanced packaging interconnects — while optimizing parameters. This innovative approach not only reduces material consumption and shortens preparation time but also generates data that better reflects real-world applications, accelerating reliability analysis and driving product development forward.

In 2024, TSMC not only focused on fostering internal innovation but also continued its collaborations with leading experts from Harvard University and Taiwan National Cheng Kung University to assess the mechanical properties and stress behaviors of advanced semiconductor materials. These partnerships played a pivotal role in accelerating the development of cutting-edge packaging technologies while ensuring production quality and driving technological advancements. Meanwhile, to strengthen the competitiveness of the local supply chain, TSMC conducts rigorous quality inspections on raw materials at key control points across its production lines. Suppliers are required to adopt SPC techniques to process control and the stability of raw material quality. Additionally, all major raw material suppliers must obtain ISO 9001 Quality Management System certification and comply with internationally recognized standards for process change management, evaluations, and quality audits. These initiatives establish a robust foundation for supply chain quality and reliability.

TSMC Quality and Reliability Laboratory Network



Sustainable Strategies from the Quality and Reliability Laboratories

Advanced Materials Analytic Center (AMAC)	– Develop the capability to identify and analyze 100% of CMR substances and improve source management in suppliers – Evaluate and adopt technologies and materials for advanced processes – Provide an analysis and technology exchange platform to strengthen suppliers' analytical capabilities
Chemical Lab	– Accelerate the replacement of hazardous substances and support new fabs in verifying the efficiency of pollution control facility treatmentst – Verify the quality of recycled and reused materials at TSMC to ensure compliance with advanced process requirements, fostering green manufacturing practices. – Validate alternative materials as part of TSMC's efforts to replace high Global Warming Potential (GWP) substances
Surface Analysis (SA) Lab	– Develop low-power consumption and high-capacity processes to improve EUV energy efficiency – Select eco-friendly materials as replacements in processes – Develop equipment consumables, reducing costs and extending lifespan by three times
Reliability Analysis (RA) Lab	– Complete reliability certification for advanced processes, specialty processes, and wafer-level packaging processes – Develop efficient, energy-saving reliability evaluation methods. – Refine reliability testing methods and processes to reduce odors generated during testing, creating a more pleasant working environment NEW
Advanced Failure Analysis (AFA) Lab Process Failure Analysis (PEFA) Lab Packaging & Assembly Failure Analysis (PAFA) Lab Product Failure Analysis (PFA) Lab Scanning Electron Microscopy (SEM) Lab	– Accelerate advanced process development, yield improvement, and product DPPM reduction learning curve (reliability point of view) – Apply for domestic and foreign patents based on innovative inventions – Donate tools to universities and elementary schools, providing training on operation and maintenance to cultivate future tech talent
Transmission Electron Microscopy (TEM) Lab	– Focus on the development of Transmission Electron Microscopy (TEM) measurement techniques, fostering industry-academia collaboration projects – Introduce a quality auto-inspection system based on artificial intelligence and machine learning technologies, enhancing work efficiency through digitalization NEW

Enhance Sustainable Chemical Management

TSMC adheres to its "Environmental Policy " and "Safety and Health Policy ," actively advancing green chemical management initiatives. The Company follows the principle of "avoid if possible, minimize if feasible" regarding the use of hazardous substances. During the R&D phase and prior to changes in chemical use, TSMC implements a rigorous chemical review process . Hazardous substances are strictly prohibited unless they are indispensable to the process and no substitutes are available. If the use of such substances is deemed necessary, the storage, transportation, usage, and disposal processes should comply with both domestic and international regulations, as well as meet the ESH standards established by customers and the Company. The Corporate ESH Division and Fab Industrial Safety and Environment Protection Department, will verify employee safety, proper waste management, and the absence of environmental contamination risks. Only after obtaining approval from Vice President-level executives of relevant department can the use of these substances proceed.

TSMC places the highest priority on the safety of its employees and supply chain partners. To ensure proper oversight of potentially risky materials, the Advanced Materials Analytical Center has implemented a screening mechanism for CMR substances, continuously expanding its scope as processes evolve. In 2024, the number of screening items increased from 178 to 273, with 24 materials screened, achieving 100% analysis of substances flagged as potentially concerning. TSMC also collaborates with VisEra Technologies Co. to share safer alternatives for high-risk chemicals and offer guidance on safety equipment as part of its CMR management initiatives. Meanwhile, TSMC extends its green management practices across the supply chain, requiring suppliers to comply with the "Supplier Sustainability Standards " and establish hazardous substance management protocols. Through education, audits, and guidance, TSMC assists its suppliers in developing the necessary capabilities to detect and manage CMR substances in materials of concern, fostering a safer and more sustainable ecosystem.

TSMC not only implements stringent environmental protection and health and safety measures for hazardous substances in current processes but also actively explores and evaluates the feasibility of replacing them with non-hazardous or low-risk alternatives. One such compound, N-Methyl-2-pyrrolidone (NMP), commonly used in semiconductor etching and cleaning, poses potential environmental and health risks when trace amounts are discharged into wastewater. Since 2016, TSMC has launched an NMP reduction program, systematically eliminating its use at the source, replacing it with lower-hazard chemicals, and conducting regular monitoring of effluent water quality. In 2024, TSMC's overseas fabs successfully achieved the complete elimination of NMP in etching and cleaning processes, meeting the annual target. Currently, only one specific wet etching process awaits research for an alternative, with full replacement of NMP in etching processes expected by 2025.

Another substance that has drawn global attention in recent years is PFASs. These materials are widely used in both consumer and industrial contexts, including semiconductor manufacturing, due to their process and equipment protection benefits. However, PFASs are characterized by their hazardous nature, environmental persistence, and bioaccumulation potential. Many countries have begun regulating these substances, with certain PFASs — particularly those containing more than six carbon-fluorine (C-F) bonds — already classified as prohibited. TSMC aligns with international trends by adopting four major management strategies . Through proactive planning and early action, the Company is committed to reducing environmental impact and contributing to global sustainability efforts.

TSMC obtained IECQ QC 080000 third-party certification for hazardous substance process management in 2006, reinforcing its commitment to green chemical management. The Company continuously improves its practices through the PDCA management cycle model. This approach ensures the effective management of raw materials and products used in processes, aligning with regulatory standards and customer requirements for hazardous substance control in both processes and final products.

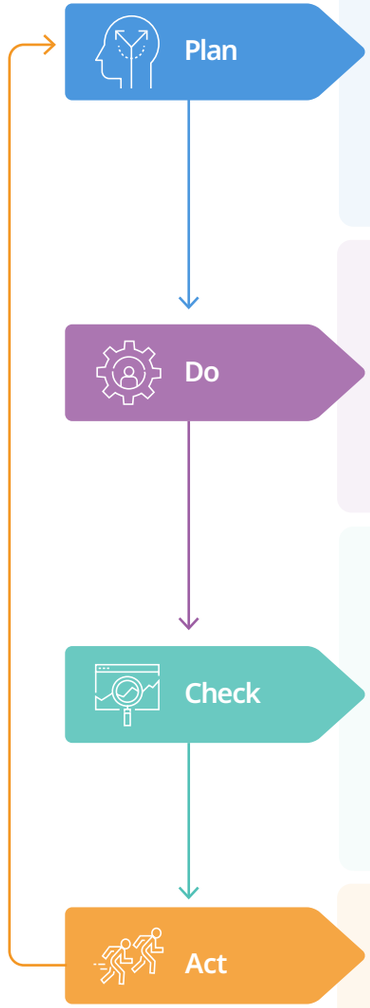
Key Highlights of CMR Substance Management Support

Purpose	Practice	Coach	2024 Achievements
• Establish a robust safety protection network to horizontally expand TSMC's sustainable chemicals management practices to subsidiaries and the supply chain, fostering industry-wide collaboration and shared prosperity	• Subsidiary: Provided TSMC's testing capabilities to support VisEra Technologies Co. in screening high-risk materials • Suppliers: Required suppliers to comply with hazardous substance management regulations outlined in the TSMC Supplier Sustainability Standards	• Subsidiary: Shared measures such as substitutes for high-risk chemicals, protective equipment, and regular workplace environment assessments • Suppliers: Provided education and training programs to strengthen hazardous substance management capacity, while improving management efficiency and quality through audits	✓ Subsidiary: Assisted VisEra Technologies Co. in completing the CMR substance testing for six materials ✓ Continued supporting all suppliers handling materials with potential risks by helping them develop capabilities to detect CMR substances

TSMC's PFASs Management Strategy

Source Control	Evaluate and replace high-risk, long-chain PFASs with lower-hazard, short-chain or non-PFAS alternatives. Use green procurement to review new materials and suppliers early in R&D or process changes. Require suppliers to confirm materials are free of PFASs with more than four fluorinated carbons and disclose PFASs with four or fewer if contains.
Industry Cooperation	Participated in the PFASs response initiatives organized by the World Semiconductor Council and SEMI to collaborate with industry peers and suppliers to research alternative technologies for PFASs applications in semiconductor manufacturing and develop environmental monitoring techniques.
Environment Monitoring	Developed PFASs detection technologies and establish in-house monitoring capabilities to track PFASs discharge levels and identify anomalies in environmental emissions.
Pollution Control	Develop and implement wastewater separation, concentration, and treatment technologies for trace amounts of PFASs. Strive to minimize environmental discharge.

PDCA Cycle for Sustainable Chemical Management



Plan

Tasks

Regulation and Customer Requirements Identification and Registration
Each month, the Corporate ESH Division identifies relevant domestic and international regulations on chemical hazardous substance management, as well as customer requirements. Notifications are sent to relevant units through the internal electronic system, prompting them to implement necessary measures and track improvement progress

List of Banned or Restricted Substances
Compile and update according to regulations, customer requirements, and TSMC's internal policies

Hazardous Substance Replacement Programs
Develop plans and targets based on regulations, customer requirements, and TSMC's internal standards

Actions in 2024

- The EU added **seven** SVHCs to REACH, and customers amended hazardous substances management measures. TSMC achieved **100%** compliance with all new requirements
- Participated in the World Semiconductor Council and SEMI PFASs initiatives, actively discussing countermeasures
- TSMC reviewed its chemical inventory to confirm that none of the newly prohibited Class 1 toxic chemical substances listed by the Taiwan Ministry of Environment Chemicals Administration were in use. This includes PFHxS, its salts, and **147** related compounds NEW

Do

New Material Review
All new chemical materials or changes to existing materials must be reviewed by the Corporate ESH Division and Industrial Safety and Environmental Protection Departments at each fab. Approval is required to confirm compliance with environmental, safety, and health (ESH) regulations before proceeding to R&D evaluation

Implement Hazardous Substance Replacement Programs
Continue executing the NMP replacement program in wet etching processes at overseas fabs. Subsidiary VisEra Technologies Ltd. continues its PFHxA-related material replacement project

- TSMC assessed **299** new chemical substances across domestic and overseas fabs. Of these, **127** received approval, while **102** were rejected due to issues such as suppliers failing to provide required documents, including Safety Data Sheets and TSMC's Green Procurement Questionnaire, or concerns about emissions affecting the efficiency of fab air pollution control systems
- Overseas fabs completed the elimination of NMP in wet etching processes, meeting the annual target NEW
- Subsidiary VisEra Technologies Ltd. progressed in its PFHxA substance replacement program, achieving **64%** of its annual target

Check

Raw Material Hazardous Substance Testing
Suppliers are required to provide hazardous substance specification test reports issued by ISO17025 certified labs. TSMC conducts random sampling to verify raw material compliance

Product Hazardous Substance Testing
TSMC annually selects key products from each facility for analysis by external ISO 17025-certified labs

Environmental Measurement
Developed internal capability to detect PFASs levels in water using the US EPA 533, 537.1 standard testing method. Extended this practice to overseas operations NEW

- TSMC employed X-ray fluorescence spectrometers to enhance hazardous substance detection in raw materials, improving sampling efficiency
- Completed random sampling tests for **103** materials, with all test results meeting TSMC specifications
- All major products across TSMC fabs underwent hazardous substance testing, with results fully compliant with applicable regulations, customer and TSMC requirements, including the **10** substances under the EU RoHS, **247** SVHCs, and **332** PFASs. All substances were found below detection limits NEW
- Regular monitoring effluent water discharge across all fabs to track PFASs levels
- Continued development of PFASs detection technology, enabling the capability to test **30** different PFASs in chemicals, wastewater, and exhaust emissions

Act

Management Review
Quarterly, management from the Quality and Reliability Organization hosts interdepartmental review meetings to evaluate hazardous substance management measures and assess progress toward annual targets

- Achieved annual targets for supplier audits, tracking corrective actions, reviewing new materials, and ensuring compliance in incoming material inspections

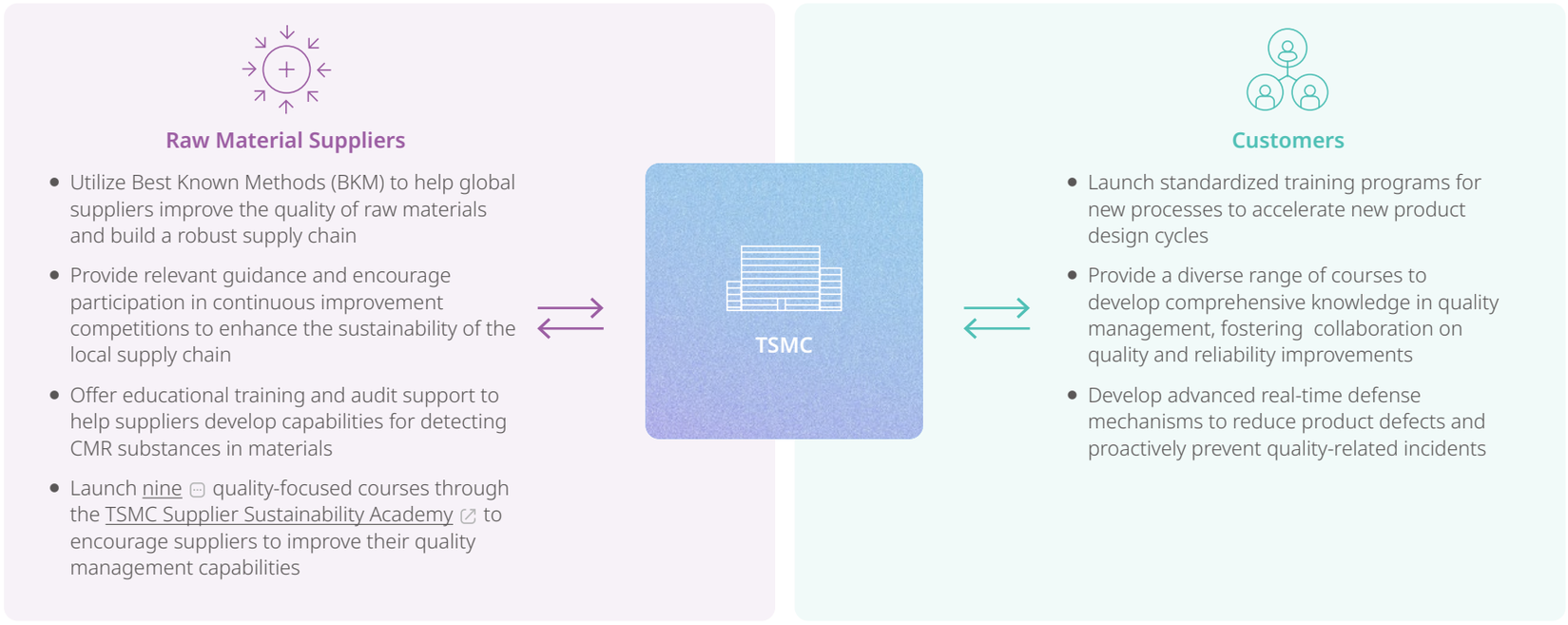
Realize Quality Applications

TSMC actively implements quality values and applications across three core domains: technology, manufacturing, and services. In the realm of technical quality, TSMC assists customers in integrating product reliability requirements into design considerations during the development phase. In 2024, the Company achieved reliability certification for the N3P process technology, CIS three-wafer stacking technology, and CoWoS® technology with larger interposer sizes. For further information, please refer to Section 5.3.6, "Quality and Reliability," in the Annual Report .

In terms of manufacturing quality, the Quality and Reliability organization collaborates with the Operations organization to leverage advanced artificial intelligence techniques alongside statistical methodologies, continuously enhancing quality tools and strengthening real-time defense systems in wafer fabs. The Quality and Reliability organization also partners with wafer fab to reinforce the application of design rules for automotive products, implement stricter process capability standards for fab production lines and electrical testing, and streamline procedures for managing abnormal wafers. To address automotive customers' stringent DPPM requirements, the organization allocates dedicated resources for assessing customer returns and conducting real-time PFA, persistently optimizing process enhancements to further enhance quality and reliability.

In the realm of service quality, TSMC provides standardized training programs for new processes, enabling customers to efficiently adapt to updated design flows. In 2024, the Company successfully assisted 12 new customers in adopting the N2 process technology and completed training sessions for 1,000 participants, accelerating product design cycles and increasing tape-out success rates. TSMC also offered a comprehensive portfolio of quality training courses, including techniques such as high voltage stress testing, burn-in, and screening. These courses aim to enhance anomaly detection, reduce product defect rates, and minimize return risks. In 2024, TSMC supported 21 customers in developing quality-related expertise, ensuring stable production line performance, reinforcing testing partnerships, and deepening customer relationships.

Focus Areas for Quality Value Chain Development



Case Study

Drive a Major Revolution in TEM Imaging Quality Workflow through Digital Transformation

To achieve efficient production and safeguard product quality, TSMC is dedicated to advancing precise measurement technologies that enable the early detection of process deviations and anomalies, facilitating process control refinement. In response to semiconductor miniaturization trends, TEM deliver an angstrom-level imaging, supporting functional validation of new materials and structures through microstructure analysis, dislocation identification, and chemical composition assessment during both R&D and production phases of advanced processes. In 2024, TSMC established the "TEM Imaging Quality Auto-Inspection System" to elevate analysis quality and efficiency. The system integrates AI models to assist in image recognition, empowering operators to monitor image quality using digital tools. As a result, laboratory engineers' review time has been reduced by 90%, significantly accelerating the image processing workflow.

TSMC's global TEM laboratories produce over 500,000 analysis images monthly. Previously, when image requesters received substandard images, they had to submit retake requests via an internal satisfaction system, which required laboratory engineers to review the images and capture new ones — a process that typically took three to six days. With the implementation of the AI and machine learning-powered "TEM Image Quality Auto-Inspection System," image quality factors such as lighting, contrast, brightness, and structural clarity are automatically evaluated and scored within seconds of capture. The system filters out poor-quality images, such as those that are blurry or excessively dark, ensuring that requesters receive high-quality images for analysis. This innovation has expedited R&D efforts and process improvements, significantly boosting efficiency.

This groundbreaking system has been deployed across TSMC's global TEM laboratories. Future enhancements will incorporate additional inspection criteria, including capture location verification, requirement alignment, and historical data comparisons, progressing toward fully automated operations. These improvements will prevent delays caused by poor image quality, offering robust support for process technology innovation and quality assurance.