U.S. Manufacturing
Insights Report 2025

With a focus on quality assurance

CONTENTS

OVERVIEW

ZEISS Industrial Quality Solutions conducted the U.S. Manufacturing Insights Questionnaire as part of its ongoing commitment to gather data on the evolving landscape, trends, and challenges facing the U.S. manufacturing industry in 2025. The U.S. manufacturing sector is navigating a complex environment characterized by technological innovation, supply chain reshaping, workforce skill gaps, and economic uncertainties. Key trends collectively shaping the sector's outlook include the increased adoption of AI and automation, reshoring efforts to build resilient domestic supply chains, rising costs, and workforce challenges.[1]

The questionnaire was distributed from February 10th through April 1st, 2025, garnering responses from more than 1,100 manufacturing professionals across 49 states, representing a broad spectrum of U.S. manufacturing industries and sectors.

Respondents included executives, managers, engineers, operators, and technicians from small, medium, and enterprise companies, ensuring a diverse range of perspectives on the industry's current state and future direction. Additionally, 15% of the participants expressed interest in follow-up interviews, which have been incorporated into this report to provide deeper qualitative insights.

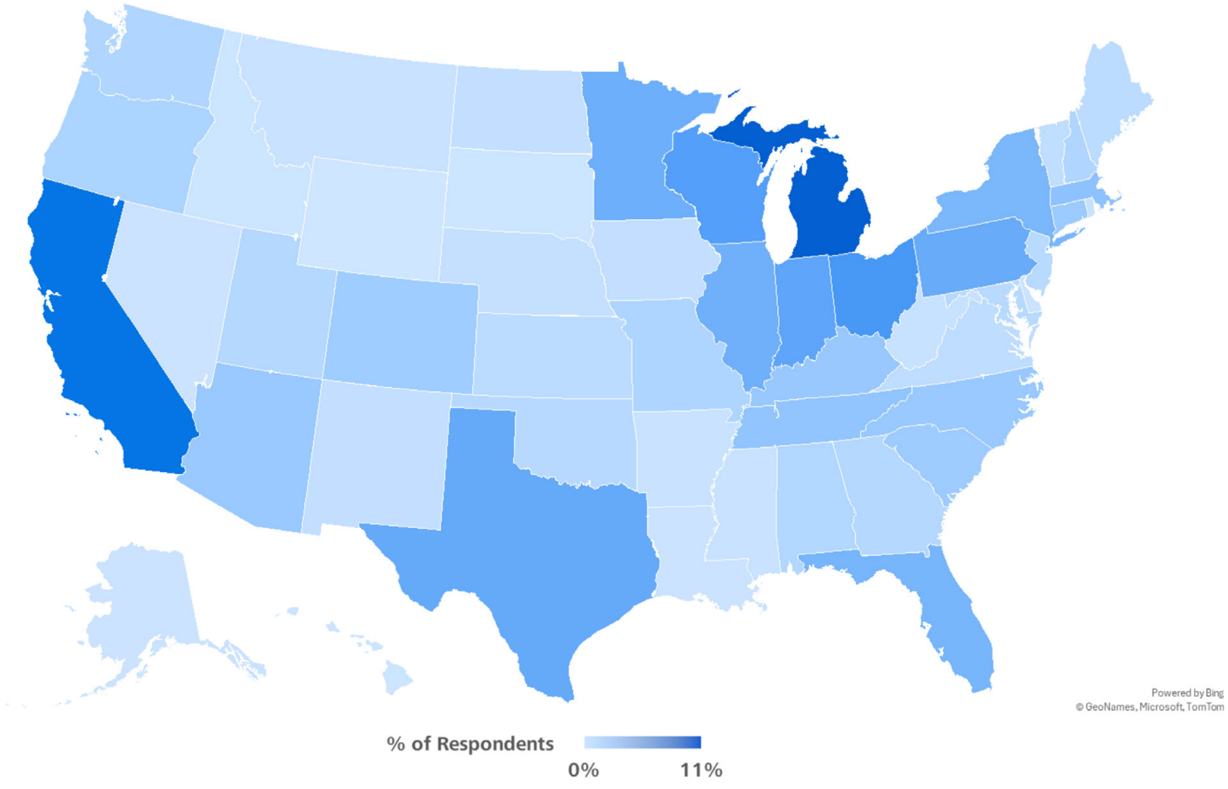
This report presents a detailed breakdown, graphs, and analysis of the findings, contextualized within broader industry trends highlighted in recent research, including Deloitte's Manufacturing Outlook 2025 and NAM's Trends Report 2025.[2] The insights gathered in this report aim to inform stakeholders of the key challenges and emerging opportunities in U.S. manufacturing, supporting strategic planning and informed decision-making for 2025 and beyond. Note that the percentages in the report have been rounded.

To stay informed on the latest trends and updates in U.S. manufacturing, please visit **zeiss.com/metrology**.

U.S. STATES COVERED

The U.S. Manufacturing Insights Questionnaire captured a broad and representative depiction of the U.S. manufacturing sector, with responses collected from professionals across 49 states. The accompanying heatmap illustrates the extensive geographic reach, highlighting especially strong participation from states traditionally recognized as manufacturing hubs, including Michigan, California, Ohio, Wisconsin, Indiana, Texas, Pennsylvania, Minnesota and Illinois. These states are historically known for their high manufacturing output levels and concentration of industrial facilities, aligning them at the forefront of U.S. manufacturing activity.[3]

This wide distribution ensures the findings reflect a diverse array of regional perspectives, encompassing the distinct strengths and challenges faced across different areas and industry segments. The results in this report provide a comprehensive view of both established and emerging manufacturing regions, offering insights into localized trends and nationwide patterns.



Geographic Distribution of Respondents

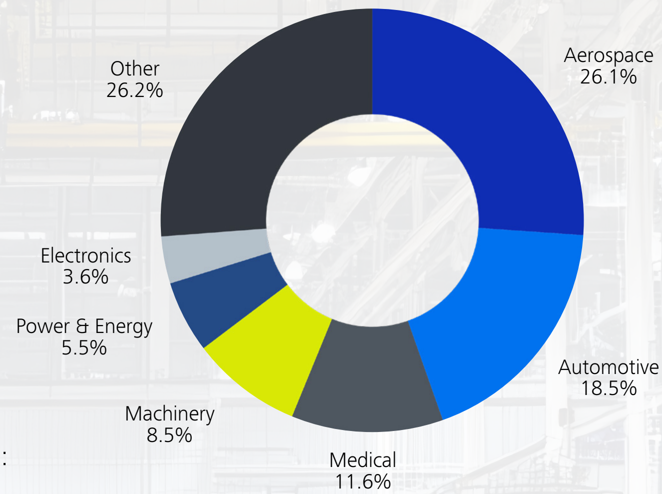
INDUSTRIES COVERED

The U.S. Manufacturing Insights Questionnaire captured a comprehensive cross-section of the U.S. manufacturing sector, with respondents representing a broad spectrum of industries. Respondents were asked to identify their primary industry, which included key industry categories such as Aerospace, Automotive, Electronics, Machinery, Medical, Power and Energy, as well as an open-ended "Other" option.

Notably, the largest segment, **26.2%** of respondents selected the "**Other – please specify**" category, indicating their organizations did not fit into the predefined categories.

Within the "**Other**" category, there was representation from:

- Contract manufacturers serving multiple industries
- Consumer goods manufacturers
- Defense manufacturers
- Machine shops
- Educational institutions



Breakdown of Respondents' Industries

This distribution highlights the diversity and interconnectedness of modern U.S. manufacturing, where many companies operate across traditional industry boundaries and serve multiple markets simultaneously. The presence of contract manufacturers underscores the increasing importance of flexible, multi-industry production capabilities,[4] a trend accelerated by the need for resilient supply chains and rapid adaptation to shifting market demands.[5]

Alignment with National Manufacturing Trends

This broad industry representation mirrors national trends in 2025, where the manufacturing landscape is shaped by:

Cross-Sector Collaboration: Many manufacturers, particularly contract manufacturers and original equipment manufacturers (OEMs), are diversifying their client bases and capabilities to remain competitive amid economic and technological shifts.[6]

Sector Growth: Major investments continue in Aerospace, Automotive, Medical, and Electronics, reflecting ongoing federal incentives and private sector momentum.[7]

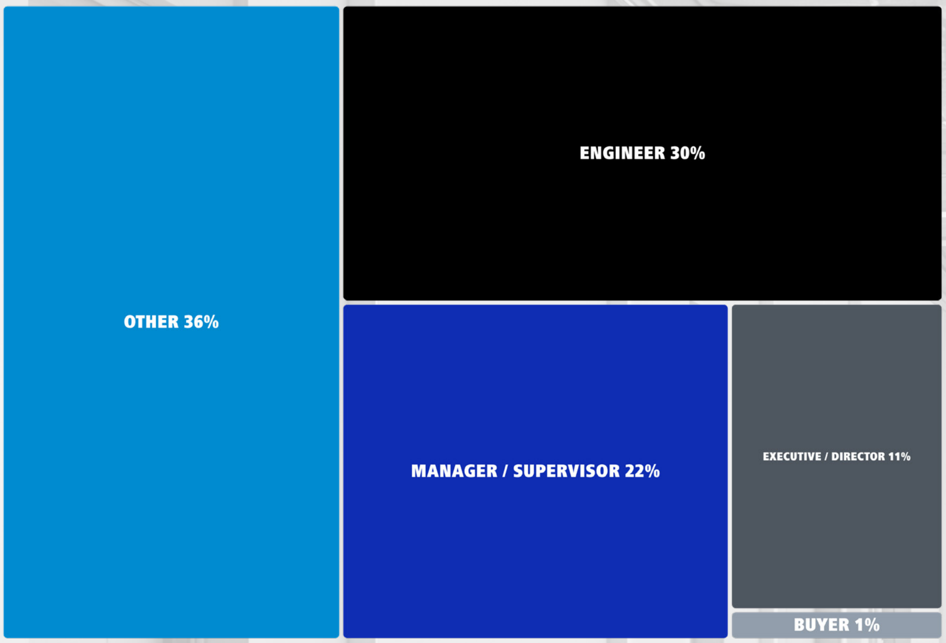
Emergence of Multi-industry Players: The rise in companies serving multiple sectors aligns with the trend toward integrated supply chains and the multiplier effect of new manufacturing facilities, which often support a web of related industries.[8]

The questionnaire's industry coverage, visualized in the accompanying charts, demonstrates a well-rounded and realistic snapshot of the U.S. manufacturing ecosystem in 2025. The strong presence of "Other" respondents, primarily contract manufacturers and machine shops, reflects the sector's ongoing evolution toward flexibility, cross-industry service, and rapid adaptation, all of which are central themes in current industry outlooks.

RESPONDENTS ROLES

The U.S. Manufacturing Insights Questionnaire was designed to capture a wide range of perspectives from across the manufacturing workforce. Respondents were asked to identify their primary role within their organization, with options including Executive/Director, Manager/Supervisor, Engineer, Buyer, and an open-ended "Other" category.

Notably, more than **36%** of respondents selected "**Other**." Upon closer review of these open-ended responses, we found that nearly half of the "Other" respondents identified as **technicians or programmers** – key personnel directly involved in the operation, programming, and maintenance of manufacturing equipment and processes. The remaining "Other" responses were comprised of **presidents, owners, and educators.**



Respondents by Job Role

Significance of Role Diversity

This diversity in job roles is a major strength of the report, ensuring that the findings reflect the full breadth of the manufacturing sector. By including voices from the shop floor (technicians, programmers), middle management, executive leadership, and educational institutions, the report:

Captures Operational Realities: Technicians and programmers provide firsthand insights into day-to-day manufacturing challenges and the adoption of new technologies.

Reflects Strategic Perspectives: Executives, managers and buyers offer a broader view of organizational priorities, investment decisions, and long-term planning.

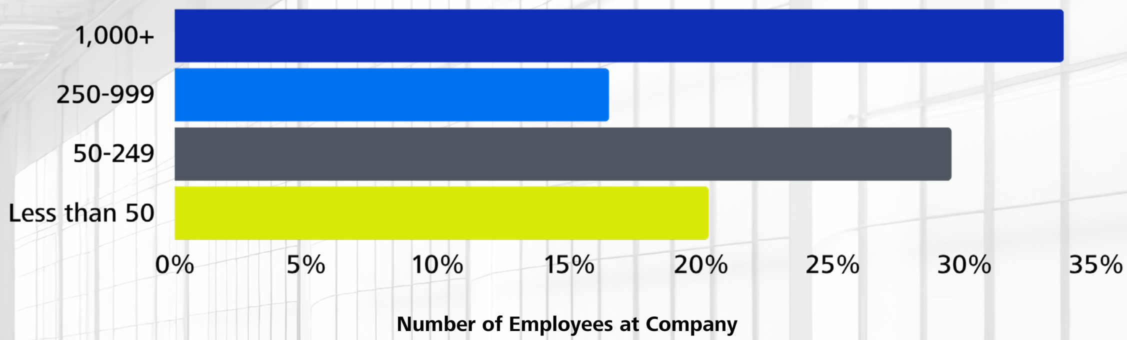
Incorporates Educational Trends: Educators contribute perspectives on workforce development, skills gaps, and training needs-critical issues for the future of the industry.

33%

of respondents were from companies with 1,000 employees or more

COMPANY SIZE

The U.S. Manufacturing Insights Questionnaire captures a diverse range of company sizes within the U.S. manufacturing sector. Respondents were asked to indicate their organization's employee count, resulting in the following distribution:



This distribution demonstrates strong representation from both large enterprises and smaller manufacturers, providing a balanced view of challenges and opportunities across the sector.

Analysis of Diversity

The mix of company sizes ensures that the findings reflect a wide spectrum of operational realities:

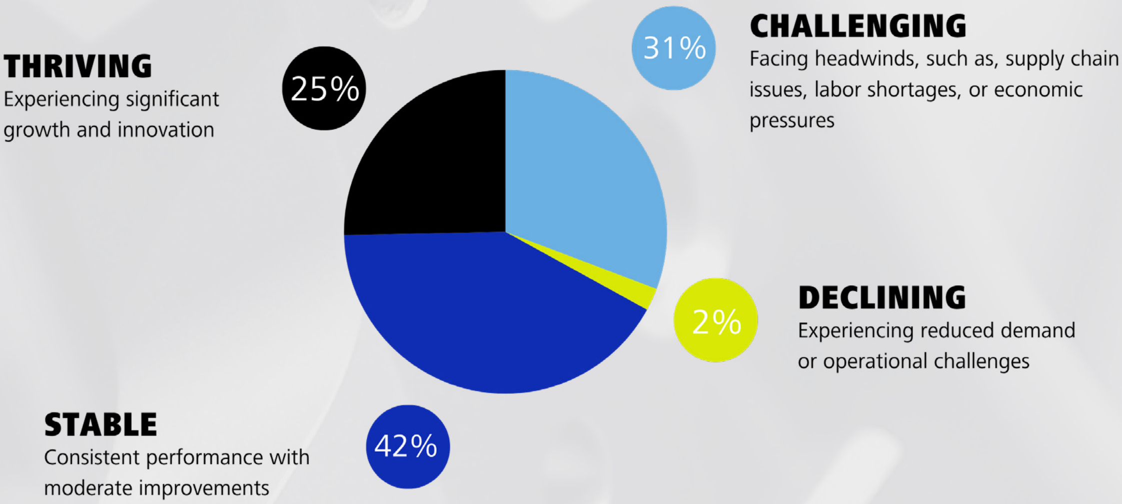
Large manufacturers (1,000+ employees): These organizations often lead in technology adoption, global supply chain management, and capital investment, setting industry benchmarks.

Mid-sized and small manufacturers: Smaller firms are typically more agile, focused on niche markets, and may face different challenges related to workforce, regulatory compliance, and resource constraints.

By including companies of all sizes, the results provide nuanced insights into how trends and challenges impact manufacturers differently, depending on their scale.

CURRENT STATE OF U.S. MANUFACTURING

The U.S. Manufacturing Insights Questionnaire asked: "**How would you describe the current state of manufacturing in your industry?**" Respondents could select from four predefined options: Stable, Challenging, Thriving, and Declining. The results were as follows:



Analysis of Findings

The largest share, **42%** of respondents, view the manufacturing environment as **stable**, suggesting that many companies are experiencing steady operations without significant growth or decline. This result aligns with broader industry data, indicating that, despite facing headwinds, the sector largely maintained its baseline activity in early 2025.[9] [10]

A notable **31%** of respondents characterized the environment as **challenging**. This sentiment reflects ongoing issues, including trade uncertainties, increased raw material costs, and persistent workforce shortages, all of which continue to impact manufacturers across the United States.[11] [12] [13]

These challenges are well-documented in recent industry outlooks referenced throughout this report, which cite factors like high input costs, shifting demand, and supply chain adjustments as ongoing hurdles.[14] Additionally, some respondents report that obtaining tools and materials from suppliers was their primary challenge. Adding to supply chain disruptions, the recent implementation of tariffs has made it more difficult to source the materials required to complete work as quoted, whether the materials are coming from within the U.S. or overseas.

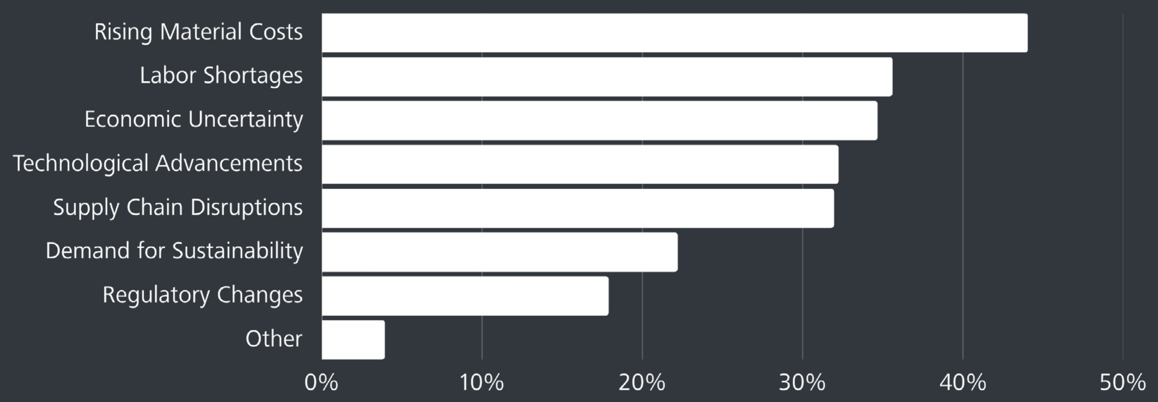
Encouragingly, **25%** of respondents indicated their segment of manufacturing is **thriving**. This optimism is consistent with forecasts for a sector rebound in 2025, driven by renewed capital investment, easing inflation, and technological advancements. Industry analysts project a 4.2% increase in overall manufacturing revenues and a 5.2% rise in capital expenditures this year, signaling renewed confidence and growth potential for many manufacturers.[15] One interview respondent from the space industry felt his sector is thriving due to increased competition driven by the U.S. government's funding and support.

Only **2%** of respondents described the sector as **declining**, underscoring the resilience of U.S. manufacturing despite recent economic pressures. This low figure is notable given the sector's prolonged period of contraction in previous years, suggesting that most companies now see either stability or an opportunity for growth.[16] [17]

Overall, the results reflect a sector in transition-balancing stability and optimism with ongoing challenges.

FACTORS INFLUENCING THE CURRENT STATE OF MANUFACTURING

The U.S.Manufacturing Insights Questionnaire asked respondents to select up to **three factors most influencing the current state of manufacturing in their industry**.



Analysis of Findings

Rising material costs emerged as the most significant concern, cited by **44%** of respondents. This reflects the ongoing impact of tariffs, global supply chain shifts, and inflationary pressures that have driven up the price of raw materials and components for U.S. manufacturers.[18 19] Recent policy changes and new tariffs in 2025 have further intensified these cost pressures, particularly for sectors reliant on imported materials.[20]

Labor shortages remain a critical challenge cited by **36%** of respondents, consistent with national data showing persistent difficulties in attracting and retaining skilled workers, especially as advanced manufacturing technologies become more prevalent.[21] The shortage of skilled labor is forcing manufacturers to invest in training, automation, and new recruitment strategies.[22]

Economic uncertainty is also a top concern, as **35%** of respondents indicated. While the questionnaire did not ask respondents to explain why they identified the business climate as a top concern, the finding aligns with broader industry research that points to shifting trade policies, geopolitical tensions, and fluctuating consumer demand as key factors shaping current uncertainty.[23] Follow-up interviews with respondents revealed that U.S. political and geopolitical events, including elections and regulatory shifts, are influencing manufacturing activity. Some interviewees described customers delaying projects until key election results to assess potential policy changes, contributing to slower business momentum. Political and regulatory uncertainty remain significant factors influencing the economic outlook.[24]

Supply chain disruptions were noted by **32**% of respondents. Ongoing supply chain disruptions compounded by global events, climate change, and logistical bottlenecks continue to challenge manufacturers' ability to source materials and deliver products on time.[25] In response, many companies are investing in supply chain diversification, including strategies such as reshoring and nearshoring.[26] Additionally, the integration of digital supply chain technologies is gaining traction as manufacturers seek real-time visibility and agility in their operations.[27]

Technological advancements were cited by **32**% of respondents, underscoring the important nature of modernizing manufacturing technology. Innovations such as AI and automation are being increasingly integrated to enhance operational efficiency and competitiveness, although their adoption often involves investment in new infrastructure and workforce upskilling.[28 29 30] Advancements in metrology technologies—particularly in 3D measurement—are accelerating digitalization by providing fast, accurate data throughout the product life cycle, supporting design, manufacturing, production, and continuous quality assurance.[31]

Some interviewees noted that CT/X-Ray 3D inspection technology is transforming fields that have traditionally relied on destructive testing methods. The ability to digitize a part and analyze it in advanced software is reshaping quality processes, enabling manufacturers to create 3D models, inspect internal structures non-destructively, and gain significant time and cost savings.

Technological advancements like these are enhancing 3D inspection capabilities across a wide range of manufacturing applications, including aerospace, automotive, electronics, and medical industries. By digitizing components and analyzing them through advanced software, manufacturers can gain deeper insights into engineering processes and leverage reliable data to drive process improvements and ensure product quality.[32] [33]

Factors such as **demand for sustainability** and **regulatory changes** were less frequently selected but remain important for specific sectors, particularly as environmental regulations and consumer expectations evolve.[34] [35]

One interview respondent from the space industry cites regulatory changes as the factor currently most impacting his sector, and says anticipated deregulation resulting from the 2024 U.S. elections is increasing enthusiasm, confidence, and business for space companies.

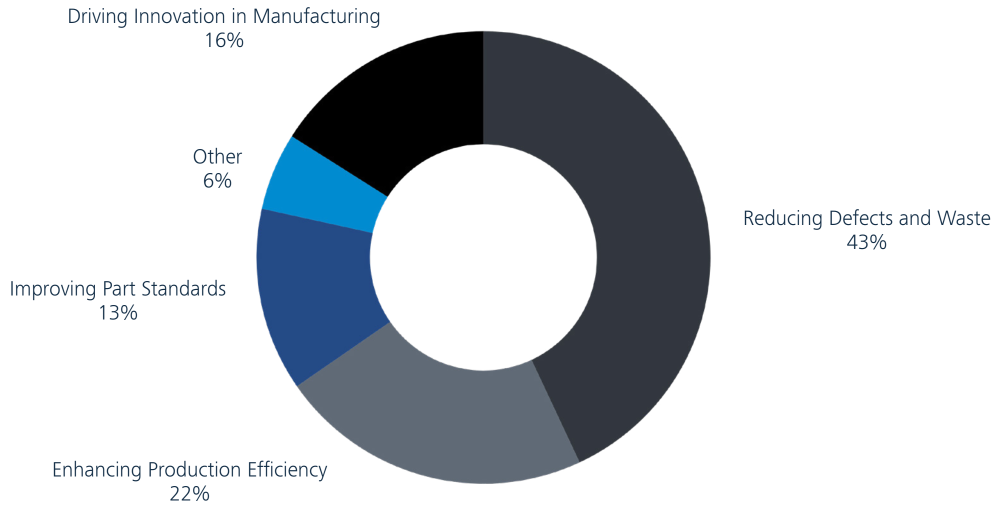
Industry References

These findings align with recent industry outlooks for 2025, which identify rising costs, labor shortages, and economic uncertainty as the most pressing issues facing U.S. manufacturers. The continued emphasis on technology and supply chain resilience reflects a sector in transition, adapting to both immediate challenges and long-term transformation.[36]

Overall, the results confirm that U.S. manufacturers are navigating a complex environment in 2025, with cost pressures, workforce dynamics, and uncertainty shaping the industry’s present and future.

PRIMARY OBJECTIVE OF MANUFACTURERS' QUALITY PROCESSES

The U.S. Manufacturing Insight Questionnaire asked, "**What is the primary objective of your quality processes?**" and respondents selected from the following options, with these results:



Analysis of Findings

Reducing defects and waste was the top priority for **43%** of respondents, underscoring a core focus on minimizing errors, rework, and material loss. This aligns with Lean and Six Sigma principles, which emphasize defect reduction and waste elimination as crucial drivers of cost savings, customer satisfaction, and overall operational excellence.[37] Manufacturers recognize that defects not only increase costs through scrap and rework but can also damage their reputation and erode customer trust.[38]

Enhancing production efficiency was the next most common objective for **23%** of respondents. This reflects the industry's ongoing efforts to streamline workflows, optimize resource use, and maximize throughput. Efficient production processes support profitability and competitiveness, especially as manufacturers face rising costs and labor shortages.[39] Manufacturers rely on industrial quality solutions that allow them to strike a balance between throughput and precision, enabling them to complete inspections quickly while still maintaining quality.[40] As revealed during follow-up interviews, some manufacturers also implement quality processes to prevent wasting time through inaccurate measurements and misreporting. In these instances, process refinement is the main objective.

Driving innovation in manufacturing is closely tied to quality, as noted by **16%** of respondents. For manufacturing **executives and directors, 24% responded that their quality processes were the primary objective for driving innovation in manufacturing**. Quality processes are increasingly viewed not merely as tools for maintaining standards, but as strategic enablers for implementing new technologies, materials, and methods that differentiate products and create new market opportunities.

Improving part standards, although cited less frequently, remains a foundational aspect of quality management. Ensuring that components meet precise specifications is essential for safety, reliability, and regulatory compliance, especially in sectors such as aerospace, medical, and automotive.

Overall, the emphasis on reducing defects and improving efficiency is central to modern quality control processes, which integrate systematic inspections, root cause analysis, and data-driven decision-making to achieve these objectives.[41]

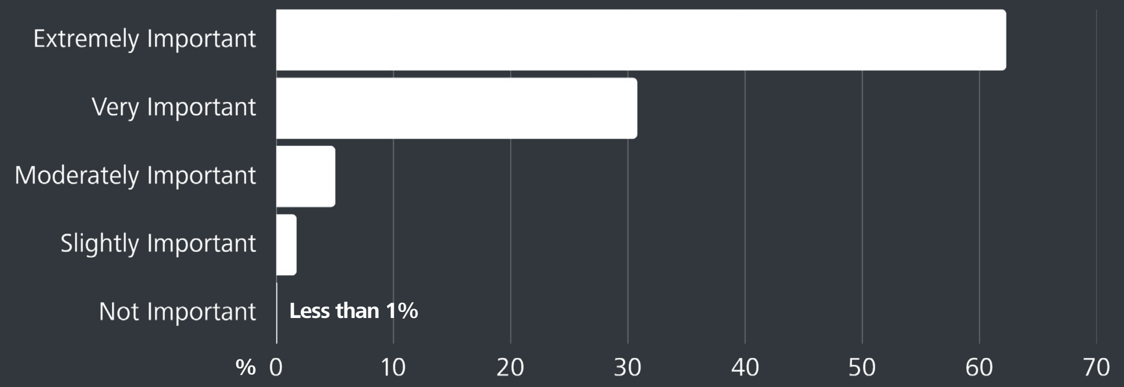
As the next question explores the importance of quality control, these findings set the stage: manufacturers view quality processes as essential not just for compliance but as strategic tools for reducing waste, boosting efficiency, and driving innovation in an increasingly competitive and complex manufacturing landscape.

IMPORTANCE OF QUALITY CONTROL IN MANUFACTURING PROCESSES

The U.S. Manufacturing Insights Questionnaire asked, **“How important is quality control in your manufacturing process?"**

93%

of respondents stated quality control was very or extremely important to their manufacturing processes.



Filtering responses from **executives and directors, 95% stated quality control was very or extremely important to their manufacturing processes**. This consensus highlights that quality control is universally recognized as mission-critical component across the manufacturing sector.

Analysis of Findings

This strong emphasis on quality control is consistent with the findings from the previous question, where reducing defects, minimizing waste, and enhancing efficiency were identified as top objectives of quality processes. Manufacturers understand that robust quality control is essential for:

Ensuring Product Consistency and Reliability: High standards of quality are vital for maintaining customer trust, meeting regulatory requirements, and avoiding costly recalls or rework.

Supporting Operational Efficiency: Effective quality control helps identify problems early, reducing downtime and resource waste.

Driving Continuous Improvement: Quality control processes provide the data and feedback necessary for ongoing process optimization and innovation.

Supporting Industry Data

Recent industry reports corroborate these findings. According to the National Association of Manufacturers, quality control remains a top investment priority, with manufacturers increasingly adopting advanced technologies such as AI-powered inspection systems and real-time data analytics to further enhance their quality control capabilities.[42]

The near-unanimous agreement on the critical importance of quality control underscores its central role in successful manufacturing operations throughout the product life cycle. As manufacturers continue to pursue defect reduction, efficiency, and innovation, robust quality control processes will remain foundational to achieving these goals and maintaining a competitive edge in the evolving U.S. manufacturing landscape.

ALIGNMENT OF QUALITY PROCESSES WITH OVERALL COMPANY GOALS

The U.S. Manufacturing Insights Questionnaire asked, "**How aligned are your quality processes with your company's overall goals**?" and provided a rating scale of **1 (not at all aligned) - 10 (fully aligned)**.

The respondents rated the alignment of their quality processes with overall company goals at an average of **8 out of 10**, indicating a strong perceived connection between quality initiatives and the company's strategic objectives.

Analysis of Findings

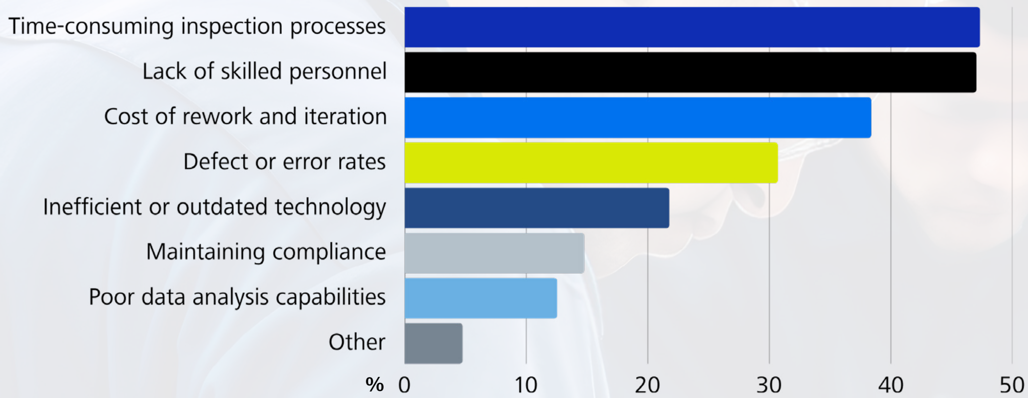
This high score suggests that most manufacturers see their quality processes as well-integrated with their company's mission, vision, and performance targets, supporting both operational excellence and broader business outcomes. Such alignment is widely recognized as best practice, driving continuous improvement, customer satisfaction, and competitive advantage in manufacturing.[43]

However, interviews with questionnaire respondents reveal that a disconnect often exists between quality control teams and upper management, which prevents organizations from achieving a 10 score that perfectly aligns their company's strategy to their quality processes. For instance, some respondents noted that upper management may choose to accept parts that are out of tolerance to avoid the immediate costs of rework, rather than addressing the root cause and investing in process improvements. In these cases, the perceived time and expense associated with implementing changes are seen as outweighing the potential long-term benefits.

Additionally, several manufacturers reported that industrial quality technologies—tools that could significantly raise quality standards—are frequently underutilized, representing a missed opportunity for further improvement.

TOP QUALITY MANAGEMENT CHALLENGES

The U.S. Manufacturing Insight Questionnaire asked, "**What are the biggest challenges your company faces in quality management?**" and to select up to three answers that are most applicable to them.



Analysis of Findings

The two most cited challenges – **lack of skilled personnel** and **time-consuming inspection processes (each at 47%)** – highlight the ongoing workforce and operational hurdles facing U.S. manufacturers. A lack of skilled personnel consistently ranks as a top challenge across industries. Some respondents shared that it is difficult to attract and maintain talent. The skills gap, particularly in advanced manufacturing and quality roles, is a challenge facing the industry.[44] At the same time, manual or inefficient inspection processes slow down production, create bottlenecks, and increase costs, especially as product complexity rises.

Cost of rework and iterations (38%) and **defect or error rates (31%)** further underscore the financial and operational impact of quality issues. These factors are closely linked: higher defect rates often lead to increased rework, resulting in higher direct and indirect costs.[45] As a result, many manufacturers are prioritizing quality management systems, real-time monitoring, and root cause analysis tools to proactively prevent defects and minimize costly iterations.[46]

Inefficient or outdated technology (22%) and **poor data analysis capabilities (13%)** point to the need for digital transformation in quality management, as legacy systems can hinder both efficiency and insight.

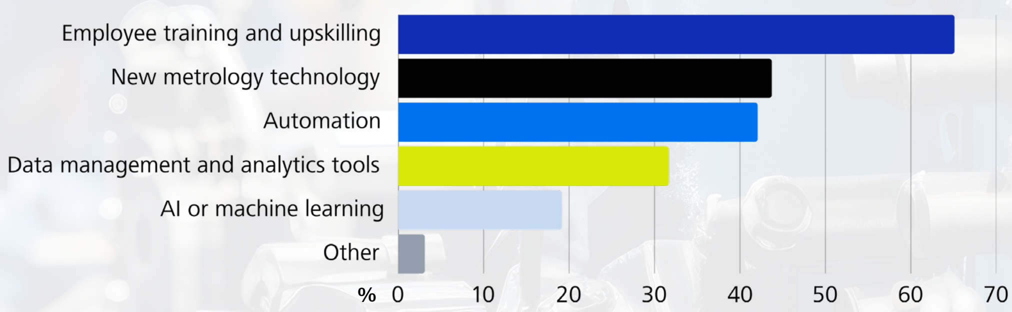
Quality professionals interviewed shared that old methods are more time-consuming, adding more time to their day-to-day, and that by implementing newer technologies, equipment, and tooling, they can move faster and more efficiently without wasting time while also eliminating human error. Technologies that can inspect multiple parts simultaneously and automatically generate a report are described as key to optimizing processes that currently involve multiple measurement tools and manual measurement documentation and reporting.

OPPORTUNITIES FOR OVERCOMING QUALITY CHALLENGES

The follow-up question asked: "**Where do you see the greatest opportunities for investment to overcome your challenges?**" Respondents could select up to three options:

44%

stated new metrology technology was one of the greatest opportunities to overcome challenges they faced



Analysis of Findings

Employee training and upskilling (65%) emerged as the leading opportunity, directly addressing the top challenge of skilled personnel shortages. This result aligns with industry research showing that workforce development is critical to closing the skills gap and adapting to new technologies.[47]

Investments in new metrology technology (44%) and **automation (42%)** are seen as key to streamlining inspection processes, reducing human error, and improving throughput. These technologies enable faster, more accurate quality checks and can help offset labor shortages. Some interviewees described the advantage of automatic part loading and unloading as increasing efficiency and decreasing the reliance on manpower. Companies are also expressing high interest in implementing robotics and AI to keep machines running overnight and drive efficiency, according to live interviews with respondents. They also noted that previously, one of the barriers to working with automation was the need to have someone on staff who specializes in robotic programming, but as automation becomes easier to program, the technology is moving within reach. In alignment with these improvements, investments in automation are increasing.[48]

Data management and analytics tools (32%) and **AI/ML (19%)** reflect the growing recognition that actionable data is essential for predictive quality management and continuous improvement. Advanced analytics and AI can help identify the root causes of defects, optimize processes, and enable real-time decision-making.[49]

During interviews, respondents described a high interest in integrating AI/ML to make inspection easier, maintain the health of their machines, and improve overall efficiency. Respondents also envisioned augmenting their work by uploading documents into an AI-system, filtering, and setting up parameters based on their specifications. Manufacturers also see opportunities for AI-powered image analysis and to replace old methods that lack analysis assistance capabilities. By moving from writing down data on paper to recording it in a data management system automatically, these manufacturers expect to increase speed, accuracy, and efficiency.

Other interviewees envision AI assisting with correlation, automatic adjustments, using ML to recognize specific deviations that humans cannot see with the naked eye, performing temperature calibration, or training AI to recognize and alert the operator when something is going wrong.

One respondent described the need for a data management system that connects data from various plants around the world. Current processes involve uploading reports into a shared drive. Replacing this method with a streamlined system of sharing and connecting data would make it faster and easier to communicate changes and complete work.

Another respondent explained the need for a data management system that compares data being collected in real-time to archived historical data to follow trends and look for key information. This capability would help parse through and analyze high volumes of incoming material.

Manufacturing Challenges and Opportunities
The results reveal a clear link between the challenges manufacturers face and where they see the greatest opportunities for improvement. Addressing workforce shortages through training, modernizing quality control with automation and new metrology technology, and leveraging data analytics are all interconnected strategies for enhancing quality management and thus improving manufacturing.

Implementing quality assurance practices across all stages of manufacturing leads to significant benefits, including cost savings, improved efficiency, and increased customer satisfaction. By proactively identifying and addressing potential issues early in the production process, manufacturers can minimize waste and ensure consistent product quality.[50]

Industry experts consistently recommend a dual focus on **people and technology** to achieve lasting improvements in manufacturing and productivity.[51] The questionnaire findings reinforce this approach, highlighting the need for holistic investment in both human capital and advanced technologies to overcome today's economic challenges and seize future opportunities.

66%

respondents are planning to invest in two or more metrology technologies for their manufacturing processes

METROLOGY TECHNOLOGIES MANUFACTURERS PLAN TO INVEST IN

The U.S. Manufacturing Insight Questionnaire asked, **"Which metrology technologies are you planning to invest in for your manufacturing processes?"** and respondents could select all that apply.

Notably, **over 66% of respondents selected more than one** metrology technology, highlighting a strong demand for a multi-technology approach for quality assurance throughout the product lifecycle in manufacturing.

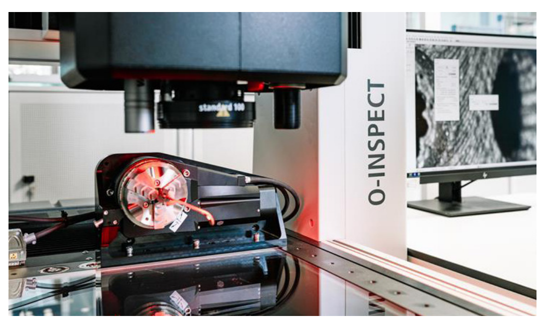
Coordinate Measuring Machines (CMMs) were cited by **43% of respondents**. This reflects their critical role in precision measurement for complex components, especially in industries like aerospace and medical manufacturing. The North American CMM market is expanding rapidly, driven by the need for ultra-precise, automated, and real-time measurement solutions that support smart manufacturing and Industry 4.0 initiatives.[52] As digital integration becomes more widespread, CMMs are increasingly used alongside advanced software and data analytics tools to provide actionable insights, enhance traceability, and ensure compliance with rigorous industry standards.

Example: ZEISS CONTURA Multisensor CMM

3D scanners were cited by **36% of respondents**. This technology enables fast, accurate, non-contact full-field data capture, also known as digital twins, and are increasingly used for part inspection, defect detection, design optimization, and reverse engineering. Advancements in technologies such as structured light, laser triangulation, and photogrammetry have significantly improved the precision and speed of 3D scanning devices, making them integral to modern manufacturing processes.[53] Respondents state that the major value of 3D scanners is that the visual data allows engineers to see where there is wear, rather than being limited to specifically programmed features.

Example: ZEISS T-SCAN hawk 2 Handheld 3D Scanner

Vision Measuring Machines (VMMs) were cited by **35% of respondents**. These systems utilize high-resolution camera technology combined with variable illumination to perform precise, non-contact dimensional measurements. This optical measurement approach is particularly well-suited for delicate, flat, or precision components, such as injection-molded parts, printed circuit boards (PCBs), stamped or bent metal parts, and finely machined surfaces. Their growing adoption reflects a broader industry trend toward improving quality assurance while minimizing production downtime, especially in high-precision manufacturing sectors.[54]

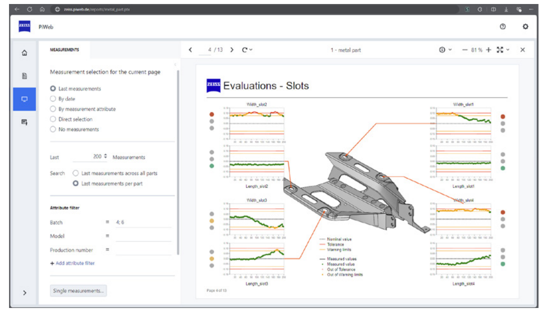


Example: ZEISS O-INSPECT Multisensor VMM

Automated inspection systems were cited by **29% of respondents**. Automated metrology solutions continue to increase in demand as manufacturers prioritize efficiency, repeatable accuracy, and productivity. Automated systems integrated with 3D scanners, CMMs, and vision technologies are now commonplace in near-line, at-line, and in-line environments, offering speed, accuracy, and reduced human error. Automated inspection systems enhance quality assurance by minimizing manual intervention and maximizing production efficiency.[55]

Example: ZEISS ScanBox Series

Metrology software was cited by **26% of respondents**. This technology is gaining traction as manufacturers prioritize data intelligence, AI/ML, and data-driven decision-making. The integration of cloud-based platforms and Industrial Internet of Things (IIoT) technologies in metrology software is enabling real-time data storage and analysis, facilitating predictive maintenance and enhancing decision-making processes. Furthermore, the adoption of Industry 5.0 technologies is fostering greater collaboration between humans and machines, with metrology software playing a pivotal role in ensuring precision and efficiency in this synergistic environment.[56]



Example: ZEISS PiWeb Data Management Software

CT/X-Ray Non-Destructive Testing (NDT) was cited by **15% of respondents**. This technology is increasingly in demand for internal inspection of complex parts, enabling precise detection of voids, cracks, and internal geometries without damaging the component. CT and X-ray NDT are especially valuable in industries such as aerospace, automotive, medical devices, and additive manufacturing, where internal integrity is critical. Advancements in AI-driven analysis are enhancing defect detection accuracy. The market is projected to grow significantly, reflecting the increasing demand for quality control and safety assurances across various industries.[57]

Example: ZEISS METROTOM 800 320kV

Microscopes were cited by **11% of respondents**. This technology is a vital tool in manufacturing applications, particularly for tasks requiring high-resolution micro- and nano-scale inspection. These instruments are essential for quality control, failure analysis, and materials research across various industries, including electronics, automotive, aerospace, and medical devices. Advancements in digital imaging and software integration have further enhanced their capabilities, allowing for automated workflows. Additionally, the integration of AI and ML into microscope technology is facilitating faster data analysis and interpretation, thereby further enhancing productivity.[58]

Example: ZEISS EVO 25 Scanning Electron Microscope

Analysis of Findings

The trend toward **multiple technology investments** reflects the complexity of modern manufacturing, where a single solution rarely meets all quality assurance needs. Manufacturers are combining contact and non-contact, manual and automated, and hardware and software solutions to optimize inspection processes and ensure compliance with increasingly stringent standards.

U.S. manufacturers are actively modernizing their quality processes, leveraging a diverse suite of metrology technologies to boost efficiency, accuracy, and competitiveness.

CRITICAL SUCCESS FACTORS FOR MANFACTURING STRATEGIES

The questionnaire asked, **"How important are these topics to your company's manufacturing strategy?"** and respondents were to rate the importance of several key topics to their company's manufacturing strategy: **AI and Machine Learning, Automation and Robotics, Additive Manufacturing / 3D Printing, Digitalization / Digital Twin, Supply Chain Innovations, and Sustainability**. Ratings ranged from "Not important at all" to "Extremely important.

Analysis of Findings

Sustainability (Highest Priority)
Sustainability leads as the most important strategic focus, reflecting manufacturers' commitment to reducing environmental impact, optimizing resource use, increasing efficiency, and meeting regulatory and consumer expectations. Metrology plays a pivotal role in advancing sustainability within manufacturing by enabling precise measurement and control throughout the production process. By integrating metrology data, manufacturers can simulate and optimize production processes, leading to reduced waste, improved energy efficiency, and minimized environmental impact. This integration supports predictive quality control, allowing for proactive adjustments that enhance product quality and resource utilization.[59]

Interviews with respondents revealed the following common themes:

- **Business Sustainability:** Maintaining profitable operations by balancing precision, speed, and throughput.
- **Equipment Longevity:** Ensuring long-term vendor support and ROI from durable metrology systems.
- **Process Stability:** Establishing reliable, long-term processes that are widely adopted across the organization.
- **Workforce Sustainability:** Preventing burnout through accessible tools, streamlined training, and ongoing skill development.

According to ISG and the National Association of Manufacturers, sustainability is now a technology-driven imperative, with digital solutions playing a pivotal role in making manufacturing more environmentally responsible.[60]

Supply Chain Innovation
Supply chain innovation ranks just behind sustainability as a top priority, reflecting its critical role in building resilience, enabling product innovation, and improving operational efficiency. Recent global disruptions have elevated supply chain agility and transparency to the forefront of manufacturing strategy.[61]

Manufacturers are also increasingly investing in digital supply chain tools, real-time analytics, and collaborative platforms to accelerate time-to-market, mitigate risks, and meet changing consumer demands.[62] One interviewee noted, coordinating a global supply chain to align with high-volume production is a challenge. They emphasized that sustaining capacity and meeting demand would be more achievable with stronger supply chain innovation and greater availability of materials and stock within the United States.

Additionally, advanced industrial metrology technologies—such as CMMs, optical 3D scanners, and CT systems—are enhancing supply chain efficiency by enabling precise inspections of incoming parts. According to MarketsandMarkets, integrating metrology data with digital twins supports real-time quality control and predictive maintenance, reducing defects and delays. This strengthens supply chain resilience and accelerates time-to-market.[63]

Automation & Robotics
Automation and robotics remain a top priority for manufacturers, driven by the need to increase productivity, address labor shortages, and improve product quality. Automation is widely recognized for boosting efficiency, reducing downtime, and enhancing product consistency.[64] [65]

Industry data shows that a growing share of capital investment is directed toward automation, with improvements in quality, speed, and capacity cited as key.[66] Interviews with respondents reveal a push towards lights-out manufacturing. By leveraging advanced robotics, manufacturers can maintain 24/7 production, a crucial factor in justifying automation investments. Respondents described using robots to handle daunting, repetitive tasks, thereby reducing operator errors through consistency and precision.

Additive Manufacturing (AM)

Additive manufacturing is valued for its capabilities in rapid prototyping, customization, and flexible production. Interviewees emphasized the benefits of metal 3D printing for producing complex designs in advanced industries. However, ensuring the quality and consistency of 3D-printed parts presents unique challenges. Metrology plays a critical role in overcoming these challenges by delivering precise measurement and quality control throughout the AM process. Advanced techniques—such as 3D scanning and computed tomography (CT)—enable non-destructive evaluation of intricate geometries, ensuring parts meet stringent specifications. Integrating metrology into AM workflows improves product reliability and accelerates time-to-market. As industry experts note, the synergy between metrology and additive manufacturing is essential for achieving consistent, high-quality results in modern production environments.[67]

Digitalization

Digital transformation—including smart factories, digital twins, and advanced analytics—is reshaping manufacturing operations, making them more agile and responsive to market changes. According to Deloitte, manufacturers are prioritizing targeted investments in their digital and data foundations to drive innovation and address persistent skills and supply chain challenges.[68]

Interviewees noted that digitalization is also shifting company culture. Access to complete, high-quality 3D data from individual parts is boosting confidence and enhancing cross-department communication. Engineers specifically highlighted a growing preference for digital twins based on accurate 3D measurement data over traditional manual methods, citing improved reliability and collaboration.

AI and ML

Artificial intelligence (AI) and machine learning (ML) are increasingly integral to modern manufacturing, enhancing efficiency, quality, and adaptability. Manufacturers report AI integration as a critical tool to improve processes. For example, some are using it to free up workforce capacity by automating processes and eliminating false positives or failures. According to a Forbes article, industrial manufacturers are not just exploring AI—they're actively implementing it to scale operations, improve quality control, and streamline workflows, leading to more agile and responsive production environments.[69] As these technologies continue to advance, their ability to support predictive maintenance, adaptive automation, and data-driven decision-making is transforming production environments.

These strategic priorities are not only vital for operational efficiency but also essential for long-term competitiveness and compliance with evolving standards and stakeholder expectations.

Industry leaders and analysts consistently emphasize the importance of these in navigating today's dynamic manufacturing environment. As Deloitte notes, **"Manufacturers have continued investing in digital technologies over the last several years despite economic uncertainty, rising costs, and a challenging business climate… Investments in digital technologies across manufacturing organizations—in other words, the push toward smart operations—is likely to continue in 2025."**[70]

Conclusion

The results align with the top industry priorities for 2025, with sustainability, supply chain innovation, and automation at the forefront of manufacturing strategies. These areas are not only critical for operational success but also for long-term competitiveness and compliance with emerging standards and expectations. Industry leaders and analysts consistently highlight these topics as essential for navigating the evolving manufacturing landscape.

TECHNOLOGY INVESTMENT TRENDS

Respondents reported a wide range of annual budgets for new technology, with **most investing under $300,000 and 11% committing over $1 million**. This reflects the diversity in company size and strategic focus across the sector. Smaller firms tend to pursue incremental upgrades, while larger enterprise manufacturers fund major initiatives like smart factories and advanced automation.[71]

This investment trend is accelerating. According to Deloitte, technology spending rose from 23% to 30% of manufacturing operating budgets between 2023 and 2024, with further growth expected in 2025.[72] A Smart Industry report found over half of manufacturers planned to boost technology budgets by at least 10% in 2024, and 70% increased software spending in 2025.[73]

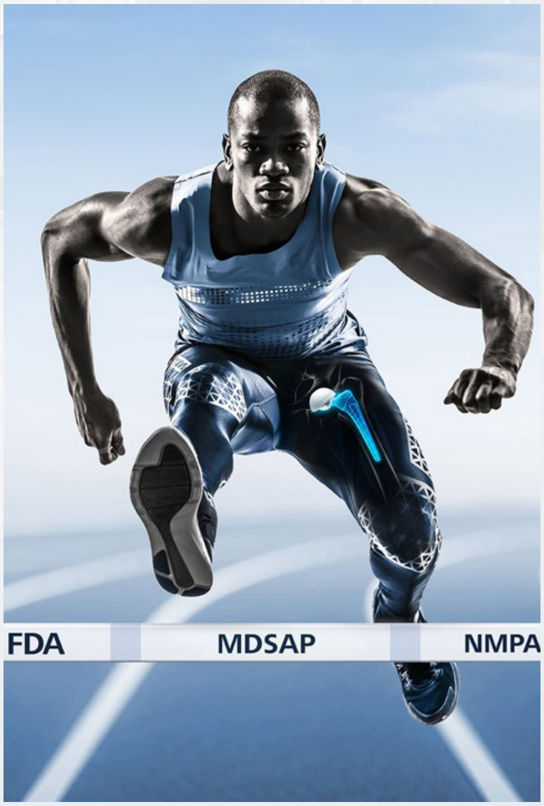
The shift toward continuous, incremental transformation—rather than one-time overhauls—underscores technology's central role in building agility, efficiency, and long-term resilience.

FINAL THOUGHTS

The **U.S. Manufacturing Insights Report 2025** reveals a sector in active transformation driven by strategic priorities such as **sustainability, supply chain innovation, and automation**. As manufacturers navigate economic, workforce, and technological pressures, they are **investing in flexible, high-impact solutions that promote efficiency, agility, and long-term resilience**.

The findings highlight a broad shift toward **data-driven manufacturing, where quality, precision, and innovation are increasingly powered by metrology technologies, AI, and smart operations**. With most manufacturers steadily increasing their technology budgets and leaders citing **24/7 automation, supply chain visibility, and digital practices as top goals**, the industry is evolving toward an integrated, intelligent, and sustainable future.

Above all, this report confirms that **U.S. manufacturing is not standing still—it is adapting, innovating, and investing to meet the demands of a rapidly changing world**.



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Carl Zeiss Industrial Quality Solutions, LLC
6250 Sycamore Lane North
Maple Grove, MN 55369, USA
(800) 327-9735
info.metrology.us@zeiss.com
zeiss.com/metrology