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Elevating manufacturing value:
The impact of Intelligent Operations

Introduction

Investments in plant floor operations across the manufacturing sector, from electronics and automotive to food and beverage, are focused on workflow optimization and driving higher revenues, profits, and employee productivity. Established manufacturing organizations are investing in tools that are foundational for intelligent operations, including mobile computers and RFID technologies for supply chain coordination, machine learning and vision for product quality, and artificial intelligence (AI) for better demand forecasting.

To understand how workflow improvements translate to financial benefits, Oxford Economics and Zebra Technologies surveyed 400 manufacturing decision-makers from around the world, then applied econometric analysis to their responses to measure business performance. Our research focused on several key workflows—including production and assembly line, quality control and assurance, supply chain coordination and inventory management, maintenance and equipment management, and material movement and handling—and found significant levels of progress and payoff.

Intelligent operations integrate advanced technologies like AI, automation, and data with human expertise to optimize business processes.

Manufacturers that focused on improving quality control and assurance, for example—an area where many respondents have made meaningful progress in recent years—reported, on average, higher top- and bottom-line impacts over the last year compared to those that did not, including 2.4-percentage-point higher revenue growth and 1.4-percentage-point higher profitability.[1] Among those that improved this workflow, discrete manufacturers, like electronics and automotive OEMs, reported higher revenue uplifts compared to other manufacturing subverticals.

In addition to quality control and assurance, our report focuses on another key workflow: material movement and handling, identified by respondents as an area most in need of improvement. In-depth interviews with industry leaders make clear that the benefits of intelligent operations are not limited to a single workflow or even a single organization—these benefits generate significant value for the entire supply chain, a complex interdependent system spanning manufacturing, transportation and logistics, and retail organizations all working together to meet customer demands for high-quality products and timely services.

In fact, organizations across the entire supply chain that reported meaningful workflow improvements saw, on average, 2-percentage-point higher revenue growth and 1.7-percentage-point higher profitability than peers over the last year.

1. The percentage-point differences show the average gap in revenue growth and profitability between organizations that made meaningful improvements to material movement and handling and those that did not, based on our analysis of the survey data.

Manufacturers are looking for ways to optimize workflows

Profitability and efficiency are the leading business goals for manufacturers—and major perceived weak spots. Fewer than half say they are better than their industry peers in either area, and just a third say the same about their return on invested capital and ability to respond to market pressures.

Improving product or service quality is a top goal for more than half of process manufacturers (i.e., food & beverage and consumer packaged goods), likely due to the regulatory focus around health, safety, and labeling requirements. Discrete manufacturers (i.e., electronics and automotive OEMs and suppliers), on the other hand, are prioritizing profitability and ROI.

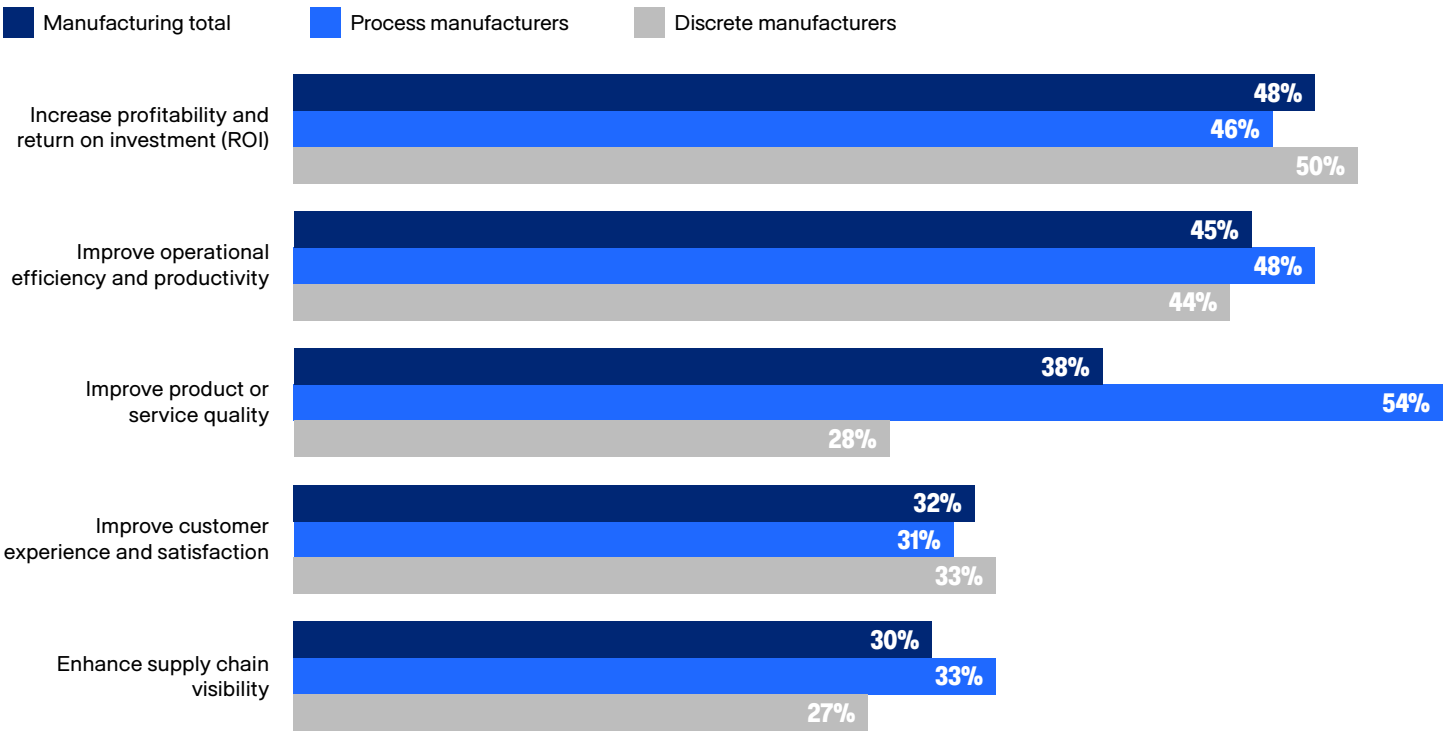
Manufacturers are focusing on these business priorities by investing in technologies that make their frontline operations more intelligent. They report allocating, on average, 69% of their IT budgets to devices, software, and other technologies used to automate workflows. "There is a big pressure to automate," says one director of manufacturing transformation at a top automotive company in Europe. "Either you do that and can compete on cost, or you will not survive."

Workflow automation takes on different meanings for different organizations. Roughly 4 in 10 define automation as the use of software and digital tools to streamline workflows and eliminate manual tasks; this is especially the case for mid-sized manufacturers. About one-third see it as the integration of advanced analytics and AI/ML to optimize decision-making and operational performance—a complex approach that is far more common for larger manufacturers.

By contrast, about one-fifth define automation as a broad, strategic concept encompassing different technological solutions, from devices to software, to improve productivity and efficiency. Even fewer emphasize the use of robotics, machinery, or hardware systems to perform physical tasks previously carried out by humans (11%). (For more detail on the differences between mid-sized manufacturers and their larger counterparts, see the sidebar on page 7.)

Fig. 1: Manufacturers are prioritizing profitability, efficiency, and quality

Q. Which three of the following business goals are your top priorities over the next three years? Select the top three. Top five responses shown by manufacturing type.

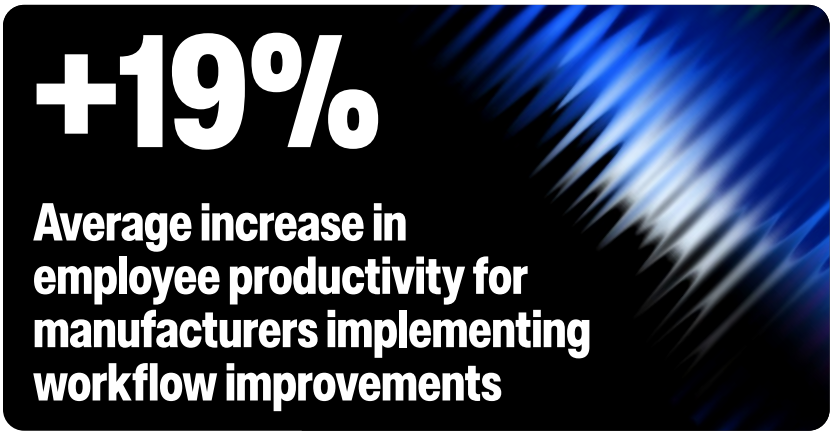


Note: Process manufacturers include food & beverage and consumer packaged goods. Discrete manufacturers include electronics and automotive OEMs and suppliers (Tiers 1 and 2).

Intelligent operations elevate business outcomes

A majority of manufacturers say they have made meaningful improvements to their quality control and assurance workflows as well as their production and assembly lines over the last two years, citing a range of benefits from increased product quality to a reduction in human errors. But certain workflows, such as material movement and handling, and maintenance and equipment management, remain pain points for most.

Manufacturing organizations that have yet to make meaningful improvements to their workflows have big opportunities ahead of them. Investing in key technologies, from RFID to machine vision and AI, can move them closer to achieving their financial goals. Surveyed manufacturers that have meaningfully optimized their workflows over the past two years noted, on average, a 19% increase in employee productivity during that time.



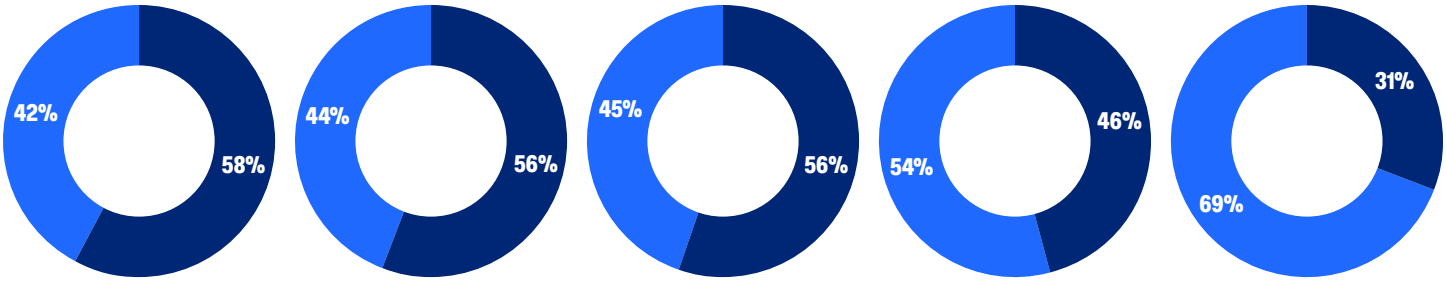
Workflow gains at scale—what they could mean for the top 20 manufacturers

If the top 20 manufacturers in the Forbes Global 2000 list—who collectively generated $4.1 trillion in revenue in 2024—were to achieve meaningful improvements in their workflows, they could potentially see an aggregate increase of $100 billion in revenue and $4.6 billion in profits.[2] That translates to an average of $5 billion in higher revenue (a 2.4% uplift) and $200 million in added profit per manufacturer.

These estimates are based on patterns observed in our survey, which included manufacturers of all sizes. The findings are applied to the top 20 manufacturers in the Forbes Global 2000 manufacturers list and assume similar relationships hold. While these figures are not predictive or causal, they provide a useful indication of the potential scale of benefits for major manufacturers.

Fig. 2: Quality control is improving, while material movement remains troublesome

Q. For each workflow that applies to your organization, select if its improvement is necessary or if it has already seen meaningful improvement over the last two years.



Note: Percentages may not sum to 100% due to rounding

2. We considered the top 20 companies from the following industries listed in the Forbes Global 2000: Aerospace & Defense, Capital Goods, Chemicals, Conglomerates, Consumer Durables, Drugs & Biotechnology, Food, Drink & Tobacco, Health Care Equipment & Services, Household & Personal Products, Semiconductors, Technology Hardware & Equipment. "Global 2000: The World's Largest Public Companies." Forbes, July 10, 2025. https://www.forbes.com/lists/global2000/.

Deep dive: Optimizing quality control and assurance reduces errors

Manufacturers that have achieved meaningful improvements in their quality control and assurance workflows over the last two years note increased product quality (selected by 73% of manufacturers), decreased likelihood for human error (52%), improved line adjustments without production interruptions (44%), and more.

These organizations relied on a range of technologies to make these improvements, including machine vision (64%) and machine learning (58%), fixed industrial scanners (56%), and AI (32%).

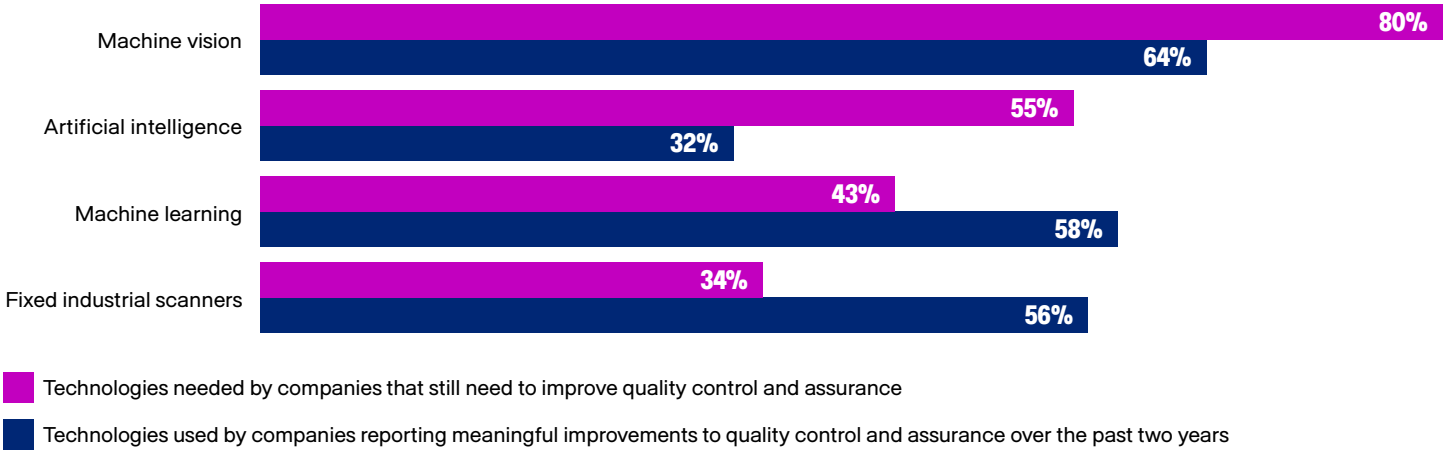
Meanwhile, those still looking to optimize quality control are betting big on machine vision (80%) and AI (55%). Intelligent visual systems are especially important for detecting quality issues in workflows that rely on manual labor, like trim and final. "We have camera systems that the operator has right on the head," says the director of manufacturing transformation at the automotive company. "The camera is watching what the operator is doing and evaluating, with help from an AI system, that the connection is done correctly." This helps prevent errors that lead to hours in repairs down the line.

Manufacturers that improved quality control and assurance reported, on average, 2.4-percentage-point higher revenue growth and 1.4-percentage-point higher profitability over the last year compared to those that did not make meaningful improvements in this area. For the typical manufacturing organization represented in our survey (see methodology and demographics on page 10), this translates to a potential $69.7 million uplift in revenue and $3.4 million in higher profits.

Discrete manufacturers, specifically electronics and automotive OEMs, reported higher revenue uplifts from improvements to quality control compared to other types of manufacturers—2.45 and 2.35 percentage points over the last year, respectively. This translates to $72.9 million for electronics and $69.8 million for automotive OEMs.

Fig. 3: AI is growing in importance for quality control and assurance

Q. Which of the following technologies are or were most important to achieving improvements for your ***quality control and assurance*** *workflow? Select two or more.*



Deep dive: Optimizing material movement and handling is key for improving inventory control and increasing efficiency

Material movement and handling is identified as a major concern for a little more than two-thirds of manufacturers, most of whom are looking to improve inventory access and control (79%), increase efficiency and throughput (51%), and reduce operational costs (36%) and material damage and waste (35%).

To improve material movement and handling, manufacturers say they would benefit most from investing in mobile computers and RFID technologies (e.g., sensors and tags)—both of which were considered the most important technologies for those that have already made improvements in this area. AI, meanwhile, is growing in importance: 20% say they need it for their improvement efforts today, while just 13% used it two years ago.

Manufacturers that improved material movement and handling reported, on average, 1.8-percentage-point higher revenue growth over the last year compared to those that did not make meaningful improvements in this area. For the typical manufacturing organization represented in our survey (see methodology and demographics on page 10), this translates to a potential $53.8 million uplift in revenue. A majority of these organizations achieved the benefits their counterparts are still struggling to attain, from improved inventory accuracy and control (89%) to reduced operational costs (56%).

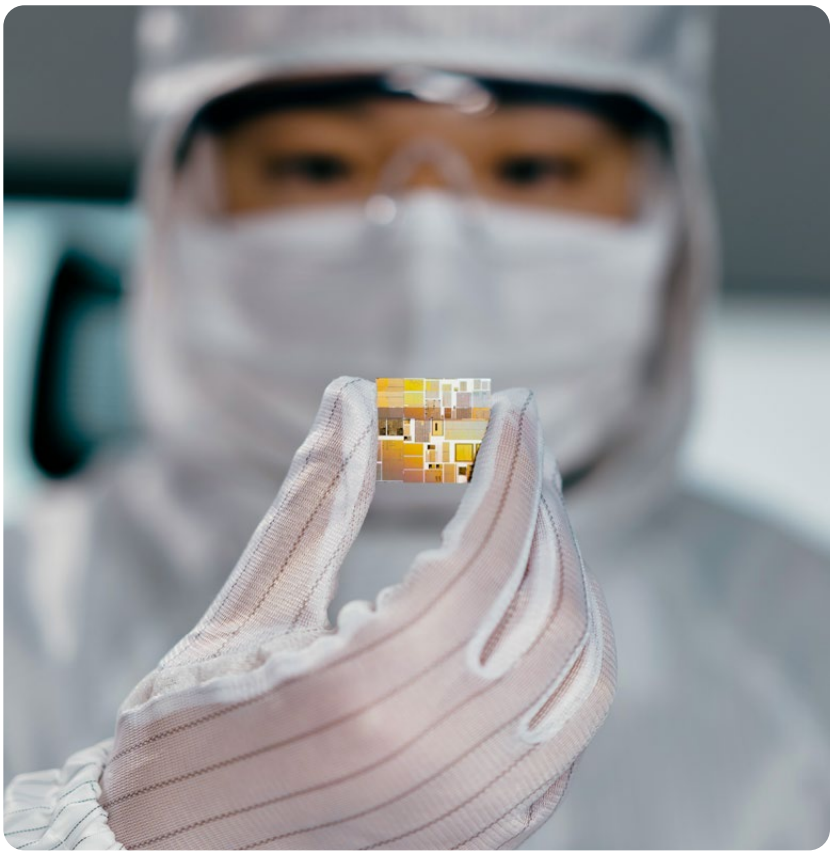
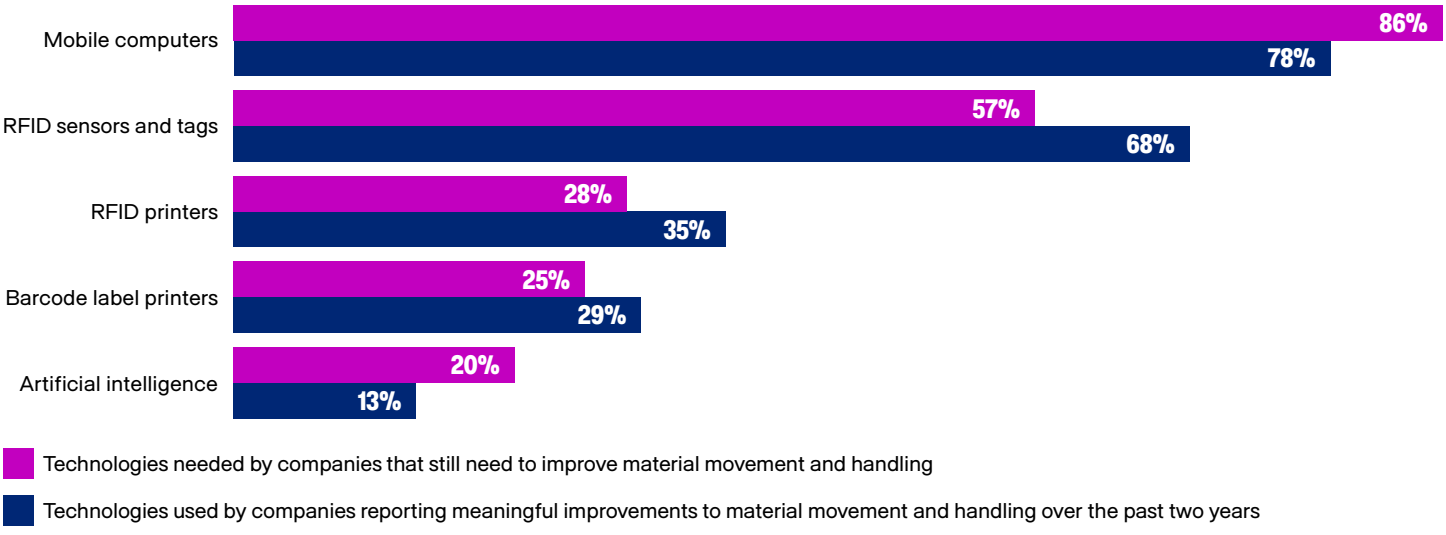


Fig. 4: Mobile computers and RFID technologies are key for material movement and handling, but AI is gaining traction

Q. Which of the following technologies are or were most important to achieving improvements for your ***material movement and handling*** *workflow? Select two or more.*



Large manufacturers are leveraging their size

An organization's approach to improving workflows is closely tied to the resources available to it. In our survey, very large manufacturers were more likely than others to say they improved areas such as material movement and handling, maintenance and equipment management, and quality control and assurance when compared to their large and mid-sized counterparts. Yet they still grapple with issues in production and assembly line.

We defined the categories as:

- **Very large manufacturers:** $10 billion or more in revenue
- **Large manufacturers:** $1 billion to $9.9 billion in revenue
- **Mid-sized manufacturers:** $100 million to $999.9 million in revenue

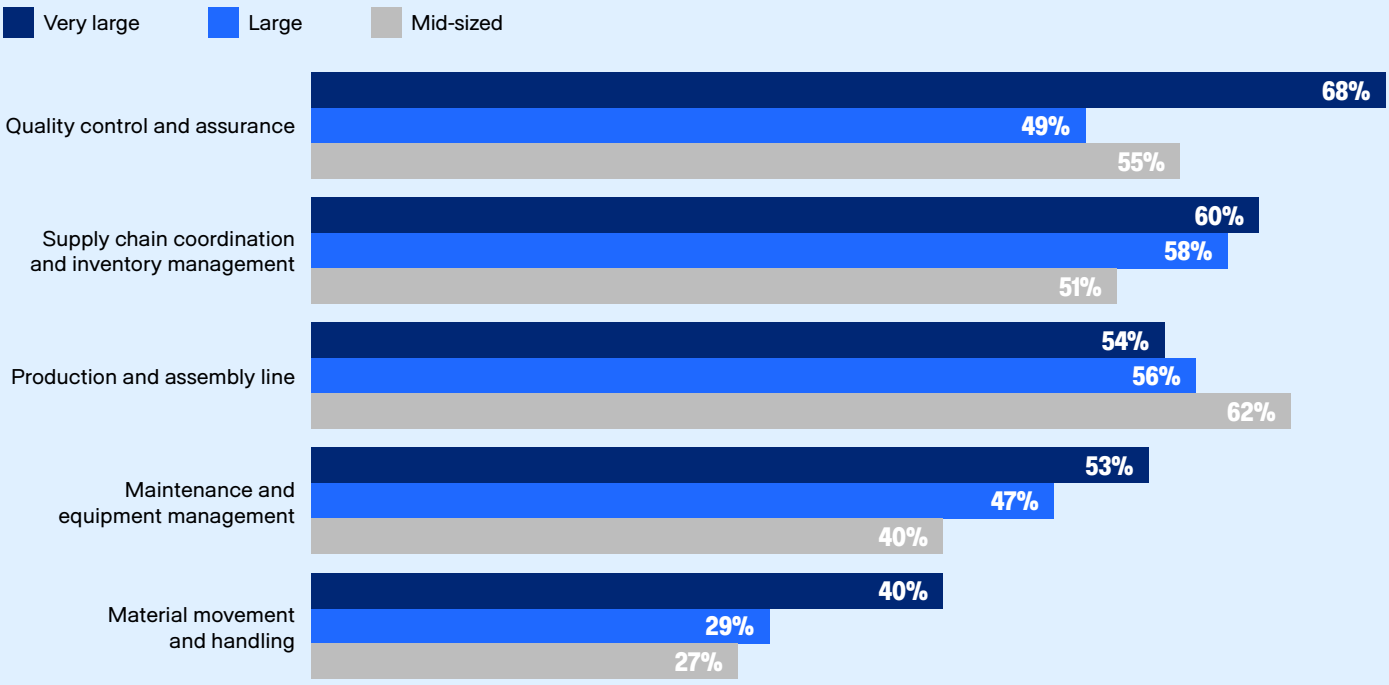
Their mature data management capabilities may be the driving factor behind their workflow optimization successes. Nearly 9 in 10 very large manufacturers say they either maintain a fully integrated, advanced data management environment with AI-driven insights embedded throughout the organization or have a well-defined, integrated, and automated data management and analytics process in multiple business functions. This is the case for 24% of large manufacturers and only 3% of mid-sized manufacturers, both of whom are far more likely to say their data analysis capabilities are performed in select areas or remain siloed.

Similarly, 70% of very large manufacturers define their approach to automation as the integration of advanced analytics and AI/ML to optimize operational performance, compared to 30% of large and just 8% of mid-sized manufacturers. These smaller organizations are in earlier stages of their digital maturity, instead emphasizing the use of software and digital tools to streamline workflows and eliminate manual tasks (65% mid-sized and 36% large, vs. 3% very large).

Manufacturers of all sizes, but especially very large and mid-sized manufacturers, struggle with legacy technologies, cited as a barrier to workflow improvements by 56% of respondents—higher than any other option, including concerns about data security, high cost of training, and lack of executive alignment. One engineering director at a global manufacturing company based in the US emphasizes the importance of keeping up with new technology trends. "It's not the strongest or smartest that will survive, it's the most adaptable," he says. Investments in new technologies can be the difference between operations that are intelligent and elevate business outcomes, and those that fall short.

Fig. 5: Very large manufacturers are ahead of others in improving most of their workflows

Q. For each workflow that applies to your organization, select if its improvement is necessary or if it has already seen meaningful improvement over the last two years. "Meaningful improvements have been achieved over the last two years" responses shown by organization size.



Progress implementing AI

The rapid advancement of AI should support organizations just beginning to improve key workflows, especially as these tools and technologies become more widely accessible. At the US-based manufacturing company, the engineering director's goals are becoming more aggressive as expectations for improved time to market and smarter ways of working increase. "Technology has been changing a lot, and AI is a big enabler these days," he says. "There's a lot of promise behind it to improve what we do in the workplace even more."

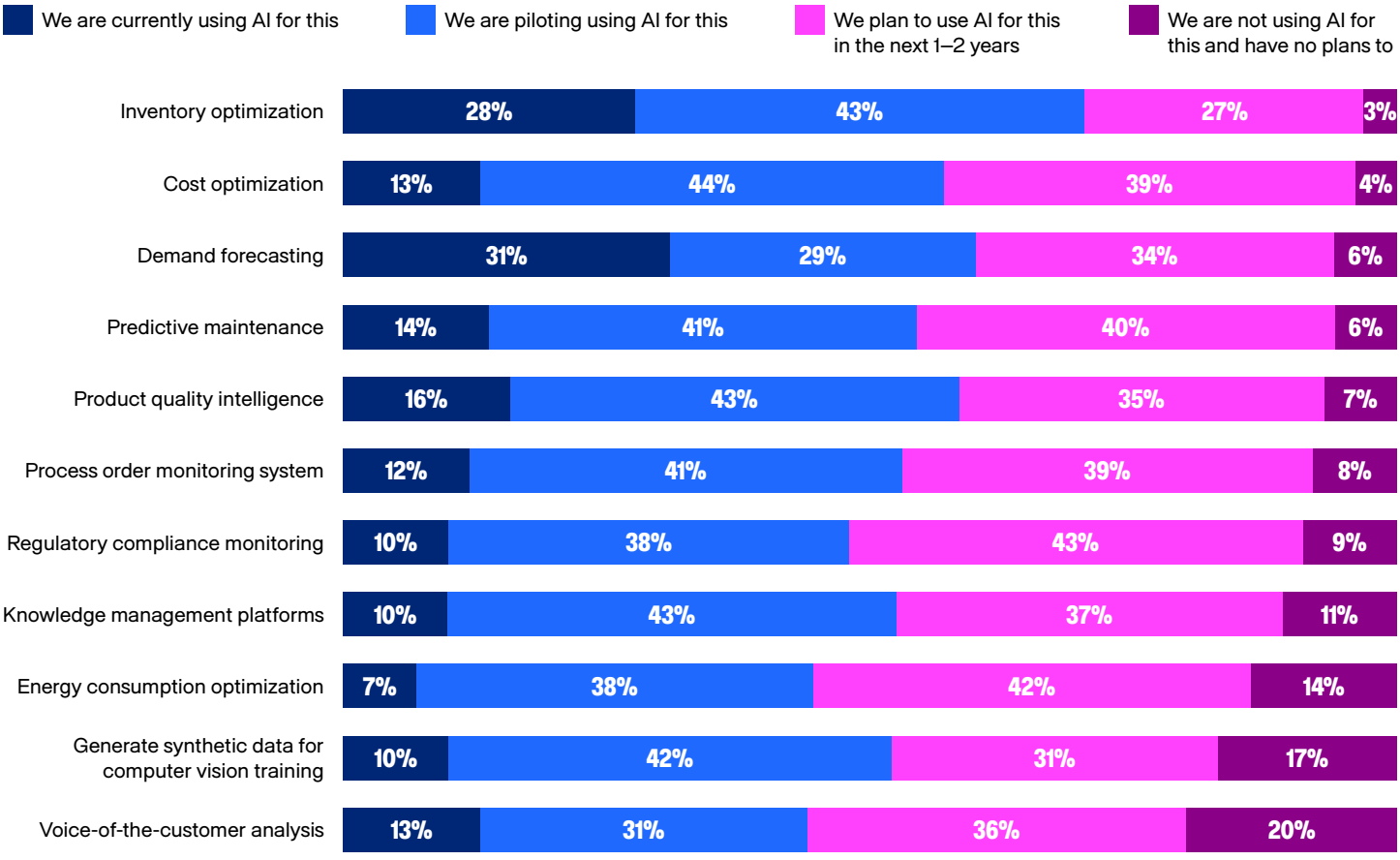
Most manufacturers say they are either using or piloting AI across a range of workflows, from product quality intelligence to generating synthetic data for computer vision training. For the engineering director, AI/ML has been crucial in creating surrogate models that replace expensive, time-consuming product testing simulations—but the key to getting to that point is data. "You have to create some data beforehand," he says. "Once that data is good enough, you can create an equation or a surrogate model, and now you're not waiting three weeks—you can wait a few seconds for one result. But that's an investment."

Robust data management systems that yield high-quality, standardized data are crucial for carrying out workflow digitization initiatives, yet most manufacturers say structured data analysis is performed only in select areas (42%) or remains limited and siloed (23%). Some are further ahead: one-fifth say their data management process is automated and performed across multiple functions, and 11% say theirs is fully integrated throughout the organization with AI insights. (For more detail on the differences between mid-sized manufacturers and their larger counterparts, see sidebar on page 7.)

"Without standardization, there is no digitization," says Dominik Schedl, Director, System and Production Engineer at indie Semiconductor. "It took a lot of time to standardize our database—sometimes it was in dollars, sometimes in Euro, and sometimes it was missing—but once that was done, it worked really well." This process improved the manufacturer's forecast planning capabilities, enabling AI-driven insights and freeing up time for workers. Mr. Schedl can now focus his efforts on the organization's production data to optimize internal processes, an increasingly important goal as his output targets become more competitive.

Fig. 6: Manufacturers are leveraging AI to optimize a range of workflows

Q. To what extent is your organization using AI for the following workflows?



Note: Percentages may not sum to 100% due to rounding

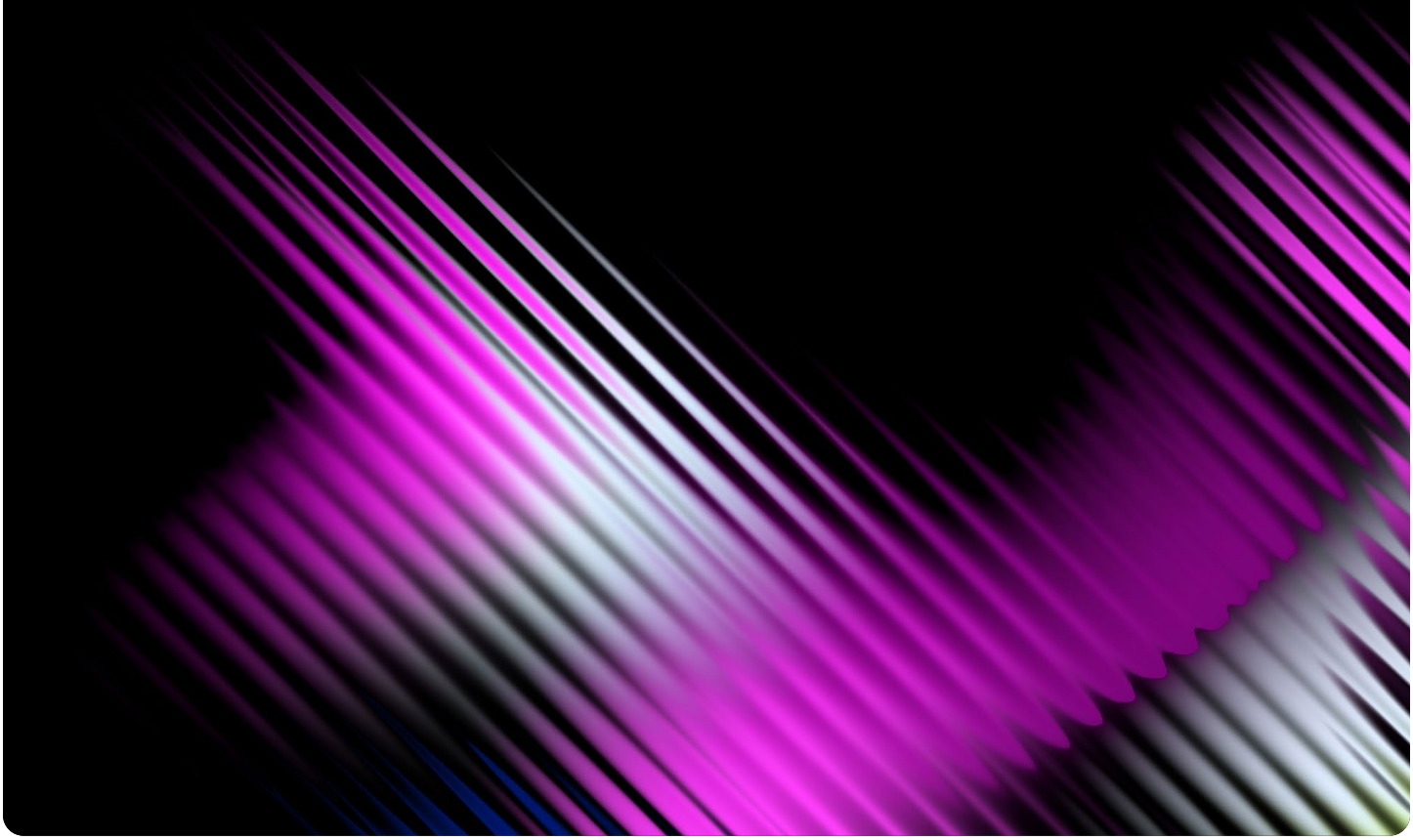
Conclusion

Manufacturers that adopt intelligent operations should enhance their operational efficiency, increase their product quality, and improve their inventory control, ultimately driving substantial improvements in both revenue growth and profitability.

Every manufacturer has the opportunity to revamp outdated and inefficient workflows while continuing to enhance the efficiencies of already improved frontline operations. Manufacturers in our survey have made meaningful progress optimizing key workflows over the last two years, especially in quality control and assurance, but they understand that this work is ongoing; product and service quality, for instance, remains a top business priority. Meanwhile, some areas of the business, like material movement and handling, pose ongoing challenges for most manufacturers.

Key takeaways from our impact analysis and in-depth interviews include the following:

- **Robust data systems are foundational for generating actionable business insights and improving product quality.** Manufacturers looking to benefit from visualization systems, forecasting tools, and advanced technology like AI will need to make sure their data management processes are well defined and integrated across their business. This is key to enabling real-time, connected insights and enhancing data-driven decision-making.
- **Intelligent operations are powered by a combination of devices and software solutions.** Manufacturers that leverage a range of tools such as RFID technology, mobile computers, machine vision and learning, and AI are better positioned to improve operational efficiency, minimize errors, and make better business decisions.
- **Manufacturers beginning their workflow optimization journeys today are set to benefit from efficiencies driven by AI.** Most are already piloting or using AI to enhance key tasks and workflows. As the technology continues to mature, manufacturers can leverage it for advanced analytics and more streamlined operations.



Methodology and demographics: Reaching manufacturing firms

In partnership with Zebra Technologies, Oxford Economics surveyed 1,000 senior leaders from the manufacturing, retail, and transportation and logistics sectors to understand how organizations are using hardware and software technologies to improve workflows.

This sample features **400** respondents from the manufacturing sector, including electronics; food and beverage; consumer products; and automotive OEMs and suppliers (Tiers 1 and 2). Organization sizes vary: 30% of manufacturers surveyed report annual revenues of $100 million to $499.9 million in their most recent fiscal year, while 70% report $500 million or more.

The survey was fielded from April to May of 2025, targeting manufacturers from the US, Mexico, UK, Germany, India, Japan, and Australia and New Zealand—all of whom are responsible for or involved in decisions around improving operational tasks and workflows. Respondents hold positions at the managerial level or higher in either IT or line of business roles.

To contextualize our survey findings, we conducted in-depth interviews with manufacturing executives who shared their experiences optimizing workflows at their organizations.

Oxford Economics then analyzed how reported improvements in business outcomes—such as revenue growth and profitability—correlate with advancements in workflow processes. Using regression analysis, we identified the extent to which specific types of workflow improvements are associated with better business performance, while controlling for factors such as organization size, industry sector, and country of operation.

Dollar values are estimates based on the "typical" organization in our sample—that is, one whose size and performance are close to the middle of the range reported by respondents (i.e., the median). The average percentage-point differences identified in our analysis are applied to this typical organization to estimate the potential indicative revenue and profitability benefits associated with workflow improvements.

While regression techniques help isolate these associations, the findings should not be interpreted as evidence of causation. Rather, they illustrate potential benefits based on patterns in the data. Additionally, the results reflect reported responses from the survey and should not be generalized beyond organizations similar to the typical respondent in our sample.

The figures in the sidebar titled "Workflow gains at scale—what they could mean for the top 20 manufacturers" are illustrative estimates based on our survey findings. We applied the average percentage point improvements in revenue and profits—reported by organizations that experienced meaningful workflow gains—to the most recent revenue and profit data for the top 20 manufacturers in the relevant Forbes Global 2000 industry categories.[3] This approach provides a simplified estimate of the potential financial uplift these leading manufacturers might see if they achieved gains comparable to those observed in our survey. These figures are not predictive and should not be interpreted as evidence of causality.

3. We considered the top 20 companies from the following industries listed in the Forbes Global 2000: Aerospace & Defense, Capital Goods, Chemicals, Conglomerates, Consumer Durables, Drugs & Biotechnology, Food, Drink & Tobacco, Health Care Equipment & Services, Household & Personal Products, Semiconductors, Technology Hardware & Equipment. "Global 2000: The World's Largest Public Companies." Forbes, July 10, 2025. https://www.forbes.com/lists/global2000/.

About Oxford Economics

Oxford Economics specializes in evidence-based thought leadership, forecasting, and economic impact analysis. Our economists use sophisticated analytical models and have access to a rich database of figures, forecasts, and analysis on 200 countries, 100 industrial sectors, and 8,000 cities and regions. Headquartered in Oxford, with offices around the world, we employ more than 600 people, including over 400 economists, industry experts, and business editors. The rigor of our analysis, caliber of staff, and best-of-class global economic models and analytical tools make us a trusted resource for over 2,500 corporations, financial institutions, government organizations, professional service firms, and universities. For more information, visit www.oxfordeconomics.com.

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About Zebra Technologies

At Zebra, we provide the foundation for intelligent operations with an award-winning portfolio comprised of automation, asset visibility, and connected frontline solutions. With operations in +100 countries, we help organizations—including +80% of the Fortune 500—respond faster to change, improve productivity, and empower teams with real-time insights. Together with our partners, we create new ways of working that make everyday life better. Learn more at zebra.com.

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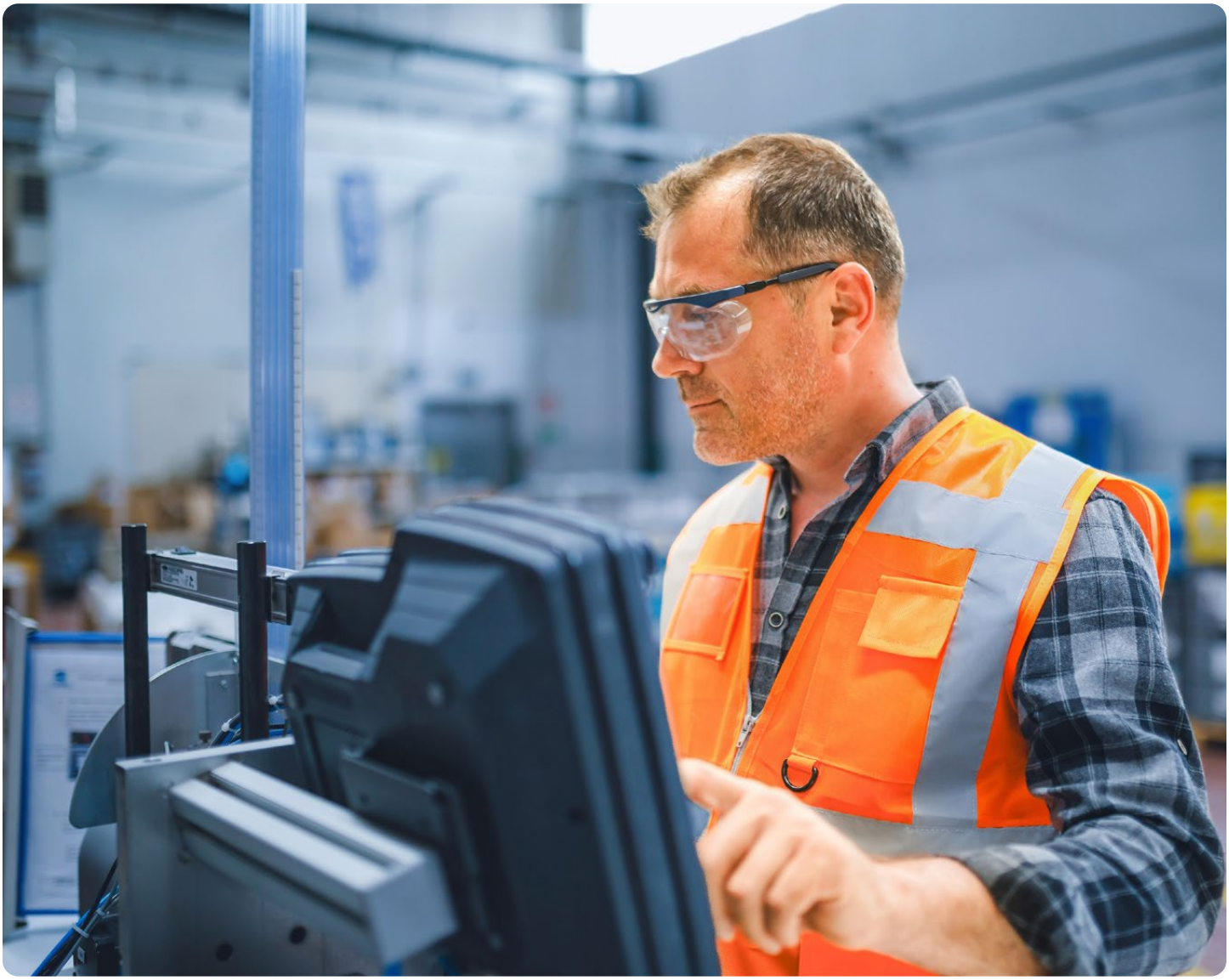

> “The manufacturers outperforming today are the ones redefining how work gets done—turning operational precision into business agility, proving that intelligent operations are no longer a back-office advantage, they’re a business imperative.”
>
> *—Joe White, Chief Product & Solutions Officer, Zebra Technologies*