



2025 STATE OF FOOD MANUFACTURING Digital Transformation



FOOD
INDUSTRY
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2025

STATE OF FOOD MANUFACTURING Digital Transformation

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Executive Summary

Food manufacturers are making steady progress toward digital transformation, with most companies operating in a hybrid state of partially automated processes. They're focusing on technologies that deliver clear returns, with warehouse management systems, production monitoring tools, and AI applications showing the best results. And while manufacturers are adding digital tools across production, inventory, and quality control, budget limitations remain the biggest challenge, forcing careful choices about investments.

Consumer attitudes add another layer of complexity. Safety concerns top the list when people think about food technology. Many consumers don't fully trust newer technologies like 3D-printed foods, lab-grown proteins, or AI applications in food safety. However, they're more comfortable with digital tracking systems and smart packaging. Younger consumers are generally more open to new technologies while also caring more about transparency and environmental impact. Across all age groups, third-party verification and scientific evidence are the most effective ways to build trust in new food technologies.

Forward-thinking food manufacturers will need to align their technology roadmaps with these insights to maximize returns and build consumer confidence in their innovation efforts.

Key Insights

- **Prioritizing results:** Food companies report that automated warehouse management systems (37%), real-time production monitoring (26%), and robotics systems (26%) deliver the highest ROI. Meanwhile, data analytics provides the greatest value in identifying production bottlenecks (33%), tracking production line performance (31%), and monitoring product yield losses (27%). Most companies (43%) are allocating 26-50% of their equipment and system investments to digital and automation projects.
- **Adopting Industry 4.0:** Real-time production monitoring dashboards is the most widely implemented Industry 4.0 technology (41% currently using), and there's also significant interest in cloud-based MES (51% planning implementation), automated warehouse systems (51%), and smart energy management (44%). Looking ahead, AI / machine learning (34%) and advanced robotics (26%) are predicted to have the greatest impact on food manufacturing over the next three years.
- **Navigating implementation challenges:** Budget constraints (57%) represent the primary barrier to technology implementation, far outweighing concerns about technical expertise and legacy system integration (8% each). Companies measure implementation success primarily through cost reduction (57%), ROI (49%), and labor cost savings (43%), while addressing skills gaps mainly through internal training programs (58%) and external training and hiring (35%).
- **Encouraging consumer trust and acceptance:** While consumers express comfort with digital tracking systems (64%) and smart packaging (61%), they remain skeptical of 3D-printed foods (61% uncomfortable), gene editing (58%), and cellular agriculture (57%). Food safety concerns (72%) dominate consumer worries about food technology, and many are putting their trust in third-party verification (31%) and scientific research publications (23%).



PART 1:

State of Digital Transformation

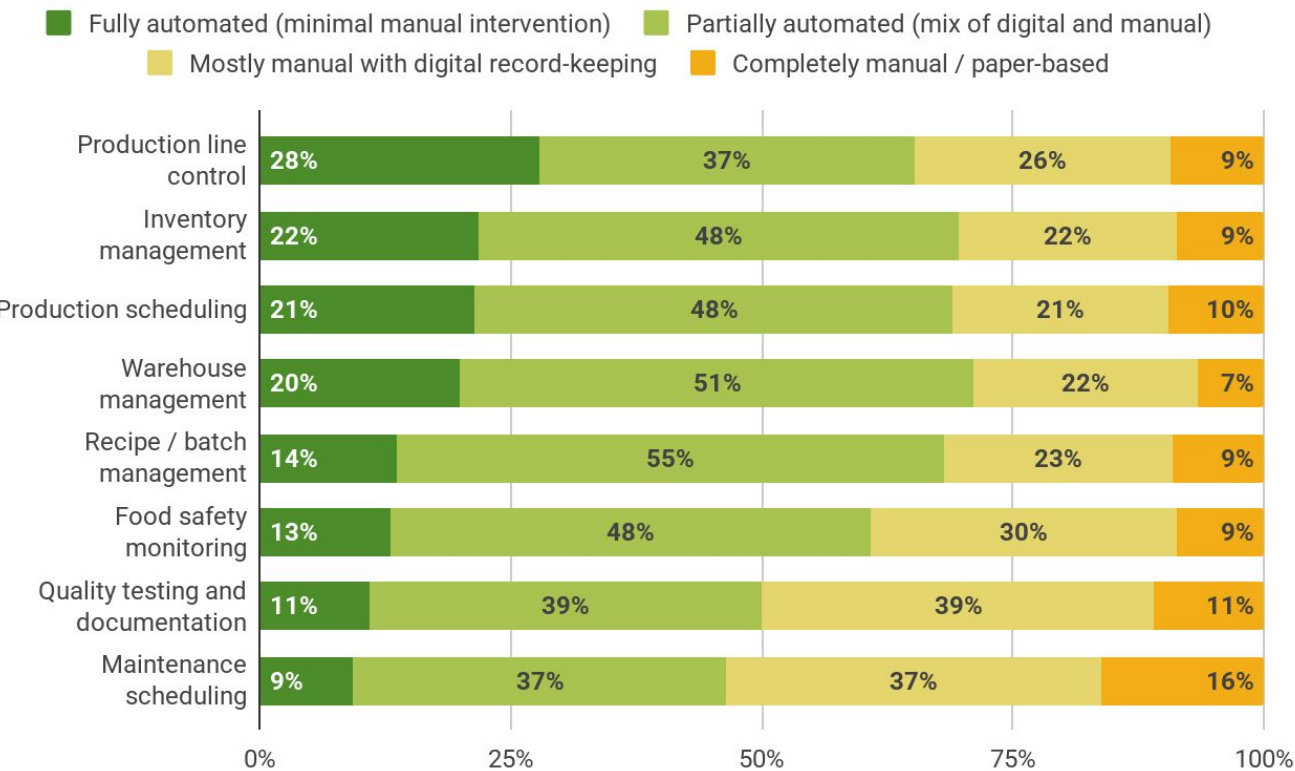
As food and beverage companies work toward automating their facilities, investment priorities lean toward solutions that deliver the highest ROI — including real-time production monitoring, automated warehouse management systems, and artificial intelligence.

Progress toward automating operations

Food and beverage companies were most likely to have fully automated production line control at their facility — 28% said they had completely automated their production line control, and 37% were using a mix of digital and manual processes.

Other commonly automated processes included inventory management (22% fully automated, 48% partially automated), production scheduling (21%, 48%), and warehouse management (20%, 51%). Meanwhile, only 9% of respondents said they had fully automated maintenance scheduling, with 16% still using entirely manual processes.

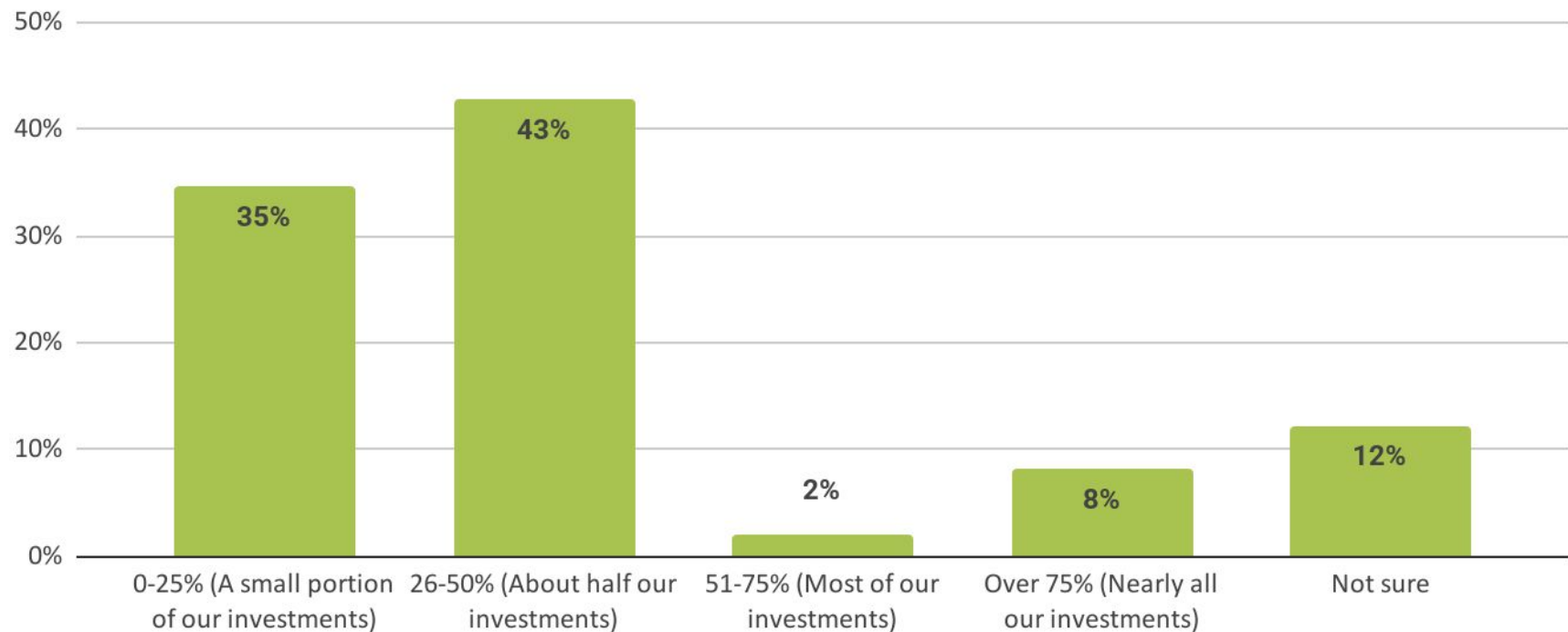
How are the following processes in your facility primarily operated?



Investing in digital and automation projects

Over the past 12 months, most F&B companies (43%) have spent between 26% and 50% of their facility's equipment and system investments on digital and automation projects. This includes investments in new hardware and software, integrations of existing systems, training and implementation, and consulting and technical services.

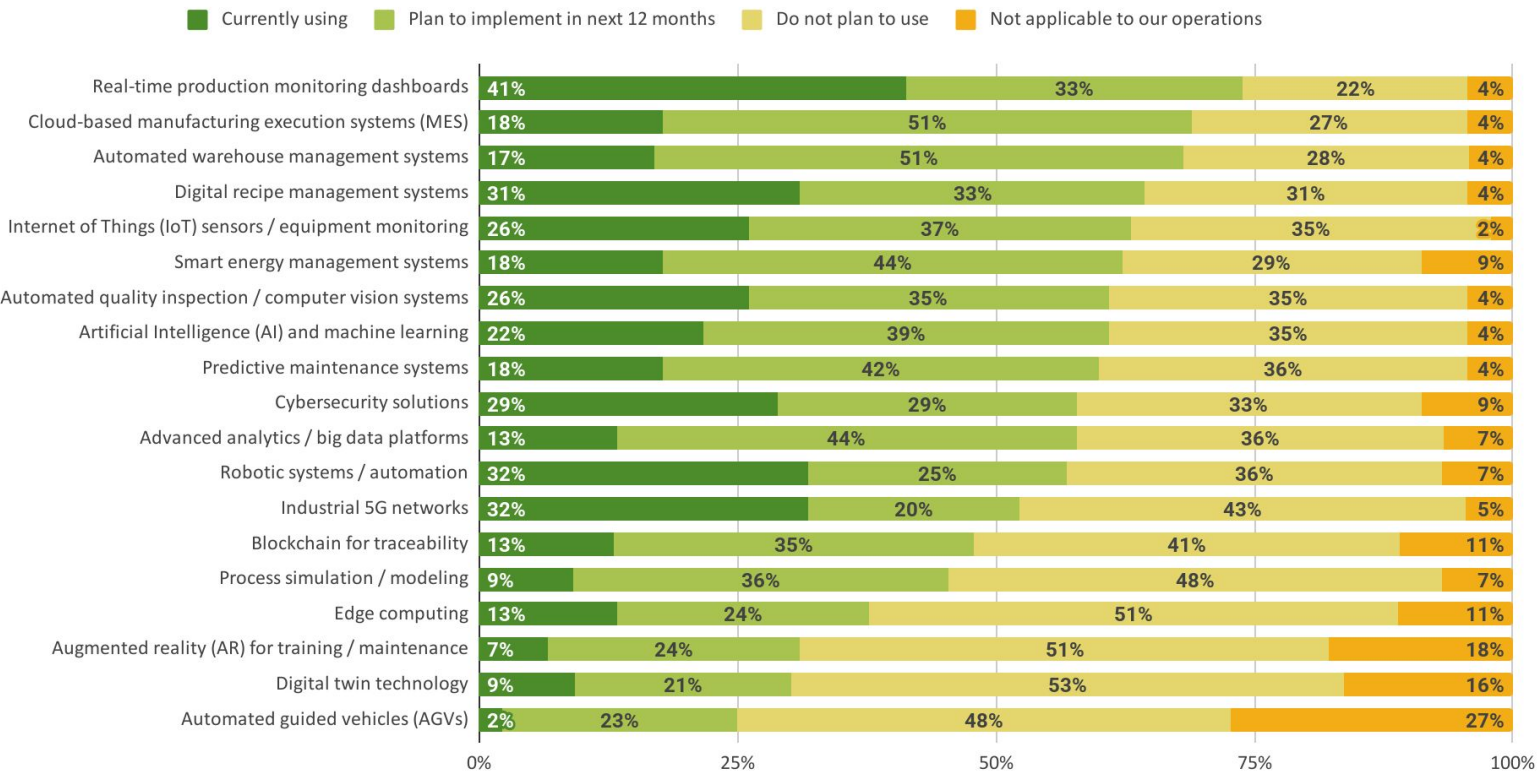
What percentage of your facility's equipment and system investments in the past 12 months went towards digital / automation projects?



Adopting Industry 4.0 technologies

Real-time production monitoring dashboards is a favorite among Industry 4.0 technologies — 41% of respondents are already using this technology, and 33% plan to implement it within the next 12 months. There was also significant interest in adopting cloud-based MES (51%), automated warehouse management systems (51%), smart energy management systems (44%), and advanced analytics platforms (44%) within the coming year. On the opposite side, more than half of companies said they had no plans to use digital twin technology, edge computing, and augmented reality (AR) for training / maintenance.

Do you currently use or plan to adopt (within the next 12 months) any of the following Industry 4.0 technologies?



How technology supports compliance with upcoming FSMA traceability requirements

Although the FDA recently announced its intention to [postpone the deadline](#) for the [Food Traceability Final Rule](#), it's imperative that companies start preparations to ensure compliance. The rule requires companies to share information with other parties across the supply chain, something key technologies can enable:

Digital traceability systems

- [Blockchain technology](#) creates immutable records tracking products from farm to fork.
- **IoT sensors** monitor environmental conditions throughout the supply chain.
- **AI algorithms** predict and prevent potential safety risks.

Cloud solutions

- [Cloud-based labeling](#) manages changing ingredients and regulatory requirements.
- **Centralized data platforms** ensure all supply chain partners access consistent information.

[Electronic data interchange \(EDI\)](#)

- Automates data exchange between businesses
- Reduces manual entry errors
- Enables 24-hour response to FDA information requests

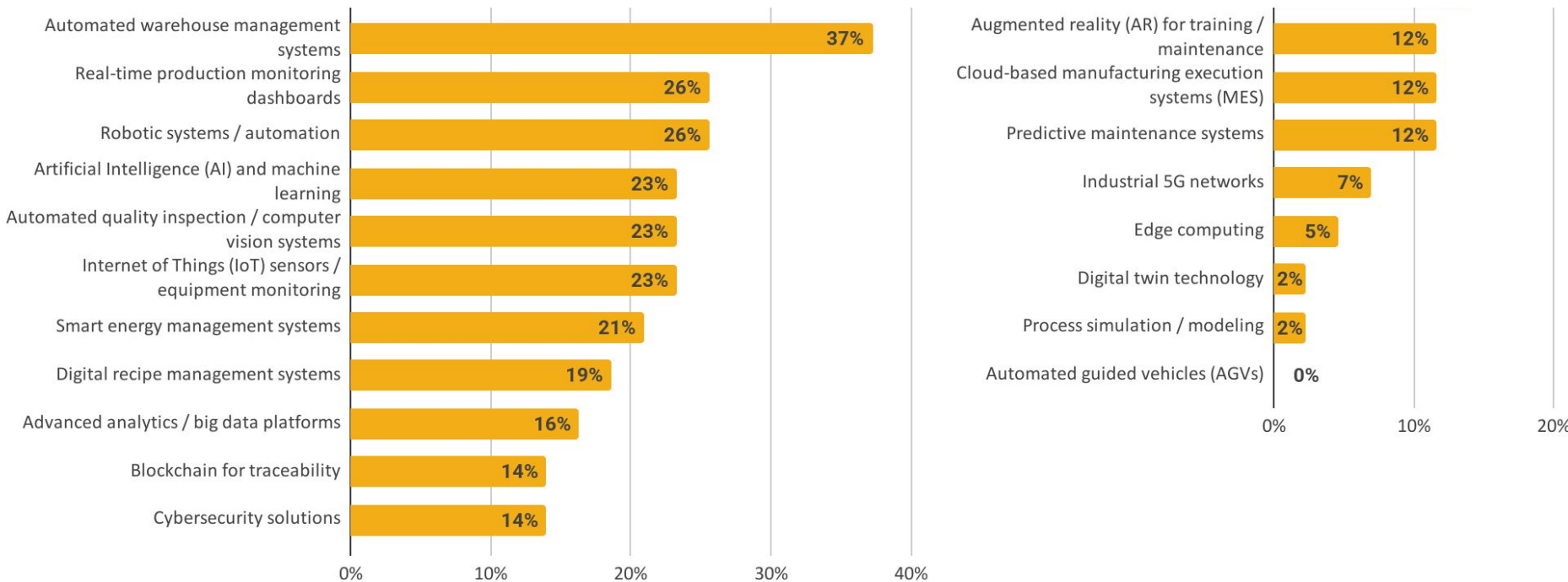
These technologies not only ensure regulatory compliance but also improve supply chain efficiency, enhance consumer trust, and reduce the impact of potential recalls.

Technologies with the best ROI

More than a third (37%) of food and beverage companies said their automated warehouse management system delivered the greatest ROI in their operations over the past year. About a quarter also reported high ROI from real-time production monitoring dashboards and robotics systems / automation.

Which of the following Industry 4.0 technologies have delivered the highest ROI in your operations over the past 12 months?

Respondents could select up to three.

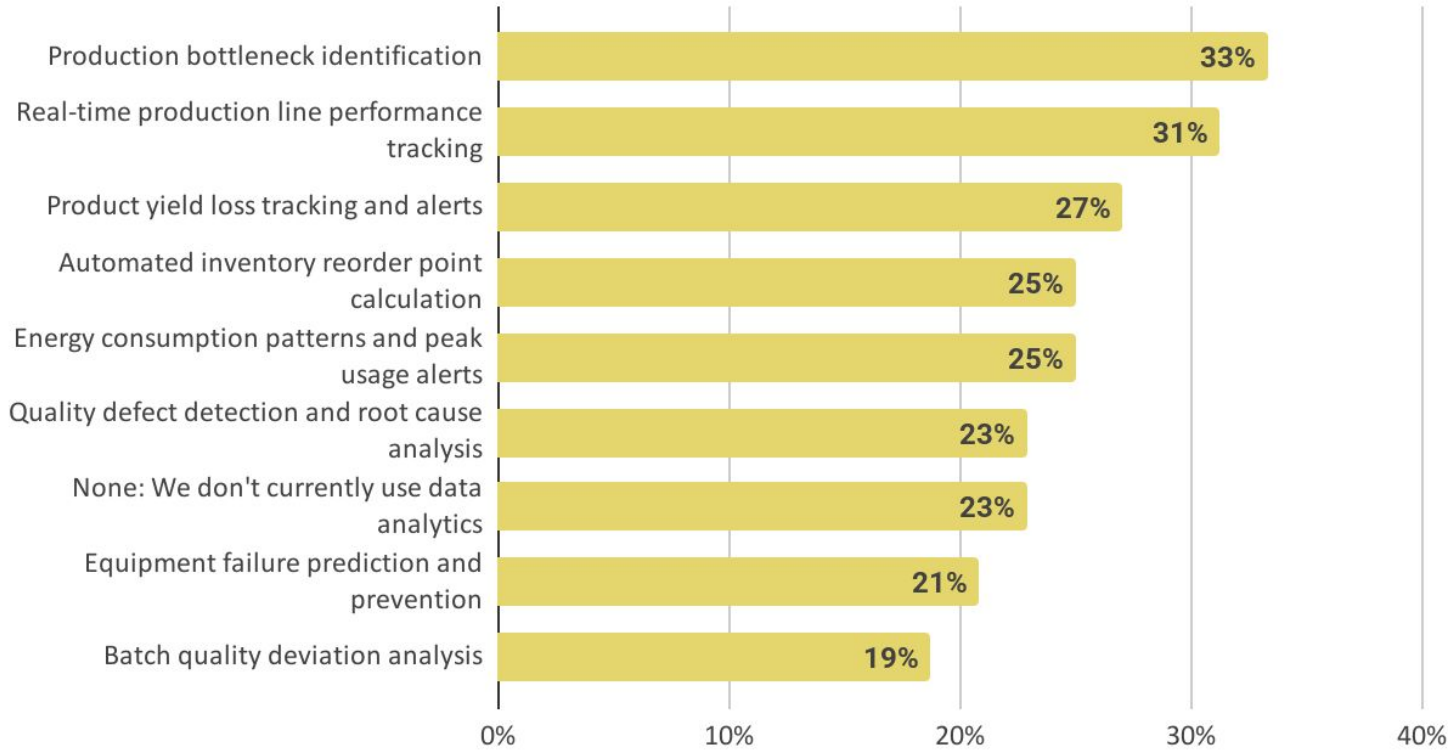


The value of data analytics

Survey respondents cited production bottleneck identification (33%), real-time produce line performance tracking (31%), and product yield loss tracking and alerts (27%) as the areas where data analytics has proven most valuable. It's also worth noting that nearly a quarter of companies aren't currently using data analytics.

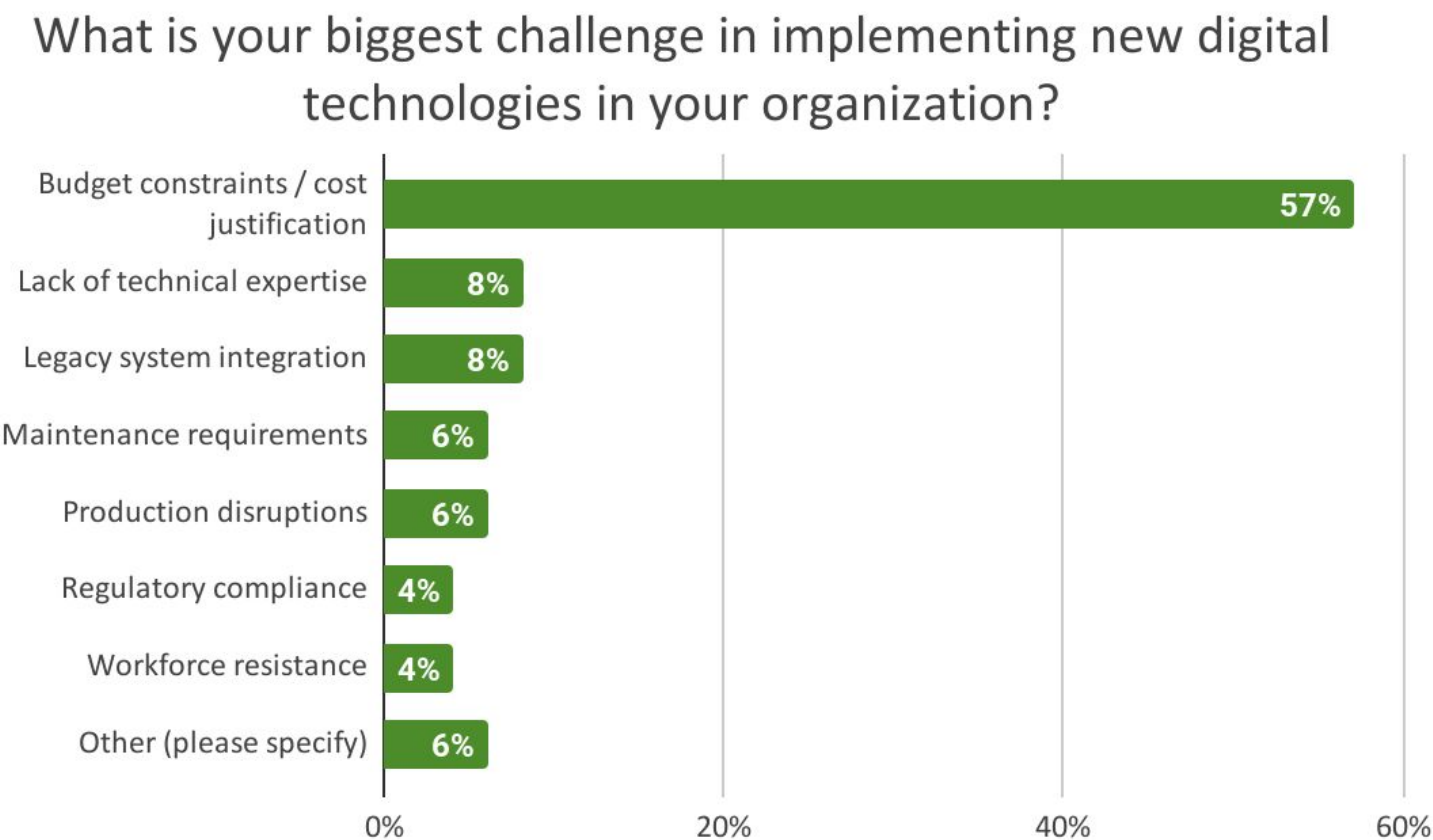
Where have data analytics provided the most value?

Respondents could select up to three.



Technology implementation challenges

Budget constraints / cost justification is easily the biggest pain point when implementing new technologies — 57% cited this as their greatest challenge. Some respondents noted additional obstacles like security protocols and training employees.

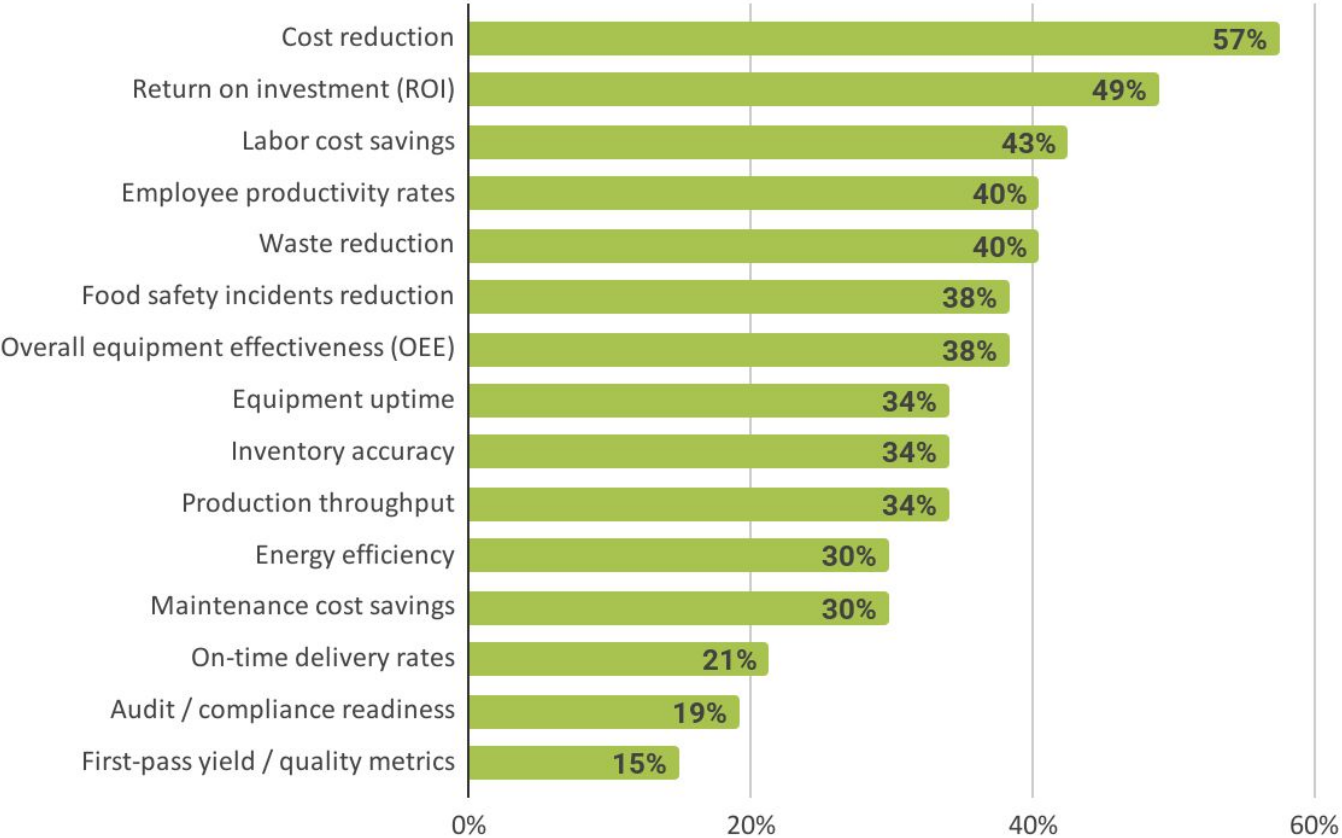


Determining implementation success

Companies are most likely to measure technology implementation success by reduction in cost (57%), ROI (49%), and labor cost savings (43%). Far fewer respondents said they use audit / compliance readiness (19%) and first-pass yield / quality metrics (15%) to determine the success of an implementation.

How do you measure the success of your digital technology implementations?

Respondents could select all that apply.

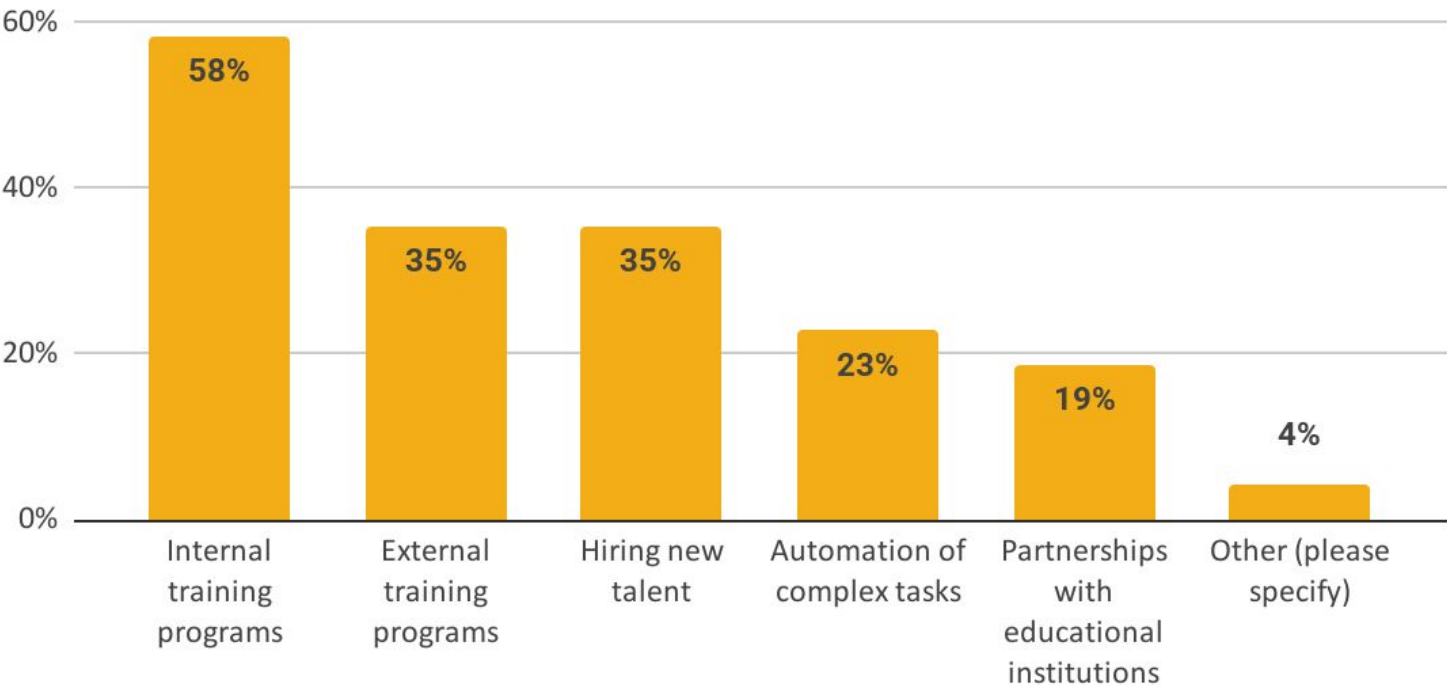


Addressing skills gaps

New technology calls for new skills. Most companies (58%) said they're tackling digital skills gaps through internal training programs, while more than a third are using external resources and hiring new talent. One respondent noted that they're trying to hire but budget constraints are making it difficult.

How are you addressing the digital skills gaps in your workforce?

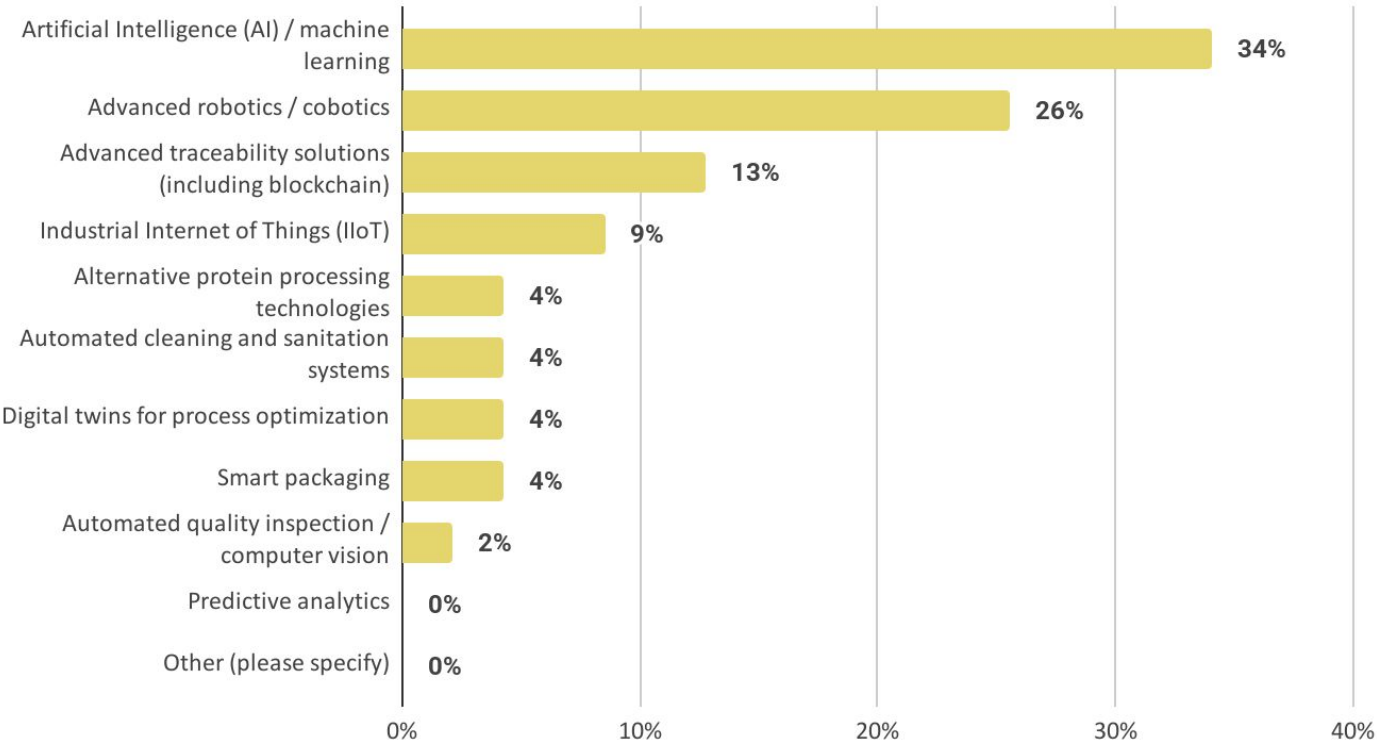
Respondents could select all that apply.



Most impactful technologies

Looking ahead, 34% respondents believe AI and machine learning will be the most impactful food manufacturing technology, followed by advanced robotics / cobotics (26%). Meanwhile, technologies like automated quality inspection and predictive analytics are expected to have little to no impact over the next three years.

Which emerging technology do you believe will have the greatest positive impact on food manufacturing in the next three years?





PART 1:

State of Digital Transformation

Recommendations for F&B leaders

- **Prioritize technologies with proven ROI:** Focus on technologies delivering proven returns, particularly warehouse management systems, real-time production monitoring, and automation solutions.
- **Focus on data analytics for operational excellence:** Investing in data analytics capabilities will drive operational excellence by identifying production bottlenecks, tracking performance, and monitoring yield losses.
- **Prepare for Industry 4.0 technologies:** Forward-thinking companies should prepare for Industry 4.0 by developing strategies around AI, machine learning, and advanced robotics, while also planning for upcoming regulatory requirements like FDA's traceability rule.
- **Address implementation challenges strategically:** To overcome implementation challenges, manufacturers should create comprehensive ROI frameworks, establish clear success metrics, and address skills gaps through internal training programs and strategic hiring.
- **Establish clear success metrics:** By balancing immediate operational improvements with longer-term digital transformation goals, food manufacturers can achieve the operational excellence, system integration, and workforce development necessary to remain competitive in an increasingly technology-driven industry.

Proven implementation recommendations from Ternpoint

A successful implementation framework:

- **Create an implementation plan:** Set up a weekly schedule with your partner and monitor progress. Involve the steering committee for any delays. Have goals for each phase before moving on.
- **Data migration:** Clean up data during onboarding to ease migration.
- **Change management:** Identify and support key individuals early, involving them in decisions to foster acceptance.
- **Training:** Provide thorough training, especially partner-led sessions for specialized knowledge.
- **User acceptance:** Develop detailed scripts for testing and apply changes to avoid surprises post-go-live.



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Common pitfalls to avoid:

- **Are the stakeholders at the table?:** Ensure the project team includes representatives from key areas and end users with deep knowledge of processes. Communicate regularly with the steering committee, ideally monthly during the project and weekly as go-live approaches.
- **Underestimating the complexity and degree of change management:** Pay special attention to change management, data cleanup, and end-user training, as neglecting these areas can derail the entire project.
- **Inadequate user training:** "Train the trainer" methods can save on costs, but involving your partner in end-user training is crucial.
- **Poor customization decisions:** Customizations increase long-term maintenance and testing requirements, creating technical debt. Adapt your business processes to the system whenever possible.
- **Ignoring post-implementation support:** Responsive post-implementation support is crucial; consider a tiered approach where core team members handle tier-one support before escalating to your partner, to save on time and ongoing support costs.
- **Being unprepared for updates:** Regularly test new software releases in a sandbox environment before deploying them to production.

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PART 2:

Consumer Attitudes Toward Food Tech

While food manufacturers adopt industry 4.0 tech for improved efficiencies, consumers express some distrust regarding technology used in processes. On the flipside, there's some excitement around tech-enabled food benefits that could unlock some consumer buying power.

Voicing technology concerns

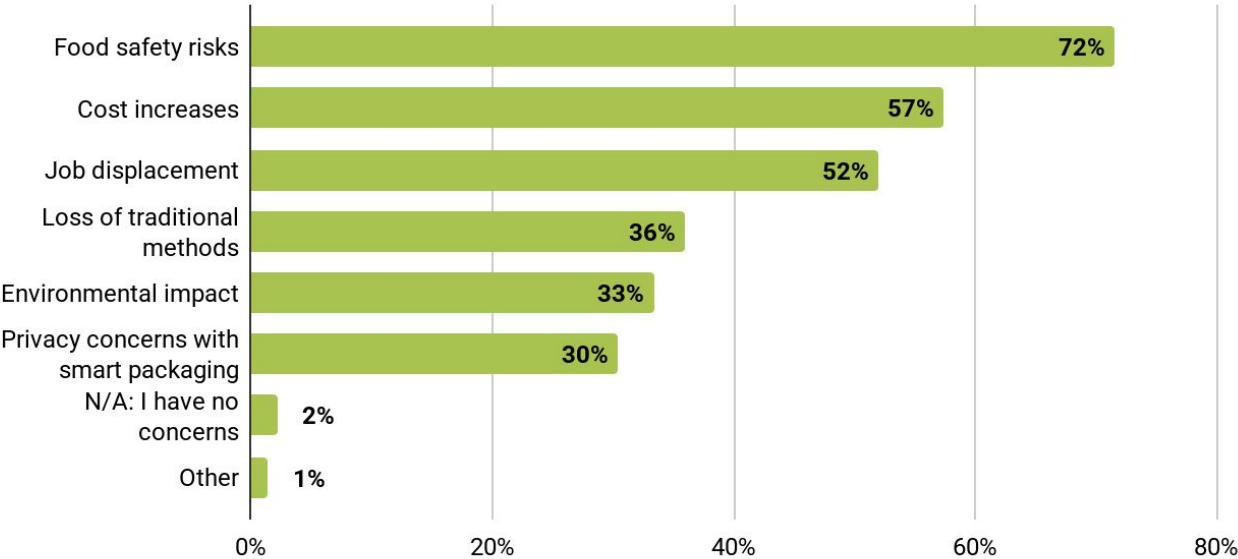
By far the top consumer concern regarding food production technologies was food safety risks — 72% of consumers shared this worry, followed by cost increases (57%) and job displacement (52%).

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- Food safety risks was the biggest concern across age groups, but Gen Z was less concerned about privacy (15%) and loss of traditional methods (26%). They were also slightly less worried about cost increases (41%).
- Consumers aged 60 and over were less concerned about environmental impact (24%), but more parents expressed this worry (44%).
- Respondents shared specific concerns about the use of AI, questioning its effectiveness in food safety applications and worrying that companies will lean too heavily on AI use.

What concerns do you have about the use of new technologies in food production?

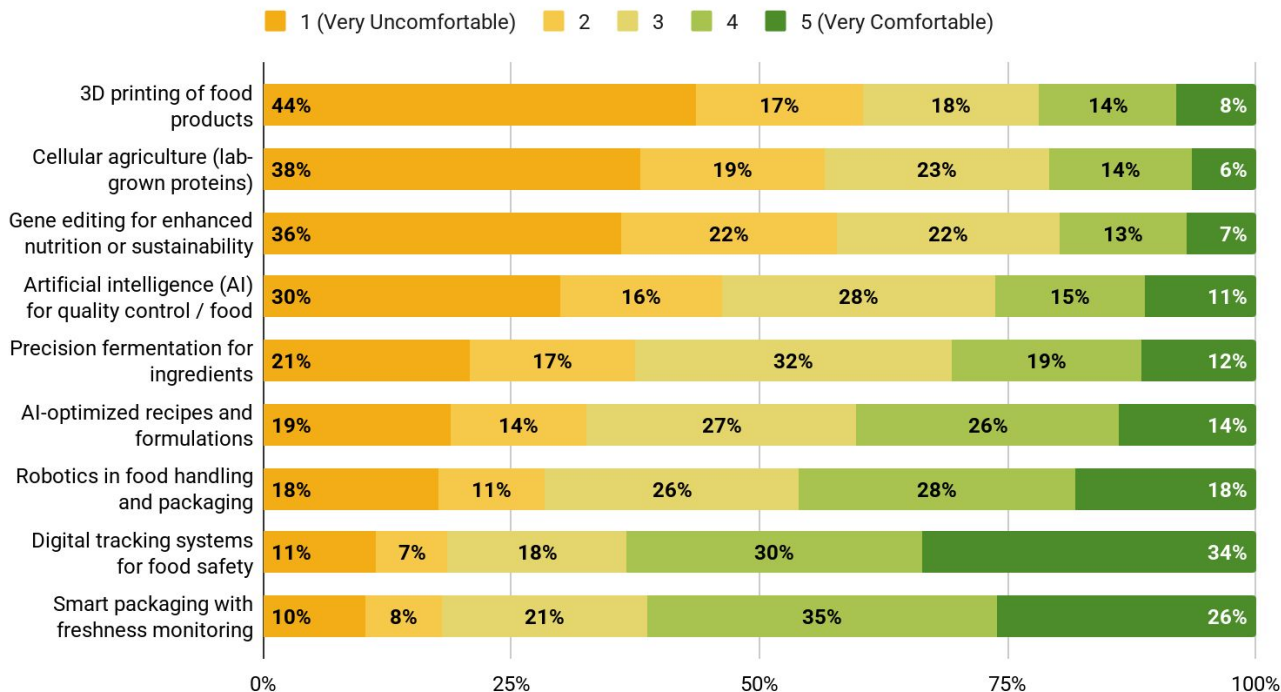
Respondents could select multiple concerns.



Comfort with food production technologies

About six in 10 consumers said they're uncomfortable with 3D-printed food products, and more than half said the same about cellular agriculture (57%) and gene editing (58%). However, the majority were comfortable with digital tracking systems (64%) and smart packaging (61%).

Rate your comfort level with the following technologies used in food production.



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- Gen Z and Millennials are more likely to be comfortable with 3D-printed food products, cellular agriculture, and gene editing, while Gen X and consumers 60 and older are more wary of these technologies.
- Parents are more comfortable with AI-optimized recipes (51% compared to 40%). Only 19% are uncomfortable with this technology, far below the general population's 33%.
- Lower income consumers (with a household income of less than \$50,000) are more likely to be very uncomfortable with all these production technologies, compared to those making \$50,000 or more.

Consumer education critical to encouraging acceptance of food technology

It's natural to be cautious about emerging technologies. While tech-savvy consumers may readily trust food advancements, others may need proof that they're safe and beneficial.

- **3D-printed food products:** Consumers lack trust in 3D-printed foods because they seem artificial and industrial. The technology feels unnatural compared to traditional cooking, raising concerns about nutritional value and ingredient safety. The mechanical production process creates psychological barriers despite potential customization benefits.
- **Cellular agriculture:** Lab-grown proteins face skepticism because they appear disconnected from traditional farming. Consumers question whether these products are "natural" and contain the same nutritional properties as conventional foods. The complex production methods are difficult to understand, generating fears about unknown health effects.
- **Gene editing:** Consumers worry gene editing fundamentally alters food in potentially harmful ways. The technology triggers concerns about unintended consequences, biodiversity impacts, and allergenic properties. The scientific complexity creates a knowledge gap that breeds caution rather than acceptance.
- **Artificial intelligence:** Distrust stems from concerns about reduced human oversight and lack of transparency. Consumers worry about AI errors affecting food safety and quality. The technology feels impersonal and disconnected from traditional food production values that emphasize human care and judgment.

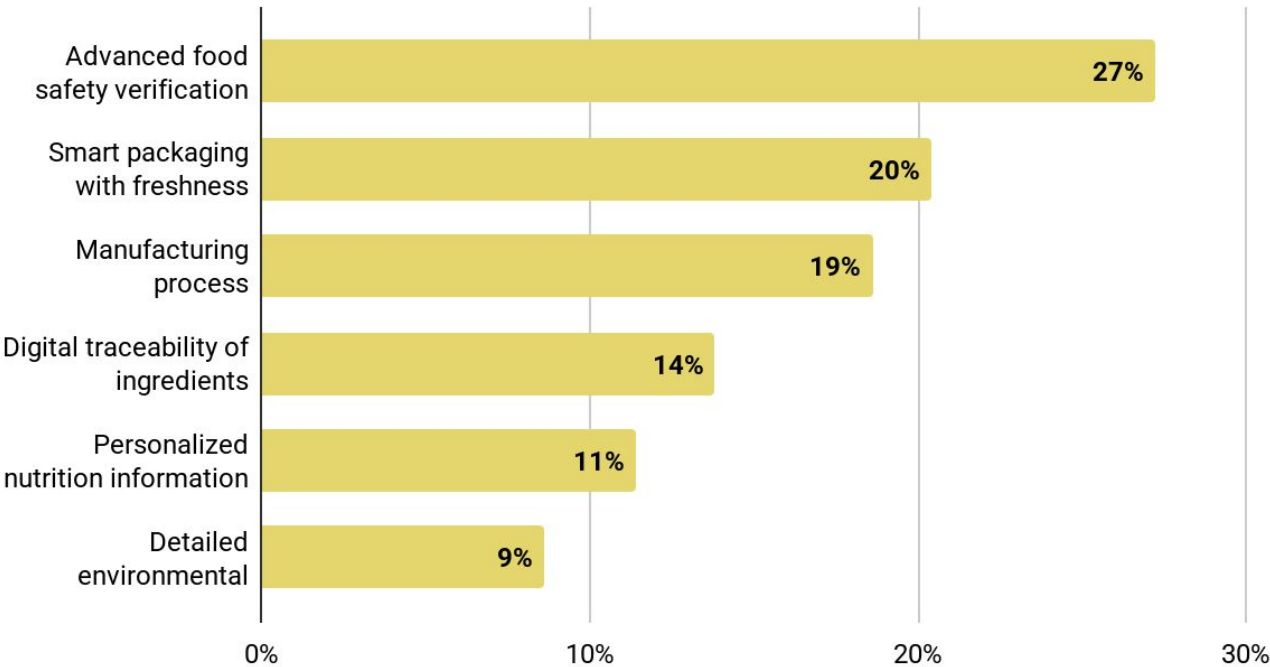
Explaining these technologies in straightforward terms and highlighting their practical benefits helps build trust in the unfamiliar. Manufacturers should emphasize safety verification, partner with trusted organizations, and provide transparent information about technology applications. Allowing consumers to experience these innovations firsthand can help shift perceptions from skepticism to informed acceptance.

How tech influences purchasing decisions

With food safety concerns top of mind, 27% of consumers said advanced food safety verification would have the most impact on what food products they buy. About one in five said smart packaging that indicates freshness (20%) and transparency about manufacturing processes (19%) would convince them to buy. Only 9% of respondents felt that information on environmental impact would sway their decisions.

Which of the following tech features would most impact your food buying choices?

Respondents could only select one answer.



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- For Gen Z, smart packaging is the most influential tech feature (30%), followed by digital traceability of ingredients (19%) and personalized nutrition information (19%).
- Millennials also expressed more interest in personalized nutrition 16%, and they were more likely to say that detailed environmental impact information would impact their decision (13%).

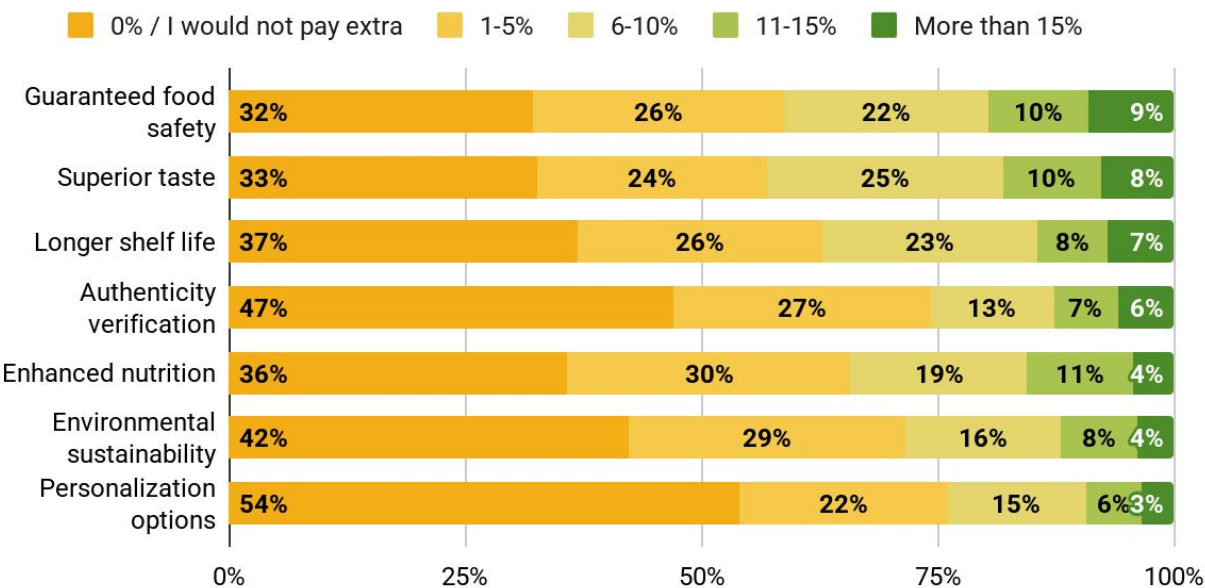
Willingness to pay for tech-enabled food benefits

Yet again, food safety proves to be a priority for consumers — more than two-thirds would pay extra for products with guaranteed food safety benefits, with 9% even willing to pay more than 15% extra. Meanwhile, 54% of respondents don't feel it's worth paying extra for personalized options.

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- Gen Z is more likely to pay more for environmental sustainability — 11% would pay more than 15% extra. In addition, 15% would pay over 15% more for authenticity verification.
- Authenticity verification is also important to Millennials and parents — 9% and 8%, respectively, would pay more than 15% for this benefit.
- Gen X and 60+ consumers are least likely to pay extra for environmental sustainability — close to half would not pay more for this benefit.
- Interestingly, respondents from lower income households were more likely to pay more than 15% extra for all these benefits, especially for improved shelf life (12%), compared to households with a \$50,000+ income.

How much extra would you be willing to pay for these food-related benefits?



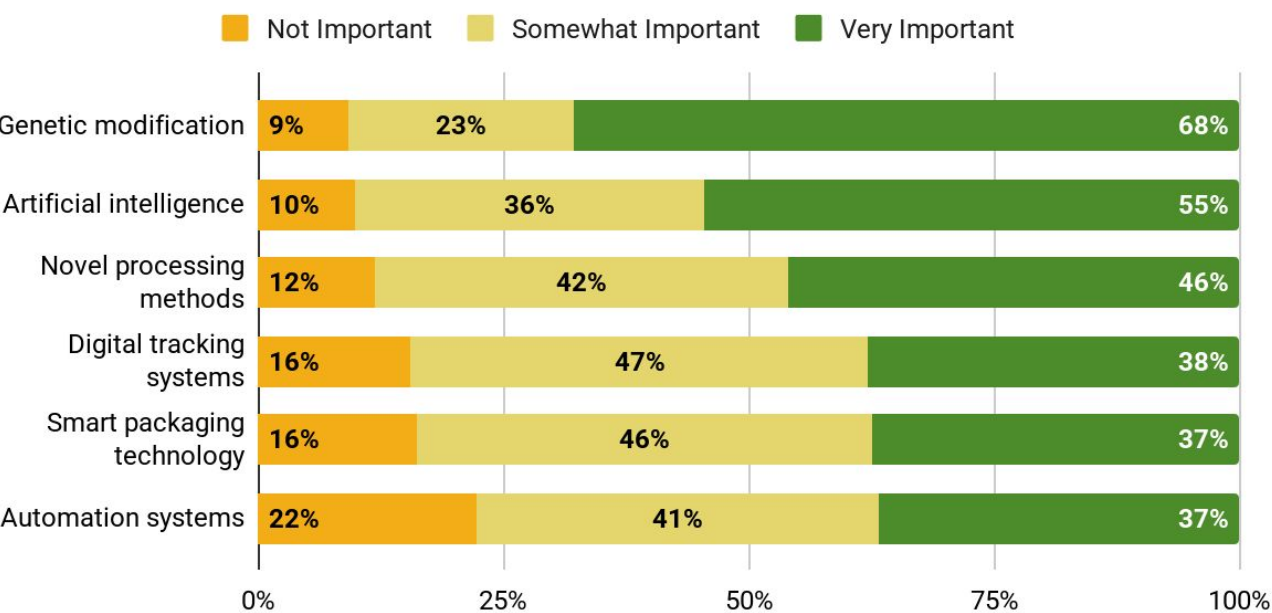
Disclosing use of food technology

Nearly seven in 10 consumers said it's very important for food companies to disclose their use of genetic modification. The use of artificial intelligence was a close second, with 55% saying disclosure is very important. On the other hand, consumers feel it's less important for them to know about a company's use of automation.

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- Consumers aged 60 and older are most adamant about the disclosure of genetic modifications, with 76% saying this is very important.
- Knowing about the use of AI is slightly more important to parents, with only 7% marking it as not important.
- Gen Z is more likely to want to know about the use of novel processing methods — only 7% said this is not important.

How important is it for food companies to disclose their use of the following technologies?



Informing consumers through packaging

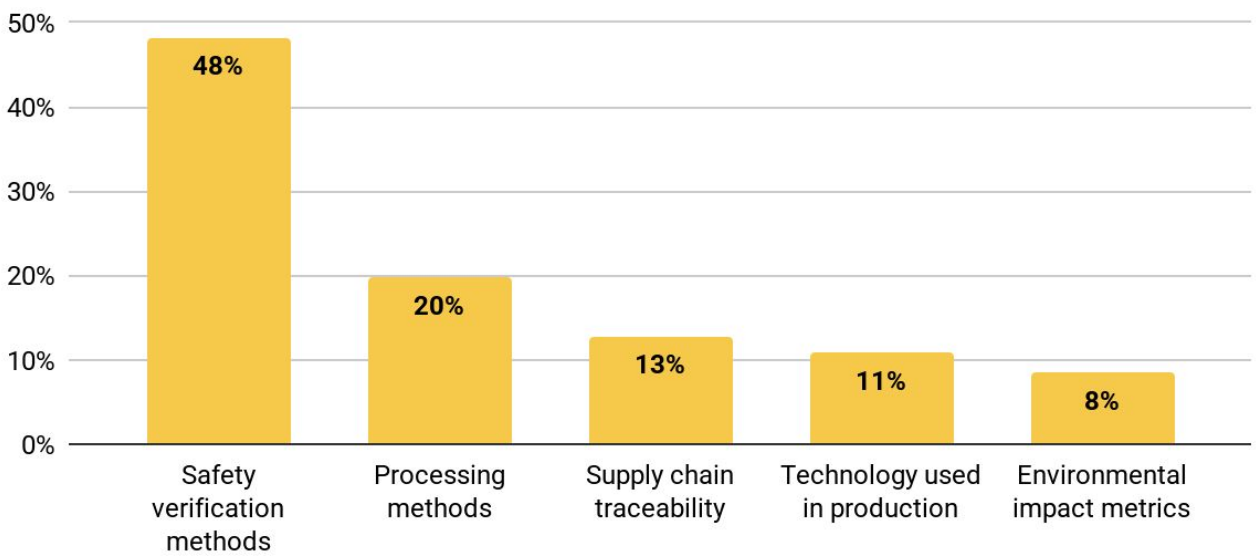
Almost half (48%) of consumers said they'd like to see safety verification methods printed on food packaging, while they were less interested in processing methods (20%) and traceability (13%). And although many consumers felt it important for companies to disclose their use of certain production technologies (see previous page), only 11% felt that this information should be included on packaging.

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- More than six in 10 Gen Z respondents (63%) said they want to see safety verification methods on the package.
- Two in 10 Millennials would like production technologies to be included on packaging.
- Including environmental impact metrics on packaging is more important to Gen Z (15%) and Millennials (10%).

What information would you most like to see included on product packaging?

Respondents could only select one answer.

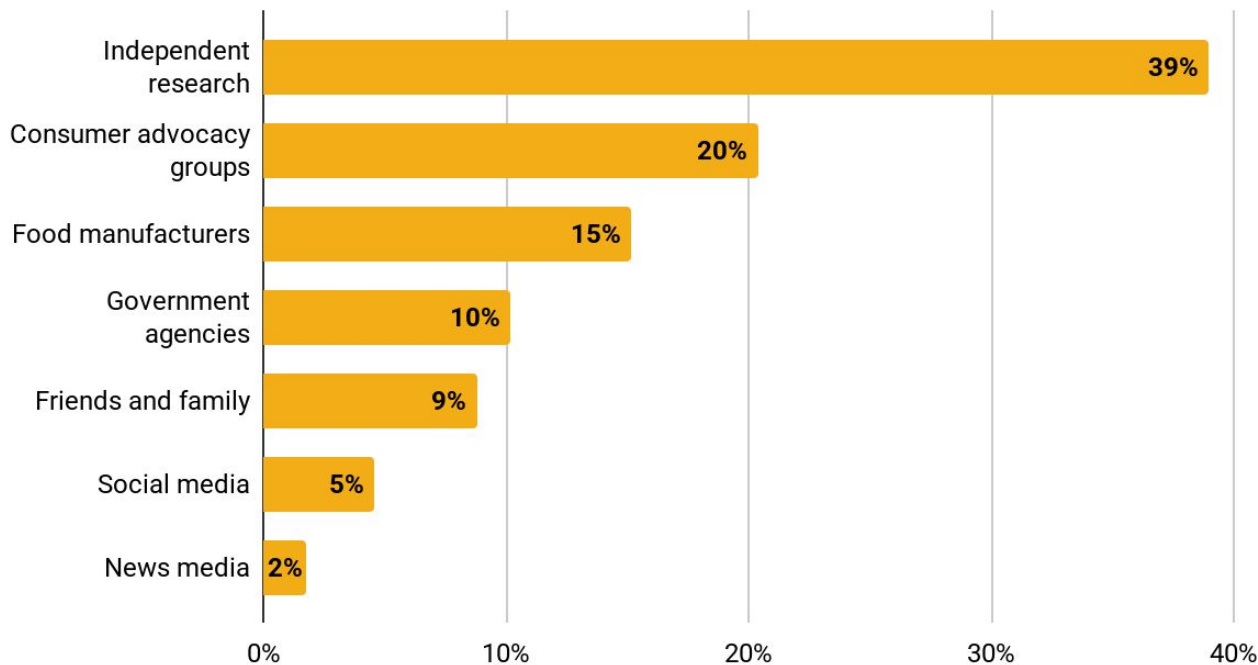


Trusted sources for tech information

When asked who they trust most for information on food production technology, the clear winner was independent research organizations. Nearly 40% of respondents named this as their most trusted source, while consumer advocacy groups (20%) and food manufacturers (15%) trailed behind. Consumers are least likely to trust social media (5%) and news media (2%).

Which source do you trust most for information about food production technology?

Respondents could only choose one answer.



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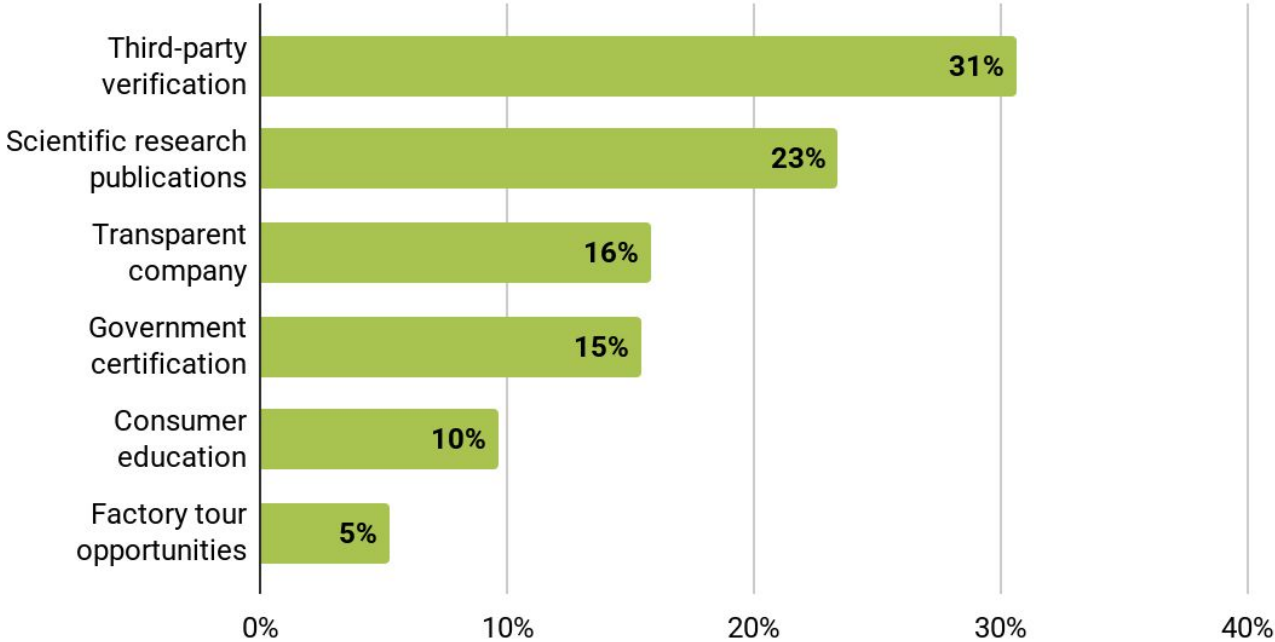
- Compared to respondents overall, Gen Z is far less trusting of consumer advocacy groups (4%) and more trusting of friends and family (19%) and social media (11%).
- Consumers aged 60 and older are more trusting of consumer advocacy groups (27%) and far less likely to trust news outlets (1%) and social media (less than 1%).

Improving trust in technology

So what’s the best way to boost consumer confidence in technology? It’s all in the science-backed data. Nearly one-third of respondents said third-party verification would increase their trust in food production tech, and 23% cited scientific research publications.

What would most increase your trust in food production technology?

Respondents could only select one answer.



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- Gen Z was the only age group to value scientific publications (37%) more than third-party verification (22%).
- Nearly 20% of parents said transparent communication and government certification would boost their trust.
- Parents were also more likely to say that factory tours would aid trust-building (9%).
- While third-party verification was the biggest trust-building factor for households making \$50,000 or more a year, lower income respondents leaned more towards scientific research.



PART 2:

Consumer Attitudes Toward Food Tech

Recommendations for F&B leaders

- **Communicate food safety benefits:**
 - Consumers want safe food above all else — they demonstrate a willingness to pay a premium for safety assurances and tech-enabled features like extended shelf life.
 - When sharing information on production processes and automation, position technology implementations primarily as safety enhancements rather than innovations for their own sake.
 - Create educational content explaining how technologies enhance product safety, quality, and freshness.
- **Back changes with science:** Partner with trusted independent organizations to build credibility when introducing new technologies.
- **Tailor marketing approaches:** Be aware that younger consumers are more receptive to emerging technologies, while older consumers may need more education on why technology upgrades are necessary.
- **Invest in smart packaging and traceable ingredients:** Focus technology investments on smart packaging and digital tracking systems, which enjoy broader consumer acceptance.

Digital Transformation

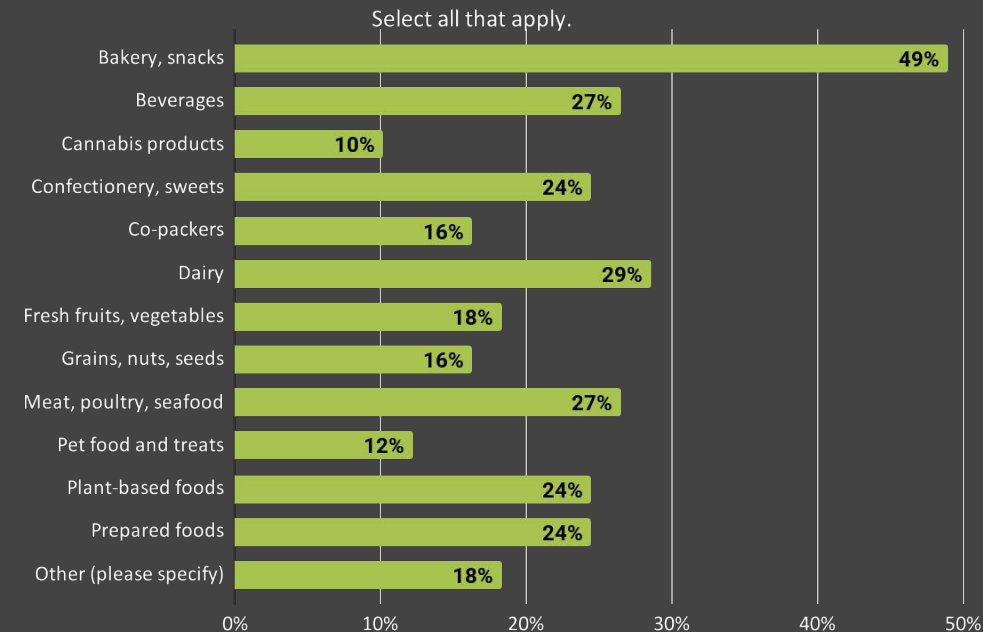
Moving forward

- **Develop ROI-driven investment frameworks:**
Create comprehensive ROI assessment models that prioritize technologies with proven returns. Focus initial investments on warehouse management systems, production monitoring, and targeted automation that address specific bottlenecks identified through data analytics.
- **Build a tech skills development strategy:**
Establish formal technology upskilling programs for existing staff, targeting both technical and managerial capabilities. Consider partnerships with educational institutions and technology partners to create talent pipelines and fill specialized roles in AI, robotics, and data analytics.
- **Frame tech adoption around food safety:**
Position technology investments in consumer messaging primarily as enhancers of food safety and quality, not just operational efficiency. Incorporate third-party verification of safety benefits and make these certifications visible on packaging to address the top consumer concern.
- **Prepare for FDA traceability requirements:**
Accelerate implementation of digital traceability systems ahead of the FDA Food Traceability Rule deadline. Invest in technology like cloud-based solutions, blockchain for immutable records, and EDI systems, aligning regulatory compliance with consumer demand for transparency.

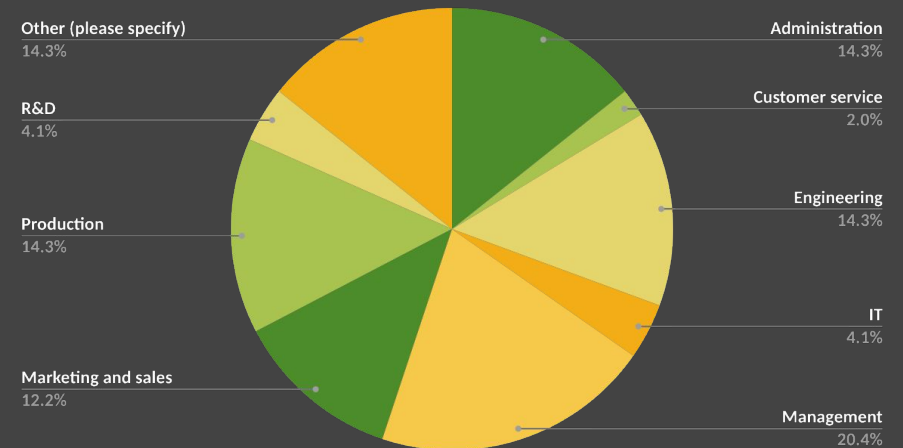
Methodology

In March 2025, we surveyed representatives of food and beverage companies on the state of digital transformation at their facilities. Respondents varied by industries served, company roles, and seniority:

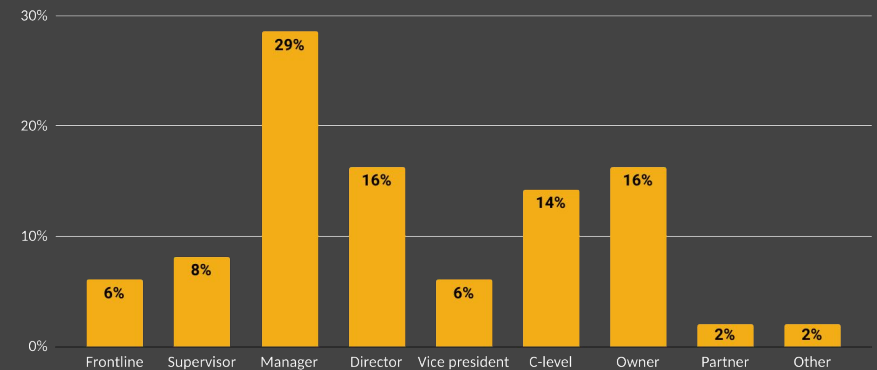
What vertical(s) does your company serve? Select all that apply.



What best describes your role in your company?



What best describes your job seniority?



Digital Transformation

Methodology

In addition, an online survey of 500 U.S.-based consumers was conducted in March 2025.

Respondents were categorized by age group, income level, and parental status. **Gen Z** included respondents aged 18 to 27, **Millennials** included respondents aged 28 to 43, and **Gen X** included respondents aged 44 to 59. The survey also included respondents aged **60 and over**. The share of respondents in each age group was as follows:

- Gen Z: 5.4%
- Millennials: 27.0%
- Gen X: 34.8%
- Aged 60+: 32.8%

- Respondents were considered **lower income** if they had a household income of less than \$50,000.
- **Parents** included respondents with children under 18 living in their household.

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