



## The AI Transformation in Food Production: Is Your Facility Prepared?

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### Need to Know

- ♦ AI can support food safety and defect detection, predictive maintenance, yield and supply chain optimization, and preservation of institutional knowledge
- ♦ Manufacturers can start with clearly defined, high-impact operational problems, rather than attempting broad AI deployment all at once
- ♦ AI applications affecting food safety, quality, or compliance require appropriate validation, documentation, explainability, governance, and human oversight

From strengthening contamination oversight to preserving institutional knowledge, artificial intelligence (AI) offers new tools for addressing persistent challenges in food production. However, realizing these benefits requires manufacturers to establish a robust digital and data foundation.

The food industry faces numerous pressures, including narrow profit margins, evolving food safety requirements, supply chain volatility, and high employee turnover. At the same time, a single recall or food safety incident can cause significant financial and reputational damage.

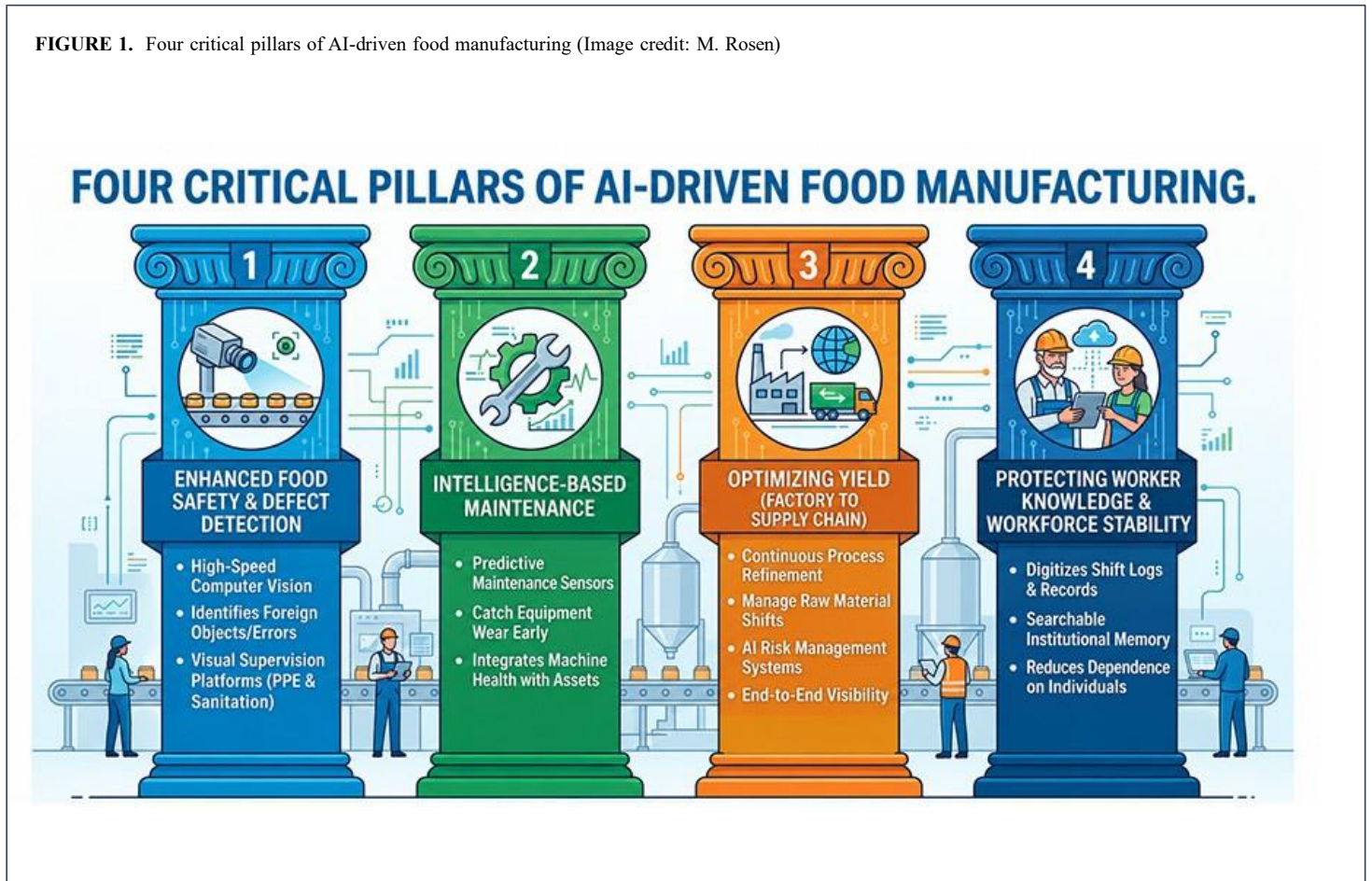
Against this backdrop, manufacturers are exploring AI applications across production and supply chain operations. Yet there remains a gap between technological potential and results on the factory floor. Successful AI implementation requires more than purchasing software; manufacturers must identify specific operational problems and build the data infrastructure needed to support AI applications.

## Critical Pillars of AI-Driven Food Manufacturing

AI applications are emerging across food production, with opportunities to support both food safety and operational efficiency. Four key areas (Figure 1) include:

1. Enhanced food safety and defect detection
2. AI-enabled predictive maintenance
3. Yield and supply chain optimization
4. Protection of institutional knowledge and workforce stability

FIGURE 1. Four critical pillars of AI-driven food manufacturing (Image credit: M. Rosen)



### *Enhanced Food Safety and Defect Detection*

Food safety and quality inspection are important areas of AI application. Computer vision, X-ray, spectral imaging, and other sensor-based systems can inspect products at production-line speeds. Reported performance varies by technology and application; for example, some foreign-object X-ray and laser systems have achieved detection accuracy exceeding 95 percent.<sup>1</sup>

AI-enabled visual monitoring can also be applied to facility operations. Cloud-based computer vision platforms, for example, can be used to monitor activities such as personal protective equipment (PPE) compliance.<sup>2</sup>

Beyond inspection, machine learning can analyze process data to identify changes or patterns that could indicate emerging operational problems. During a recall or traceback investigation, AI-enabled data analysis can also help manufacturers more rapidly identify potentially affected lots, ingredients, suppliers, and distribution pathways.

Such capabilities may become increasingly valuable as industry prepares for FDA's Food Traceability Rule, established pursuant to Section 204 of the *Food Safety Modernization Act* (FSMA). The original compliance date was January 20, 2026. FDA subsequently proposed extending that date by 30 months to July 20, 2028.<sup>3</sup> The additional implementation time provides covered entities with an opportunity to evaluate and improve their supply chain data and traceability systems.

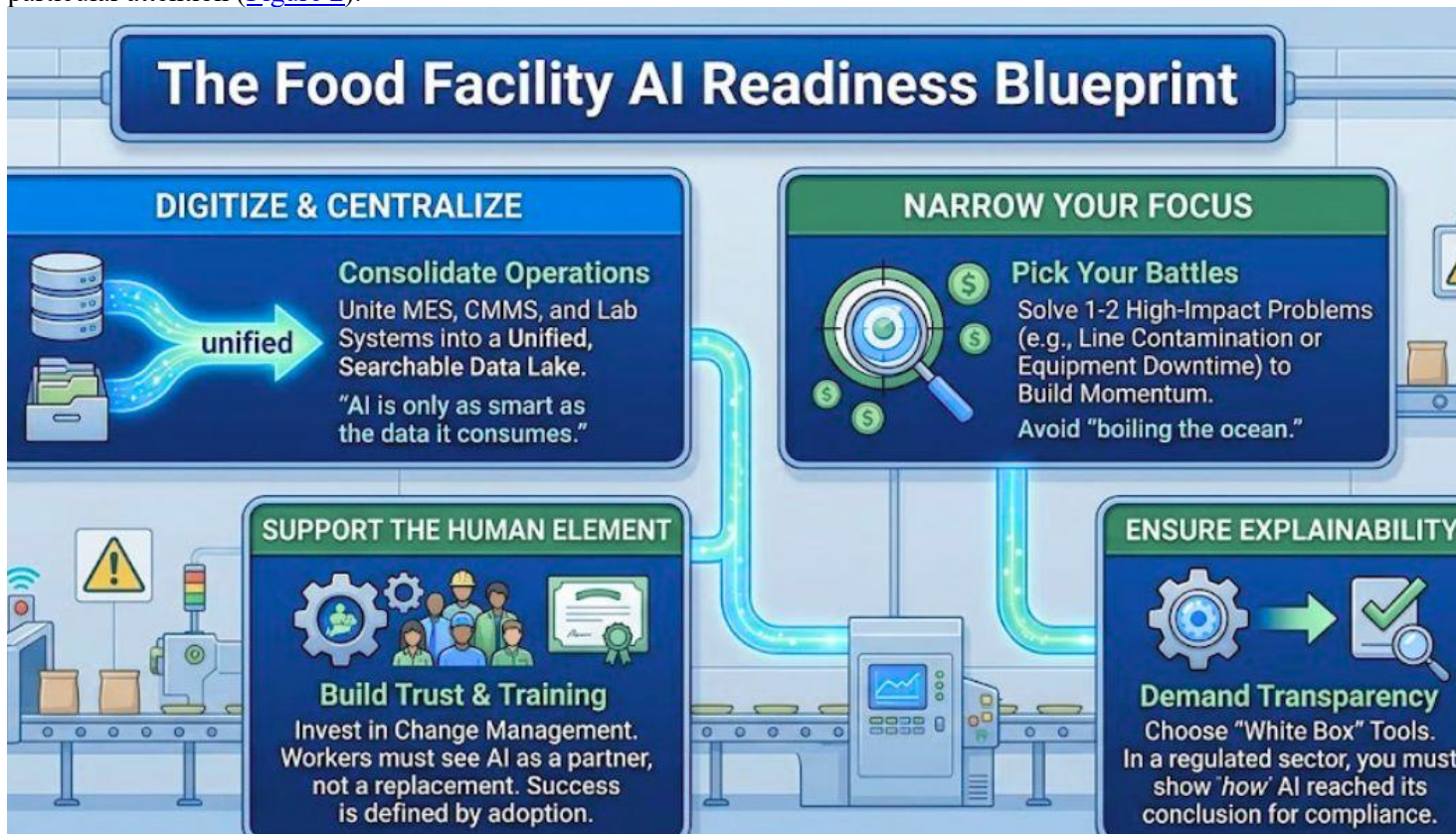
### *AI-Enabled Predictive Maintenance:*

Within food production, unexpected equipment downtime can contribute to waste, production delays, and depending on the process, temperature-control

and other food safety concerns. Predictive maintenance uses equipment and sensor data to identify changes that may indicate developing equipment problems. Specialized software, often integrated with enterprise resource planning (ERP) or asset-management systems, can connect equipment-condition data with maintenance activities, allowing teams to intervene before some failures occur.

## The Blueprint for AI Readiness

Successful AI implementation depends on preparation. For food manufacturers considering AI applications, four areas warrant particular attention ([Figure 2](#)).



*Digitize and centralize operational data.* AI systems depend on the quality, availability, and context of the data they consume. Manufacturers should evaluate how information from systems such as MES, computerized maintenance management systems (CMMS), laboratory systems, ERP platforms, sensors, and other sources can be organized and made accessible for analysis. Establishing a robust data backbone is a fundamental step in supporting advanced analytics and machine-learning applications.<sup>5</sup>

*Start with clearly defined problems.* Rather than attempting to automate numerous processes at once, manufacturers can begin by identifying one or two high-impact operational problems for which appropriate data are available. Focused applications provide an opportunity to assess performance, refine data and workflows, and establish internal experience before expanding AI use.

*Prepare and involve the workforce.* Technology implementation also depends on the people who use it. Training, change management, and employee participation can help workers understand the purpose and limitations of AI tools and how those tools fit into existing food safety, quality, maintenance, and operational responsibilities. Human expertise remains particularly important when AI is being used to support decisions with safety or compliance implications.

*Establish AI governance and appropriate explainability.* Manufacturers should also consider how AI systems will be evaluated, monitored, documented, and governed throughout their lifecycle. The National Institute of Standards and Technology (NIST) AI Risk Management Framework provides a voluntary framework for incorporating trustworthiness considerations into the design, development, use, and evaluation of AI systems.<sup>11</sup>

For AI applications affecting food safety, quality, or compliance decisions, manufacturers should prioritize appropriate transparency, validation, documentation, traceability, and human oversight. In a regulated sector, it is essential to be able to show how an AI reached a conclusion, which makes choosing "white box" tools (e.g., systems where the logic is transparent, rather than a "black box" of hidden algorithms) that support audit and compliance needs an absolute necessity. Explainable AI techniques can provide insight into the factors influencing model outputs, although the appropriate level and method of explainability will depend on the system, its intended use, and associated risks.<sup>12</sup>

For manufacturers preparing to adopt AI, treating operational data as a strategic asset and beginning with clearly defined, high-impact applications can

provide a practical foundation for broader implementation. AI alone cannot resolve the complex food safety and operational challenges facing food manufacturers, but facilities with reliable data, appropriate infrastructure, defined governance, and an engaged workforce will be better positioned to evaluate where these technologies can provide meaningful value.

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