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FOOD ENGINEERING'S TOP 10 NEW PLANT PRODUCTS OF 2024

Planning for AI-based Automation Systems

Quality Control, Safe Food Rely on People and Technology

Raising a Higher-quality Mushroom Product

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DECEMBER 2024
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Top 10 New Plant Products of 2024

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Planning for AI-based Automation Systems

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Quality Control, Safe Food Rely on People and Technology

Quality control of food products goes hand-in-hand with safe foods, yet there have been a number of food safety incidents over the past year.

Raising a Higher-quality Mushroom Product

Viewers of a reality show may have seen farmers grow mushrooms in a bunker, but the true reality of growing quality mushrooms is far more complex.

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From the E

Derrick Teal I Editor-in-Chief

Daring to Try Something New

I'VE NEVER TRIED FOIE GRAS. While I have tried veal and lamb in the past, and I choose not to eat them anymore, foie gras has been beyond a line I don't feel comfortable crossing. I'm definitely curious as to why it's considered a delicacy, is it really that good? As it turns out, I may actually be able to try it without the guilt. Vow, an Australian cultivated meat producer, held an event last month with foods featuring foie gras made from quail cells brewed in a bioreactor as the main ingredient.

The angle the company is taking is a fascinating one. Citing the higher-than-usual costs for cultivated meat products, among some of the other challenges, Vow is looking to position cultivated meat products as an upscale offering. I think it's a good angle that has the potential to benefit not just Vox but the entire cultivated meat industry. The idea of positioning goods as a high-end product to let first adopters cover the initial costs while other players enter the market and bring the overall costs down is a tried-and-true method. It frequently works in the tech space, after all.

Elsewhere in alternative protein, it's possible to get people to try new flavors by getting away from the "eww" factor. Yes, it's very scientific name, I know, but I'm reminded of the time I tried escargot. The magazine I worked for at the time was putting on an event at a French restaurant in San Francisco to kick off a tradeshow. A group of us were sitting at a table with a number of appetizers that had apparently been ordered indiscriminately. The other plates had been picked at, but the escargot remained untouched. Nobody was really willing to be the first, including me. That is, I wasn't willing until I had gotten enough adult beverages into me. I was the first, and last, to go since I ended up eating the plate by myself. So, I think that more people would be willing to try it if they knew that it wasn't the "real" thing.

However, why does alternative protein have to be an analogue of animal protein? That's a question Beyond Meat asked earlier as it released Beyond Sun Sausage, which wasn't designed to replicate pork, beef or poultry. Breaking away from what people already know could help get them out of the compare and contrast attitude many take when trying an alternative protein. Let the R&D departments go crazy with different flavor and texture combinations. And, who knows, maybe it won't take numerous drinks to get someone to try it. **FE**

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The Intersection Of IoT Sustainability And Food Safety:

A New Era in Supply Chain Management

Investing in the right IoT hardware and software package can provide actionable data that will help you improve business operations.

All images courtesy of Surgere

BY THOMAS STRAIN

WHEN CONSUMERS PURCHASE FOOD FROM THEIR LOCAL GROCERY STORE, they don't often think about how it got there. As food travels longer distances from all over the world, the responsibility for keeping those supply chains safe and accountable falls to the food producers themselves. Thankfully, the necessary technology to monitor those supply chargereins with increasing accuracy (enhanced with artificial intelligence [AI]) has evolved significantly since the supply chain disruptions four years ago.

More than ever before, food producers are deploying Internet of Things (IoT) solutions that allow them to track food products from the moment they leave the field to the time they reach the consumer. It is crucial to deploy the most evolved supply chain hardware and software packages to manage the extensive and often complex data necessary to make this possible. Companies that can locate their products with pinpoint accuracy in real time have significant advantages over less technologically advanced competitors.

Thomas Strain is Surgere's vice president of technology and leads Surgere's technology organization, as well as its hardware integration, to bring data-driven supply chain software solutions and AI platforms to the market.

Technological Advances Drive Progress

Well-functioning supply chains allow farmers and manufacturers to ensure food is delivered safely to grocery stores sustainably. Additionally, should problems occur within the production cycle, IoT technologies can aid in protecting consumers from food that doesn't meet the high standards required by the Food and Drug Administration (FDA).

Building robust supply chain monitoring systems can seem daunting, but working with the right partners can help you identify what technology you need and the most cost-effective method of using it. Whether it's radio frequency identification (RFID) tags, ultra-wideband, cellular tracking or GPS data, technological advances can help secure today's ever-lengthening food supply chains.

There are now combined hardware and software systems that provide 99.9% or better data accuracy as businesses track assets from the field to consumer, which offers companies a plan to use their strategic assets more efficiently and effectively. By combining IoT hardware with groundbreaking software, building a safe, secure and sustainable food supply chain is possible.

Data Collection Drives Safety

According to the World Economic Forum (WEF), food supply chain transparency is vital, as almost one in 10 people suffer from foodborne diseases annually. The same WEF study estimates that these diseases kill nearly 500,000 people a year. Improved traceability allows food producers to act quickly to stop contaminated food from reaching consumers .

The more granular the data collection at each step of the process, the better. Enhanced real-time monitoring reduces food waste and ensures compliance with environmental, social and governance standards. Catching problems as quickly as possible can also save your organization time and money.

Item-level traceability technologies enable food suppliers to provide information on the origin, sourcing methods, and freshness of products, building customer trust. These technologies also simplify recall management by quickly identifying and removing affected products. Compliance with regulations, such as the FDA's Food Safety Modernization Act (FSMA), is made much easier through accurate record-keeping and tracking using the latest technology.

By tracking the food throughout the production process, you can prove definitively that all the proper steps were followed. Additionally, you can halt production if you discover that steps were missed before the tainted food ever reaches consumers. Having the right technology in place to accomplish these goals is critical.

Why Traceability Matters

Traceability of the food from field to factory and beyond is essential. Not only is it important on the rare instance where unsafe food makes it out of the factory and can be recalled quickly and efficiently, it also allows food producers to make sure the product is as fresh as possible when it reaches the consumer.

Partnering with companies that can offer sophisticated supply chain monitoring hardware and software offers you insights into how long products have been at a specific location. By deploying the latest AI-driven technology, you can be alerted when food has been sitting too long.

Additionally, IoT solutions can provide you with the ability to put in place a more accurate "first-in, first-out" (FIFO) inventory management system. Without adequate oversight and software integration, inventory management depends solely on human input, which could lead to errors. Making sure the right food products are shipped to processing facilities allows those partners to certify the freshness of their products as they are delivered to consumers.

Serve Your Sustainability Goals

Environmental sustainability is increasingly important to business partners and consumers alike, and IoT technology can help make your operations more sustainable over time. There are two action items companies can implement immediately using IoT technology to improve their operational sustainability:

- Rather than use disposable shipping containers, consider using multiuse and long-term-use reusable containers to ship your food products. IoT technology, combined with an AI-powered software package, can help you keep track of where your containers are at all times. It can help supply chain managers prove the return on investment associated with reusable containers. When that data is integrated with other variables like the number of trucks on the road, distance traveled by those trucks, and how much product is on each truck, supply chain managers can make better decisions that protect the business while improving overall sustainability.
- IoT technology will also allow you to cube your trucks more efficiently, allowing you to use fewer half-filled trucks on the road. Deploying tags and tracking software will provide you the necessary information to cube your trucks as close to 100% as possible. Fuller trucks mean more efficient delivery using fewer vehicles, which reduces your carbon footprint by using less fuel and decreasing emissions.

The Bottom Line

The cost of purchasing an overarching technology solution to manage your supply chain may seem steep, but it is quickly becoming a necessity. As the food production industry grows increasingly competitive, any technology that can provide you with an edge can be the difference between being profitable or not. Over time, however, your streamlined organization will save enough money to pay for your technology investment many times over. The more sophisticated the package, which should include AI-driven searches, the more savings you'll accrue to the bottom line. Given the trend of automation in other aspects of the food manufacturing industry, it makes sense to use IoT tools to hone your understanding of what is going on in your supply chain.

With the complexity of food and beverage supply chains, many existing systems may already be in place and relied on for business intelligence and planning. The right partner can integrate data both to and from those systems to provide seamless views of how your supply chain operations and volume production affect all aspects of business intelligence and trend monitoring. A qualified, reputable partner should be able to determine what elements of your business must be tracked and create solutions that are scalable and repeatable so your hardware and software package can expand as your business does. Adding tracking hardware and a robust software system to collate and categorize the most important operational data will allow you to keep the food supply chain safe, trace the food from the time it leaves your facility to the time it reaches the consumer, and help you reach your sustainability goals. **FE**

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AIR PRODUCTS

DIGITALIZATION

Bakery Locks In Product Quality with New SCADA System

Goodman Fielder, a large Australian baking company, bucks the digitalization project trend by integrating system software platforms for three factories.

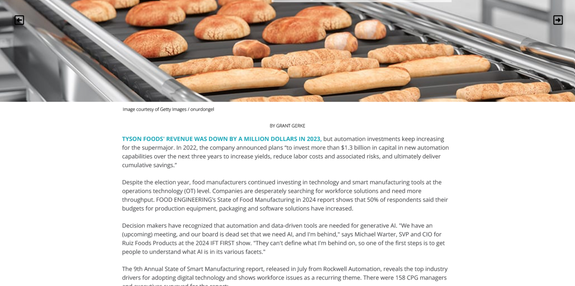


Image courtesy of Getty Images / cnurdongel

BY GRANT GERKE

TYSON FOODS' REVENUE WAS DOWN BY A MILLION DOLLARS IN 2023, but automation investments keep increasing for the supermajor. In 2022, the company announced plans "to invest more than $1.3 billion in capital in new automation capabilities over the next three years to increase yields, reduce labor costs and associated risks, and ultimately deliver cumulative savings."

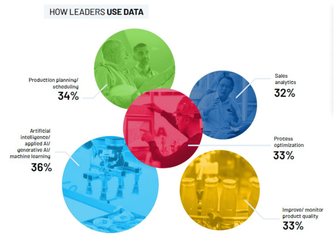
Despite the election year, food manufacturers continued investing in technology and smart manufacturing tools at the operations technology (OT) level. Companies are desperately searching for workforce solutions and need more throughput. FOOD ENGINEERING's State of Food Manufacturing in 2024 report shows that 50% of respondents said their budgets for production equipment, packaging and software solutions have increased.

Decision makers have recognized that automation and data-driven tools are needed for generative AI. "We have an (upcoming) meeting, and our board is dead set that we need AI, and I'm behind," says Michael Warter, SVP and CIO for Ruiz Foods Products at the 2024 IIFT FIRST show. "They can't define what I'm behind on, so one of the first steps is to get people to understand what AI is in its various facets."

The 9th Annual State of Smart Manufacturing report, released in July from Rockwell Automation, reveals the top industry drivers for adopting digital technology and shows workforce issues as a recurring theme. There were 158 CPG managers and executives surveyed for the report:

1. Worker and knowledge retention
2. Deploying new technology, and capturing and understanding data to improve their business.
3. Onboarding new employees
4. Balancing quality and profitable growth
5. Attracting employees with desired skill sets
6. Capturing, understanding, interpreting and using data to improve their business

"This year's report underscores the need for CPG manufacturers to prioritize workforce development, as ensuring employees are well-trained and equipped to leverage emerging technologies will be essential in overcoming industry challenges and achieving sustainable growth," says Steve Deitzer, vice president of global industry CPG for Rockwell Automation.

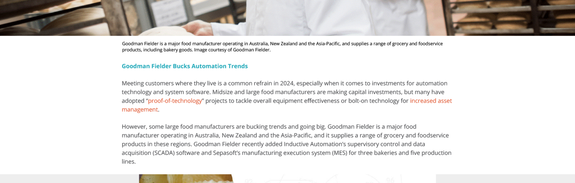


While food manufacturers are investing in automation to alleviate workforce challenges, data maturity in the enterprise is growing. Image courtesy of Rockwell. Image courtesy of Rockwell Automation

From the report, decision makers see the best return on investment (ROI) centered around production monitoring systems. According to the report, the top five ROI are production monitoring, generative AI/machine learning, cloud/software as a service, digital thread and energy management. In July's issue of FOOD ENGINEERING, G&J Pepsi needed accurate data visibility into its production stoppages due to manual data collection for OEE. G&J Pepsi adopted Sage Clarity's ABLE (Automation Business Engine Logic) technology that allows food and beverage manufacturers to leverage production data from machine and line programmable logic controllers (PLCs). In keeping with current trends, this is a small technology investment but with big implications.

"The real 'ah-ha' moment was when we could see the Mean Time Between Failure (MTBF) number and lines stopping every three minutes, and the best line was stopping every 16.5 minutes," says Jeff Erwin, VP of manufacturing and quality for G&J Pepsi. "With the real-time insights into performance, we've been able to increase MTBF to 30, 40, and in some instances 50 minutes MTBF, so we know the true value the data acquisition solution brings."

The Smart Manufacturing Report for 2024 also revealed that spending in technology investment increased by 27% this year and landed between 21% to 27% of the operating budget for the 158 decision makers.

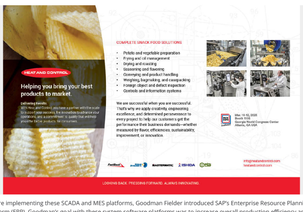


Goodman Fielder is a major food manufacturer operating in Australia, New Zealand and the Asia-Pacific, and supplies a range of grocery and foodservice products, including bakery goods. Image courtesy of Goodman Fielder.

Goodman Fielder Bucks Automation Trends

Meeting customers where they live is a common refrain in 2024, especially when it comes to investments for automation technology and system software. Midsize and large food manufacturers are making capital investments, but many have adopted "proof-of-technology" projects to tackle overall equipment effectiveness or bolt-on technology for increased asset management.

However, some large food manufacturers are bucking trends and going big. Goodman Fielder is a major food manufacturer operating in Australia, New Zealand and the Asia-Pacific, and it supplies a range of grocery and foodservice products in these regions. Goodman Fielder recently added Industrie Automation's supervisory control and data acquisition (SCADA) software and Sepasoft's manufacturing execution system (MES) for three bakeries and five production lines.



Before implementing these SCADA and MES platforms, Goodman Fielder introduced SAP's Enterprise Resource Planning platform (ERP). Goodman's goal with these system software platforms was to increase overall production efficiency and product quality.

For the MES and SCADA platforms, Goodman identified these objectives for the initial rollout across five baking lines and three sites:

- Right-first-time dough mixes
- Reduction in scrap
- Increase in dough mixer availability

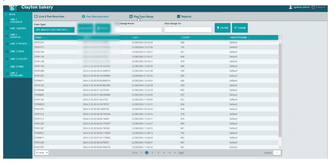
Before implementation, production operators on the baking line received printed work order sheets from SAP and then re-entered this data into the mixing equipment, which led to inefficient mixing schedules and quality issues.

"The daily operations team relied on managing production using a combination of basic human machine interfaces (HMIs) as well as printed Excel sheets with no integration into other production or business systems," states David Hermann, ANZ electrical, instrumentation and process automation manager for Goodman Fielder.

"If a production schedule was changed (in the past), an operator had to run through the line and modify/change the existing paperwork," adds Richard Anderson, OT consultant for Deloitte.

"By implementing an MES system, we eliminated the manual handling of data and paperwork for our recipe and production schedule," says Hermann. "A recipe management system was developed to allow the technical teams to manage all mixing recipes from anywhere onsite and from remote locations."

For the integration, Goodman Fielder and Deloitte rolled out the recipe management pilot to a small audience. Within a short time, there was positive feedback, according to Deloitte at a recent presentation at ICC 2024. The technical baking staff was able to create, edit and delete recipes based directly on bill of materials (BOMs) pulled from SAP. The recipe parameters were written to the PLCs.



Goodman Fielder targeted three facilities and five production lines with its initial rollout of the SCADA and MES platforms. Image courtesy of Goodman Fielder

Inductive Automation's MES/SCADA platform, via the MQTT industrial networking protocol, automatically pulls down production schedules—data—from the ERP system. For the integration, the MQTT publish and subscribe engine allowed integrators to discover the operations network in a few seconds, including thousands of PLCs with hundreds or thousands of tags. MQTT's publish and subscribe technology reduces project integration time since PLC tags for equipment appear instantly. This networking tool eliminates the need to manually provide tag names and input engineering units and ranges. The MQTT protocol was also essential due to Goodman Fielder's purchase of new baking equipment from UK-based Bakers Perkins.

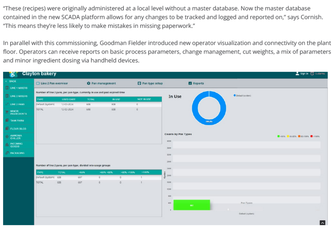
"The equipment was under warranty, and we couldn't make changes to the PLC code," adds Gordon Cornish, principal for Deloitte Smart Manufacturing. "In addition, it had its own scheduling system and recipe management. These had to be incorporated into the SCADA and MES integration."

The SCADA platform uses an autonomous gateway for operations and connects to the business enterprise gateway. "System security always impacts the implementation of these systems," says Cornish. "Communication paths were required from each (factory) site to the enterprise server. The enterprise server, in turn, required a connection. We worked closely with our IT team to ensure that we had reliable and secure connections between machines."

A second obstacle for Goodman Fielder with older processes has been recipe management, governing ingredient additions and ratio parameters at the mixing equipment. Local mixing led to "siloing data" and inefficiencies with customized recipes at each mixer across the three plants.

"These (recipes) were originally administered at a local level without a master database. Now the master database contained in the new SCADA platform allows for any changes to be tracked and logged and reported on," says Cornish. "This means they're less likely to make mistakes in missing paperwork."

In parallel with this commissioning, Goodman Fielder introduced new operator visualization and connectivity on the plant floor. Operators can receive reports on basic process parameters, change management, cut weights, a mix of parameters and minor ingredient dosing via handheld devices.



Goodman Fielder removed variability from baking line management with automated orders from its ERP system to the production line. Image courtesy of Goodman Fielder

Operators now have agency and can troubleshoot before shift meetings. The new platform allows operators to download data to a client PC, and run real-time reports or produce historical data for comparison of present to previous. In addition, operators have a clearer picture into process parameter audits that allows for quicker analysis of | root cause analysis.

"There are a number of opportunities to connect and display new live data by introducing Internet of Things (IoT) devices and connecting through MQTT, including more data consumers through the limited web clients interfaces," adds Anderson.

This continuous improvement project is still moving forward, which started in 2022. "We've already expanded on the original system and introduced the system to track baking pans to improve efficiency and the final product quality," says Hermann. "New edge devices use the MQTT broker and the unified namespace to provide better inventory control." FE

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Planning for AI-based Automation Systems

Artificial intelligence, coupled with machine learning, promises to improve plant operations from sensor level to the enterprise, but adoption has been slow with some overzealous starts.

An engineer meticulously performs calibration checks on signal and manufacturing equipment. With AI-based systems, the function could be accomplished automatically, allowing engineers to spend more time innovating new process controls. Image courtesy of Vinci Futuretools from Pixabay

By Jennifer Lee, CFE

A recent McKinsey article suggests that while many plants could benefit from the use of AI to accelerate process optimization, few are actually ready for it—from equipment on the plant floor to sensors and instrumentation, base-level controls, supervisory/advanced process controls (APC) and finally advisory models. The McKinsey report notes that 13% of plants use AI to describe, predict and optimize process conditions.

Only 34% of plants have installed APC systems for critical unit operations, while 71% of plants have instrumentation and sensors in place, but only 30% of these instruments are properly calibrated and catalogued. Only 19% of plants have dedicated IT teams supporting AI systems, and 60% of organizations have a change management strategy in place to use AI solutions in their current operations.

Implementing a sensor network and AI system requires sensor and process upgrades to enable AI deployments. So, what are system integrators and automation suppliers doing to help their customers? Some are providing consulting services to help customers select sensors and software to build an automation infrastructure that uses AI to make better informed decisions at the supervisory controls/MES level.

With TwinCAT 3 software, automation experts can now tap into new machine learning and deep learning capabilities in a familiar engineering environment and on a standard machine controller. Image courtesy of Beckhoff Automation

A Sane Approach to Sensors and Data

The McKinsey report found that manufacturers' process automation teams "want to install sensors indiscriminately, without a plan to link to value creation." So, how can food and beverage processors plan for and intelligently increase sensor coverage when they already spend much time and money on maintaining and calibrating existing instruments? How should they plan an intelligent sensor deployment that could greatly optimize systems?

"Many facilities already have smart sensors and devices in place that could greatly improve efficiency of their overall process; they just don't know it," says Aaron Pfeifer, principal at Atlas OT, a CSIA (Control System Integrators Association) member company. "Sensors are the 'eyes and ears' of automation systems, and they're the first step in the data collection process. It's not worth more data. First, it can require more hardware and software to be installed, which can be costly. However, the greatest ROI for low quality product or unplanned downtime can be found in networking existing PLCs and HMIs into a SCADA dashboard or OEE system. Sometimes, the data is already there."

"I can understand the desire to install additional sensors," says Brandon Shiffer, Beckhoff Automation software product manager. "But, in many cases, there are already sensors in place that can provide more than enough information for analysis. Typically, there are sensors that are essential to the process, and then there are sensors that are nice to have—I like to if possible, refrain from adding to the redundancy common at additional insights for purchase-driven, manufacturing analysis."

Instead of blanketing their facilities with sensors, a more effective approach focuses on identifying and monitoring the most critical process variables, says Chris Spicer, Livewire customer success director. These are the specific factors, such as temperature, pressure, humidity, flow rate and vibration, that can have a significant impact on the quality of a product. By prioritizing these key parameters, processors can ensure that their sensor network provides the most relevant and actionable data.

"Developing a sensor network geared towards AI-based process control involves careful planning of sensor types, locations and applications that directly link to desired outcomes," says Gregory Powers, VP digital transformation, Gray Solutions, a CSIA controls member. Sensors should be selected and placed to measure the variables that can be

Rockwell Automation's AI-based Analytics Accelerator for FactoryTalk Historian is an integrated platform solution built using ThingWorx to make it easier to apply AI, to data stored in FactoryTalk Historian data archives. The solution consists of several services and ThingWorx mashups which make up the user interface. Image courtesy of Rockwell Automation

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To begin, teams should inventory key processes, says Thomas Kuhlhoff, product manager, core technology, Omron Automation America. This is commonly accomplished through value stream mapping with cross-functional teams. From there, entire sensor flows can be created to manage the performance indicators that accurately reflect baseline operations. Kuhlhoff says that this process can be time-consuming, but it's necessary to ensure that the sensors and data collection, processing and manufacturing engineers to bring their years of experience to shaping the "sensor network" that will be used to prioritize which processes get the attention first. These team members will be quick to point out tribal knowledge that a sensor is needing to quantify or address.

Enlist Outside Help in Planning

For some processors, job requirements of certain newly-transformed employees may preclude their desired participation in planning activities. When this happens, outside engineering houses and SIs can help.

"It may be best to get the support of some experts experienced in automation and AI-based process control," says Frank Lamoreux, director, Rockwell Automation's Food and Beverage Global Industry Group. "They can help with the initial discussions on the real-time and predictive AI-based processes for a plant system and learn what needs to be monitored, what data is precisely select sensors and locations where they need to be installed based on the actual data required.

"The most important aspect when it comes to AI is the data," says Jeff Winter, industry solutions executive, at CSIA member. "Spending time on 'upfront' planning and requirements gathering is the best way to ensure that resources are being used effectively in automation. This includes understanding the problem that is being attacked, the desired outcome—and having a detailed implementation plan to stay on course. The short answer—make sure that the problem is well understood, the data is there to solve it, and that the data is of high quality. Without these three things, AI will not yield results. Data is critical. Having accurate, timely, and qualified data will shorten and prioritize transition to AI in the future."

To effectively expand sensor coverage and plan their usage, start by developing an overall control systems philosophy outline, suggests Jim Kirchmeyer, CMI sensor division, control systems integration. This should include an architectural assessment of the processor's current state, its goals and its staff's capabilities. From this data, create a plan that leverages existing assets and sets the stage for future growth. Develop a preliminary instrumentation, sensors and control hardware with built-in diagnostic capabilities enables predictive calibration and maintenance, improving time efficiency and freeing up resources.

When designing a sensor network, organizations should, at the adage goes, "measure twice, cut once," says Lindsey Bergeron, industry consultant, operational excellence, at CSIA member OSIsoft. "By taking time in planning and implementation, organizations can ensure that their sensor network delivers accurate, reliable data that can be leveraged for long-term value."

Rockwell Automation's AI-based Analytics Accelerator for FactoryTalk Historian is an integrated platform solution built using ThingWorx to make it easier to apply AI, to data stored in FactoryTalk Historian data archives. The solution consists of several services and ThingWorx mashups which make up the user interface. Image courtesy of Rockwell Automation

Use a Phased Implementation Plan that is Scalable

To start, teams should set out a phased implementation plan, Hildreth adds. Rather than attempting to overhaul everything at once, they should start by defining clear improvement goals, and then focus on areas where additional data can create measurable value.

"A phased implementation approach is going to be more effective, starting with pilot areas that can demonstrate clear ROI while setting maintenance expectations for long-term success," says Trupan Modi, CEO and cofounder of The Modern Data Company. "We've seen this succeed with a major equipment manufacturer who transformed their sensor data into predictive insights that helped them shift from a reactive maintenance and predictive maintenance model, which reduced downtime by 30% and maintenance costs by 25%."

In a phased implementation plan, once goals are identified, smart sensors and edge computing can be leveraged to monitor equipment, reduce maintenance and improve safety, Modi says. Implementing machine learning (ML) algorithms on these advanced solutions can help alleviate the burden of maintaining and calibrating existing instruments while pairing the way for more sophisticated analytics.

As the sensor network expands, it's essential to build a scalable data pipeline capable of ingesting and harmonizing information from both legacy systems and new IoT devices, Hildreth says. This unified data architecture can support both real-time data streaming, edge analytics and seamless integration with cloud platforms, laying the groundwork for advanced AI-driven process optimization and predictive maintenance strategies.

AI and its Roles

AI plays a crucial role in the optimization process by enabling the creation of "virtual sensors," adds Lowrentz Durgin. These are essentially AI-powered models that can accurately estimate key critical variables, such as viscosity, consumption, based on data from existing sensors and historical records. For instance, AI can analyze the operational patterns of various drives and motors to predict overall electricity usage with a high degree of accuracy. This reduces the need for dedicated electricity sensors, minimizing installation and maintenance costs.

To future-proof sensor networks for AI-driven process control, processors should make strategic decisions around return on investment (ROI) and scalability, Durgin says. Prioritize sensors that offer a clear ROI, such as those that help with remote product monitoring, energy management, OEE monitoring, Mass Americas, Inc., a CSIA partner member. While AI and looped systems can reduce calibration efforts, standard protocols like time-sensitive networking (TSN) are critical for accommodating diverse requirements and ensuring scalability. By adopting TSN, manufacturers can support both real-time control and future data-intensive AI applications. Additionally, eliminating future bandwidth needs, which could require costly infrastructure upgrades down the line, will help ensure the long-term success of the system.

The Siemens SIMUX 3011 Intelligent Risk module uses artificial intelligence, for example to examine current fluctuations for anomalies that indicate a defect in motors and drives. This significantly increases the planning reliability for maintenance, availability, and cost-effectiveness of the system. Image courtesy of Siemens

APC and AI to Improve Operations

To optimize advanced process controls (APC), processors need robust, well-structured data from sources like SCADA, MES, PLCs and ERP systems, says Grady Powers. This data must be cleansed, validated and consistently structured to support reliable AI models. Next, AI can be used to enhance APC by dynamically adjusting control parameters in real time based on applications across production stages. APC models thrive when regularly optimized through feedback from plant performance, helping to extend APC coverage to more processes, including upstream/downstream operations and utilities.

Processors can improve the use of advanced process controls, while keeping an eye on AI-based APC by understanding, choosing, then piloting the right control architecture for their desired outcome, says Omron's Kuhlhoff. Generative AI-based advanced controls, trained on either algorithms or synthetic data, may be best suited for producing unique process recipes—for example, where a novel output is considered more valuable than a standard.

Applied AI-based advanced controls, trained through a vast amount of unstructured data, may be best suited for predicting process outcomes, Kuhlhoff adds. An example is where accurate forecasting is critical to meeting production targets. Machine learning, trained through process observation, may be best suited for maintaining current production parameters within a tighter allowable threshold where consistency is critical to meeting quality goals.

To future-proof sensor networks for AI-driven process control, processors should make strategic decisions around return on investment (ROI) and scalability, Durgin says. Prioritize sensors that offer a clear ROI, such as those that help with remote product monitoring, energy management, OEE monitoring, Mass Americas, Inc., a CSIA partner member. While AI and looped systems can reduce calibration efforts, standard protocols like time-sensitive networking (TSN) are critical for accommodating diverse requirements and ensuring scalability. By adopting TSN, manufacturers can support both real-time control and future data-intensive AI applications. Additionally, eliminating future bandwidth needs, which could require costly infrastructure upgrades down the line, will help ensure the long-term success of the system.

AI and APC: Beware Buzzword Traps

Advanced process control (APC) is utilized by processors to incrementally improve their product yield based on subtle changes to variables. A goal is for optimizing PID loops and adjusting tooling and gain of equipment to account for fluctuations in temperature, pH or relevance of batches.

The use of AI for these processes should be considered for long-term data to find higher-order fluctuations that are not obvious, Durgin says. Examples are "seasonal changes in ingredients or environmental considerations that may not be affecting the process for a long-term incremental increase/decrease."

Comparing your production data against weather and HVAC use and power consumption can help highlight subtle patterns. In this regard, AI could be on the OT side of the firewall, specific for the process controls. Whereas "AI should aggregate data from across the facility, on the IT side of the firewall. While everybody is busy trying to use AI as a buzzword, the key opportunities emerge where the technologies are best applied and be sure not to fall for buzzword traps."

— Aaron Pfeifer, Principal, Atlas OT

Is AI-based APC Ready for Prime Time?

While AI-based APC solutions are still developing, Powers suggests that AI-driven vision systems are already widely deployed, showcasing the potential of AI-based tools in food processing operations. (See sidebar, "AI Sorting Process Speeds Up Chicken Nugget Sorting.")

"Many AI-based APC solutions are available now," says Beckhoff's Shiffer. "For starters, look for controllers that have broader connectivity and data acquisition capabilities. In addition to running the process, they can also share the necessary information with any required external systems for analysis and/or training. If a machine learning (ML) model is identified and trained to refine a specific process, it is possible to execute this model in sync with the real-time control — think of it as a 'virtual sensor' that can be used to help control the process. Ideally, you'll want the loop to close so that the model and improve the process."

But not all APCs are ready for really high process control, according to Wouter Dek's Post. "Adding APCs to production and distribution can reduce process variance, improve consistency and quality and consolidate the workforce to work on higher value shortage concerns. This can manifest in many ways, depending on the problem. AI-based solutions are fine for data collection, advisory and decision-making support. However, they are not ready for prime time for real-time APC. Right now, that needs to stay within a traditional APC system," Post says.

To examine the potential of APC, food processors can first prioritize high-quality data from robust sensor networks and implement effective data-management systems, says Linsheng Lee's Sprague. Accurate process models, utilizing lean-driven principles, can then be developed to optimize operations. Finally, a hybrid approach that combines AI with traditional control methods can yield the best results. This strategic shift allows manufacturers to build on capabilities more efficiently while making talent development and recruitment more manageable.

— Payne Abrahe, The Modern Data Company

Automation suppliers play a vital role in helping food processors leverage AI advisory models to inform process decisions, Sprague says. They can develop user-friendly interfaces that present AI-generated insights in an easily digestible format, enabling operators to make informed decisions and act on recommendations. Additionally, they can offer optimization suggestions based on both historical and current process data, which can enhance decision-making significantly.

Tailored AI model solutions that integrate AI into existing process control systems can describe, predict and inform decisions by analyzing historical and real-time data to determine optimal parameters for energy usage, product quality and equipment maintenance, says Mount Cisco. Suppliers should guide processors on when to deploy AI—typically in areas where traditional methods struggle with complexity, such as managing variations in raw materials or ingredient mixing. AI models should be employed gradually, starting with predictive maintenance or quality control, and scaling as confidence in AI-driven insights grows. Continuous monitoring and model adjustment are key to long-term success and ensuring sufficient, high-quality quantity and type of data for training the algorithms.

AI can automated solutions only make sense when it comes to safety or if there is a net cost savings, says Maribeth Dee's Post. It's important to realize that an AI-like solution will not address unique plant problems and will lead to failed implementations. AI-based implementations should be driven by process improvements and/or cost savings and mitigating onsite operating conditions. ■

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FOOD ENGINEERING'S TOP 10 NEW PLANT PRODUCTS OF 2024

We've compiled the Top 10 processing and packaging equipment solutions FOOD ENGINEERING's readers were most interested in this year.

BY ALYSE THOMPSON-ARCHIBEQUE

Image courtesy of Getty Images /

INCLUDING BOTH PROCESSING AND PACKAGING TECHNOLOGIES, here are the manufacturing plant products that FOOD ENGINEERING's readers were most interested in this year.

10. CIRCLE PACKAGING MACHINERY'S 424DTI LARGE VOLUME VFFS

Circle Packaging Machinery Inc.'s 424Dti handles large-volume filling with three-side seal and traditional stick pack-style pouches. Filling capability includes thin to viscous liquids and free flowing to non-free flowing powders. The company says its eight-lane machine provides efficient and high-tolerance auger filling of 40 grams of powder at 75 cycles per minute (600 pouches per minute). The stainless-steel constructed machine, with FDA-approved product contact parts, offers an Allen-Bradley PLC control system.

Additional capabilities include the ability to incorporate typical manufacturing options, such as online date coding, data gathering, etc., along with customizing integrations based on customer needs.

9. ELITER'S STAINLESS STEEL GRAIN SONATA BALCONY CARTONER

ELITER Packaging Machinery introduced a full stainless steel wash-down version of its latest Grain Sonata Balcony Cartoner.

The machine's construction offers hygienic features to serve as the packaging end-of-line for the food industry where the ease of cleaning and hygiene are prioritized. It features a dual-axis racetrack collator and an extended carton hopper that allows for continuous operation. The machine also has a tool-less change parts, facilitating feeding the hopper with blanks during the machine's operation and at the end-user's production pace.

The collation system is capable of paralleling multiple primary packaging products and feeding them toward the cartoner. Following this step, the machine can load them into a shelf-ready packaging carton and finish the closure by applying adhesive from the Nordic Meter glue melting system.

The machine is joined by ST-1515 2PK PLC and 13+ axis of servo drive systems from SIEMENS for reliable and stable control. The machine offers the availability of recipe-based and motorized changeover for minimized downtime and minimal manual intervention. With an incorporated remote access device, the manufacturer is able to offer support for the control system and programs, as well as offer a diagnosis from a distance for quick technical support.

8. DONALDSON'S DALRAMIC G2 SMART COLLECTOR

Donaldson Company, Inc. introduced the Dalamatic G2 Smart Collector. Engineered to work with materials that create sticky or agglomerative dust, the Dalamatic G2 dust collector includes patented Dura-Life bag filters. The envelope shape allows for greater bag movement to dislodge challenging dust cakes and helps provide twice the life of a standard 16-oz. polyester bag.

The system's radial seal filter design and fixed cages can help reduce the time for filter changeouts by up to 75%, compared to earlier designs. The filters also contribute to improved pulse cleaning, which results in extended bag life, less maintenance and energy savings.

The Dalamatic G2 Smart Collector is also integrated with Donaldson's iCore Connected Filtration Technology, which tracks collector performance to deliver real-time analytics to help maximize uptime, increase maintenance efficiency and manage critical compliance data.

7. LEUZE'S SOC AND SSC SENSORS

Leuze's SSC and SSC Sensors feature a housing made of V4A stainless steel and a glass-free, scratch-resistant optics cover. The sensors can withstand demanding cleaning and disinfection cycles, as well as large temperature fluctuations.

The SSC and SSC series can be used as through beam photoelectric sensors, retro-reflective photoelectric sensors or diffuse sensors. Depending on the model, Leuze solutions can detect glass, PET, film or small parts. The IR lead of transparent objects down to 0.1 mm. The IP69K and IP67 protection ratings are also dustproof and waterproof and meet the requirements of protection classes IP67, IP69 and IP69K. The housing is designed to prevent bacterial-carry-overs and contamination. Smooth contours without fastening holes prevent deposits.

6. VOGELSANG USA'S REDUNIT XRL260 GRINDER

Vogelsang USA brought its largest format grinding system, the RedUnit XRL260, to North America. The company's largest hopper-fed grinder is designed to reduce large quantities of cold-waste material quickly. The RedUnit XRL260 features two 50 hp geared motors capable of handling up to 130 cubic yards of solid waste per hour (100 m3/h). The 5-ft. by 2-ft. inlet handles whole logs and higher volumes of waste material. The achievable output is geared at fitting a gap in the market oversize requiring multiple grinders or inefficient, high maintenance hammer mills. Units are available in different sizes with various blade options, offering continuous height adjustment.

Among the features of the XRL260 is its side-entry maintenance design, engineered to provide quick and safe access to the grinder's cutting elements. A "side flap" is easily opened to remove foreign objects, typically allowing one person to dismantle the one-piece cutting rotors. This ensures maximum uptime and quick, cost-effective maintenance.

5. APV'S SEAMLESS INFUSION VESSEL

SPX FLOW's APV brand released the Seamless Infusion Vessel to help ultra high temperature (UHT) infusion systems have longer running times, less product waste and more yield. UHT infusion systems process many products, including dairy (milk, cream and ice cream), plant-based beverages (soy, oat and almond drinks) and specialized nutrition foods (liquid meals, protein drinks and infant formula).

Instead of the traditional clamp connection, the seamless connection links the vessel bottom and pump housing in UHT infusion systems without a sealing gasket and hot water cooling on the pump casing and impeller. This results in:

- **NO PRODUCT BUILD-UP AND DECREASED PRODUCT LOSS:** With less fouling, there are fewer stoppages for cleaning in-place (CIP), which can take up to two hours per cleaning.
- **LONGER PRODUCTION RUNS BEFORE CLEANING:** Systems have shown 20% longer running time using the Seamless Infusion Vessel. That's an estimated 100 additional production hours and approximately 1.3 million gallons (5 million liters) of product for a 12,000 hour year (DPY).
- **INCREASED SYSTEM EFFICIENCY AND OVERALL SUSTAINABILITY:** In a plant that can produce 12,000 liters per hour, this translates to 39 fewer CIP cycles per year, which lowers product waste, energy, water and detergent consumption.

4. DANFOSS' BOCK HGX56 CO2 AND FSH COMPRESSORS

Danfoss' BOCK HGX56 CO₂ T-6 cylinder semi-hermetic reciprocating compressor for large-capacity industrial heat pumps and the FSH scroll compressor for reversible rooftop units and hydronic systems in cold climates, offer extended compressor ranges to help OEMs accelerate the green transition for comfort and industrial heat pumps.

Ideal for large-capacity heat pumps, the 6-cylinder semi-hermetic BOCK HGX56 CO₂ T achieves water temperatures up to 90°C/194°F and offers an efficient alternative to ammonia and synthetic refrigerants.

The new FSH scroll range compressor is ideal for North American reversible rooftop units and hydronic heat pump systems with higher discharge gas temperature limits. Featuring liquid, vapor and wet injection, it comes with a full package of accessories designed to manage the injection and delivers year-round comfort with a water supply temperature of up to 65°C/149°F. The versatile FSH scroll range is optimized for new-generation systems transitioning to lower GWP options like R454B.

3. KEY TECHNOLOGY'S VIBRATORY CONVEYING SYSTEMS

Key Technology, a member of the Duravant family of operating companies, introduced vibratory conveying systems designed to improve the efficiency of processing and packing lines. Each series of integrated conveyors separates, singulates and/or aligns product, depending on the application, to provide product separation, speed and orientation for ideal presentation to the robotic system for pickup.

Suitable for primary or secondary packaging, these systems can handle frozen foods such as potato products, meat, poultry and seafood, as well as dry products such as cookies, pet treats, confectionaries and snacks.

The integrated conveying system often begins with an optional shaker or belt conveyor to meter product, if needed. Then, a separating shaker evenly spreads product, followed by a singulating shaker that directs product into single-file lanes. The next shaker aligns the product in the correct direction, if required, and achieves the optimal speed to feed one or more pick-and-place robots, which are installed on one or both sides of the conveyor. Products that are not picked up by the robots can either be collected in a hopper or recirculated to the beginning of the system.

2. ALLPACK'S AUTOMATED POUCH LOADING AND UNLOADING SYSTEM

Allpax, a PrimaTech brand, released the Synkrono automated pouch loading and unloading system to a customer to feed an existing bank of Allpax retorts.

At the load side, the automated system uses Delta robots to orient and form a pattern of unprocessed pouches, and then uses 4-axis robots to pick and place full patterns of pouches onto self-loading trays at a rate up to 200 pouches per minute. A secondary 6-axis robot is used to stack the trays on top of each other, and then the tray stack is conveyed out to an existing shuttle system that feeds the retorts. After the pouches have been retorted, the shuttle transports the tray stacks to the unloading cell. Trays are de-stacked by a 6-axis robot and the full pouch pattern is removed from the tray by another 6-axis robot and placed onto a mass take-away conveyor.

As the pouches are moved down the mass conveyor, one row of pouches is discharged at a time to form a single lane of pouches, which are then sent to the packaging line. The 6-axis robot flips empty trays over to ensure there aren't any remaining pouches. The robot then re-stacks the empty trays so that complete tray stacks can be automatically returned to the load cell for use in loading the next batch of unprocessed pouches. Full automation maximizes output while reducing headcount in the retort room and lowers the risk of damage to the packages and trays compared to manual loading and unloading operations.

This scalable and customizable system integrates the robotic tray loading and unloading cells with an automated tray tracking system to ensure unprocessed tray stacks of pouches are sent to the unloader cell and empty trays processed in the retorts. The latest generation of Allpax automation controls are employed and are integrated with the retort process controls.

1. HERON INNOVATORS' SUSPENDED AIR FLOTATION SYSTEM

Heron Innovators introduced its advanced Suspended Air Flotation (SAF) system for solid/liquid separation in the food, dairy and animal products industries. The system is designed to enhance separation efficiency, ensure regulatory compliance and reduce operational costs. Its innovative design delivers superior performance, including reduced flocculant and coagulant usage, and reduced operator attention and maintenance requirements. SAF systems scrapp a small footprint while increasing hydraulic flow and solids loading capacities.

Heron Innovators offers custom designed systems that are patented, wired and tested with filtration and ancillary equipment to meet specific needs. The SAF system is available in standard and custom sizes to fit any application. A standard system features include a Suspended Air Generator, Clearfeiner, Clearfloater flotation cells, serpentine-style flux mixer, influent flow meter and process control panel. If needed, coagulant metering pump, polymer dilution system, chemical staging, pH sensor/controller and acid/base metering pumps can be supplied as options.

SAF systems are available in sizes ranging from 50 gallons per minute capacity to greater than 8,000 gpm. Smaller flows can be treated by batch processing. Skid-mounted systems are available with capacities from 50 gpm to 1,800 gpm. FE

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Quality control of food products goes hand-in-hand with safe foods, yet there have been a number of food safety incidents over the past year.

What lurks in the ingredients of your salad? Listeria monocytogenes, Salmonella, E coli O157:H7 or something else? Has any ingredient passed QC/QA but now found to be contaminated, and if so, what is its origin? Photo courtesy of Jeremy Keith from Pixabay

BY MICHAEL LAES

A September Gallup Revealed That 27% Of U.S. Adults have little to no confidence in the safety of U.S. foods at the grocery store. Is it any wonder with results like the recent Blue Bell's lawsuit involvement of two people in a QC program if it doesn't include food safety?

The recent closure of Blue's Heath's Jarratt, Virginia bonecourt plant—due to a serious outbreak of Listeria Monocytogenes (Lm)—is not the first facility one to have a resident strain of the bacteria, which caused a recall of several products and/or closed a facility—sometimes permanently. In October Brucellar recalled 11,765,280 pounds of RTE chicken due to possible Lm contamination, affecting a large number of manufacturers' products (USDA update on 10-17-08).

In June Totally Cool, Inc. recalled all of its ice cream products due to an outbreak of Lm. In 2015 Blue Bell shut down its Broken Arrow, Oklahoma facility—and FIE reported issues at other plants going back to 2013. Today, after many repairs, Blue Bell facilities are back in operation.

While a facility may have a quality control program that inspects packaging or product defects, perhaps the more appropriate question to ask is whether a processor has an environmental monitoring (EM) program that places a priority on not only food quality but also food safety. USDA's FSIS found several insanitary conditions at the Brian's Meat facility, potentially causing the following contaminations.[1] Situations like this can be avoided with an extensive QC program that includes food safety measures and procedures.

This article concerns itself with the food safety aspects of quality control. More can be found on defect control at the FDA's "Food Defect Levels Handbook," online.[2]

In establishing a QC program to ensure food quality and safety, it should include—among other considerations—procedures for cleaning and sanitizing, temperature control, pest control, training, proper equipment cleaning and maintenance, regular testing of product throughout the production cycle, well-documented HACCP and finished-product QC programs, adherence to FDA's FSMA Preventive Controls and more.

Prerequisite programs

1. Personal hygiene
2. Food additives and food fraud
3. Housekeeping and hygiene
4. Chemical and physical product contamination
5. Product control
6. Product withdrawal
7. Traceability
8. Product flow and segregation
9. Production risk zoning
10. Staff training
11. Pest control
12. Cleaning and sanitation
13. Allergen management
14. Waste management
15. Management of water, ice and other gasses
16. Construction and layout of buildings
17. Maintenance
18. Storage and transport

Alan Treverrow, Director – A Talent Company (FHEDK)

The Basics Start With People

How does a processor evaluate if it has a sufficient QC program in place? Are HACCP programs alone sufficient to establish an effective QC program? Can automation help fix the problem?

"One place that automation will never be able to replace humans is in managing company culture," says Aaron Pfeifer, principal at Atlas QC a Control System Integrators Association (CSIA) member. "Even with all of the latest tools in place such as QC programs that require photo evidence, explicit checks, QR and bar code scanning of equipment—a company culture that doesn't place a priority on food safety will find ways around these measures. Conversely, a culture that is proud of process improvement and measures that speak up about risks or concerns is safety concerns, not admonish them. Building this culture from the ice cutting corners to save costs at the expense of long-term breakdowns in procedure, which ultimately lead to less profits in the long run, requires root and corner cutting."

Testing and standards only go so far, but according to Adam Richards, food safety engineer at Gray Solutions, a CSIA member, it's people that matter. "Excellent goods and environmental test results are key to understanding how robust processes are and how they're trending," he says. "But the most important factor is the people. They're the ones on the front line but are not limited to—quality standards, internal audits, training and competency, sanitation and environmental monitoring program (EMP), pest control, food defense, management review and continuous improvement. The key to a great food company is a culture of constant improvement and reward for physical hazards, and detection of biological, chemical and physical hazards. Creating a food safety culture is prevalent as you set the expectations up front and hold your employees accountable for finished goods results."

FDA had linked together HACCP and HARPC programs, but has renamed HARPC to "preventive controls." Today, if a hazard analysis reveals a significant hazard, the facility must implement a preventive control to address that hazard. The FDA's Food Safety Modernization Act (FSMA) is a feedback loop, particularly requiring a reevaluation and revision to ensure any changes to any part of the process. Image courtesy of FDA

What Constitutes A Good QC Program

To evaluate whether a processor has a sufficient QC program in place, it's important to go beyond just having a HACCP plan, says Kira Loiseau, Nexgen Food Safety technical services and specialist manager. While HACCP is a foundational component, ensuring the program is effective requires validation, monitoring and verification steps:

- Validation ensures that the preventive controls and critical limits defined in the HACCP plan are scientifically and technically reliable and will prevent or control the identified hazards. This could involve microbiological testing or environmental monitoring to confirm that the controls are working.
- Monitoring involves continuous or periodic checks during production to ensure that the preventive measures are being followed consistently. It's key to catching potential issues before they lead to a larger problem.
- Verification ensures that the system is working as intended over time. It includes reviewing records, conducting audits and product testing to confirm the effectiveness of the controls.

However, these steps alone are insufficient without a strong food safety culture, adds Loiseau. A processor must promote a culture where employees at all levels understand the importance of food safety and feel empowered to report issues or take corrective action.

A HACCP plan paired with mandatory software enforcement and a single, digital source of the truth for capturing required testing results provides greater support for quality control programs, says Jim Brenden, Plex director of product management. "Unlike old-fashioned, manual HACCP plan implementations, these building-block software features enable the use of safety materials (like on traps) and proper enforcement of these standards through mandatory check sheets.

Remove or Replace Equipment and Structures?

The decision to remove a structure or replace equipment depends on thoroughly analyzing the facility and its specific challenges. Food safety is ultimately about validation, cross-functional collaboration and careful data- driven decision-making.

A strong hygiene monitoring program, which includes tools like ATP testing and indicator organism testing, is critical for identifying trends and pinpointing potential hot spots where bacteria may reside and spread, Dr. Loiseau explains. By tracking these trends, a processor can better understand which areas or equipment may present risks.

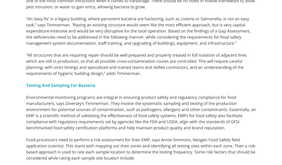
Corrective actions for problematic sites or equipment might involve modifying cleaning procedures, modifications or modernization of machinery, or even replacing equipment if it's too difficult to clean properly. This is where having a solid food safety culture becomes essential. A company with a robust food safety culture is more likely to invest in the necessary resources and make smart decisions based on the data, helping to ensure long- term operational safety and compliance.

A collective review of the building's integrity, hygiene monitoring data, and its impact on food safety is essential in determining whether a structure is beyond repair. This review should involve cross-functional teams from engineering, maintenance, and food safety, ensuring that decisions are based on validated evidence and focused on long- term sustainability.

– Taylor Lacy and Kira Loiseau, Nexgen Food Safety

In addition to HACCP plans, maintenance management software can also be employed to support regular maintenance activities for both plant and equipment. Additionally, compliance manager software plays a pivotal role in supporting documentation and actions related to food safety standards such as the Safe Quality Food (SQF) and Global Food Safety Consortium (BRC). Compliance systems may be utilized to guide and document a structured audit program to help verify the housekeeping, safety and quality requirements.

Other risk analysis tools, such as a Failure Modes and Effects Analysis (FMEA), may also be utilized to evaluate a processor's risk profile. In this context, a robust quality management system (QMS) such as the QMS by Arcweb Automation, is often required to bring together the multiple tools used to manage food quality and safety into a harmonized framework that can be consistently and accurately accessed while making a number of continuous improvement

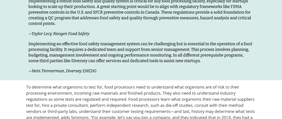


As required by FDA's Preventive Controls for Human Food. With a hazard analysis processors are required to identify any known or reasonably foreseeable (i.e., potential) biological, chemical and physical hazards, and determine if any of those hazards require a preventive control. Image courtesy of FDA

Beyond software, says Brenden, certain workplace organization methods, such as 5S programs go beyond HACCP and place safety and cleanliness into everyone's hands.

It's good to keep in mind that a QC system is only a part of a full food safety management system, which should be the base of what is seen as a food safety culture and should be supported by all employees in a facility, says Kim Timmerman, global sector specialist - F&B at Diversey—a Solenis company and also president of FSREDG. A HACCP plan is only one component within many others such as:

1. Food safety policies, procedures, and work instructions
2. Prerequisite programs (See sidebar, "Prerequisite programs")
3. An overall Hazard Analysis of Critical Control Points (HACCP)
4. Regular inspection and maintenance
5. Validation and verification
6. Training



Per FDA's Preventive Controls, if the hazard analysis identifies a hazard that requires a preventive control, processors are required to develop and implement a control to significantly minimize or prevent the hazard. Image courtesy of FDA

Facilities And Equipment: Replace Or Repair

Quality control often hinges on the facilities and environments where work takes place, says John Robertson, vice president, food & beverage and consumer packaged goods at Life Cycle Engineering. Companies must regularly assess their facilities to ensure they meet the necessary quality standards for both the plant and the products being produced. This means developing formal risks and prioritizing areas that could impact food safety or product quality, such as equipment.

A strong hygiene monitoring program, which includes tools like ATP testing and indicator organism testing, is critical for identifying trends and pinpointing potential hot spots where bacteria may reside and spread, says Taylor Lacy, Nexgen Food Safety technical services and specialist manager. By tracking these trends, a processor can better understand which areas or equipment may present risks.

The first line of defense is a dedicated quality assurance team that actively evaluates risk levels and stays current with best practices, says Robertson. Inspectors for regulatory bodies such as USDA and FDA provide another layer of oversight. Additionally, hiring independent experts who specialize in a specific food industry to conduct a preventive risk assessment can offer valuable insights before official inspections. If a facility continues to face significant compliance failures, it may be time to consider a comprehensive redesign or even relocation.

Design for Reliability

Reliability starts at the design phase of any food and beverage production facility. Equipment must be designed and selected not just for initial performance but for its long- term reliability to ensure quality control. When new equipment is purchased or where facilities are expanded, reliability considerations should be integral to the decision- making process. Design for reliability (DfR) ensures that the equipment chosen is durable, easy to maintain, and resistant to the rigors of continuous production.

This approach also extends to the physical layout of a production facility. For example, designing a facility with easy access to equipment for operations and maintenance activities, or with proper environmental controls to avoid contamination and corrosion, can significantly improve long- term reliability. Ensure maintenance becomes manageable and maintains both food safety and production uptime.

– John Robertson, Life Cycle Engineering

If the facility and equipment cannot be cleaned to a satisfactory level, then changes must be made, says Gray's Richards. These changes could be procedural, chemical concentration or degradation of the facility/equipment requiring a capital investment. Some of the most common issues that Richards has seen in his career include the following: Poor equipment repair. Equipment built 20-plus years ago likely has hollow tubing for framework, which is a red flag for an auditor, as it is one of the most common infractions when it comes to harborage. There should be no holes in hollow framework to allow pest intrusion, or water to gain entry, allowing for biofilm growth.

"An easy fix" in a legacy building, where persistent bacteria are harboring, such as Listeria or Salmonella, is not an easy task," says Timmerman. "Razing an existing structure would seem like the most efficient approach, but is very capital intensive and not always practical. Instead, a deep dive into the root cause should be the format for a Gap Assessment. The deficiencies need to be addressed in the following manner, while considering the requirements for food safety management system documentation, training, and upgrading of buildings, equipment, and infrastructure."

"All structures that are requiring repair should be well prepared and properly treated in full isolation of adjacent lines which are still in production, so that all contamination concerns are controlled. This will help to ensure that the planning, with strict timings and specialized and trained teams and skilled contractors, and an understanding of the requirements of hygienic building design," adds Timmerman.

Testing And Sampling For Bacteria

Environmental monitoring programs are integral in ensuring product safety and regulatory compliance for food manufacturers, says Diversey's Timmerman. They involve the systematic sampling and testing of the production environment for potential sources of contamination, such as pathogens, allergens and other contaminants. Essentially, an EMP is a scientific method of validating the effectiveness of the cleaning systems. EMPs for food safety are designed to compliance with regulatory requirements set by agencies like the FDA and USDA, align with the standards of GFSI benchmarked food safety certification platforms and help to maintain product quality and brand reputation.

Food processors need to perform a risk assessment for their EMP, says Anne Simmons, Nexgen Food Safety field application specialist. This starts with mapping out their zones and identifying all testing sites within each zone. Then a risk-based approach is used to rate each sample location to determine the testing frequency. Some risk factors that should be considered while rating each sample site location include:

1. Proximity to food
2. Accessibility to cleaning and testing
3. Equipment age, material and condition of surface
4. Potential for cross-contamination
5. History of area testing positive

The harsher the area is to clean and the closer it is to food, the greater the risk, adds Simmons. High-risk areas are put on a high testing frequency, such as daily. Lower risk areas (those that are further away from food and easiest to clean) will be put on a lower testing frequency, such as monthly.

Setting up a QC Program: Some Pointers from the Experts

Many startups begin by buying low-cost equipment individually from different manufacturers without considering how to fulfill the integral all the additional control equipment. Companies should be designing their facilities with a fully integrated data management and reporting system in mind. This could be an OEE, SCADA, ERP or other systems to aggregate important data such as equipment runtimes, product quality, maintenance schedules, operator actions and QC data.

– Aaron Pfeifer, Atlas QC

Automation revolves provider procedure management software that allows processors to electronically specify what needs to be done, enforce the execution of these requirements and capture ample information to verify how these tasks had been performed. The activities to be specified include those performed by the automation equipment as well as the many activities required to be performed by operators.

– John Parraga, Director, ECS Solutions, a CSIA certified member

There are multiple online tools and technology to help create a food safety program. The CSIA has a Food Safety Plan Builder that helps companies develop a food safety plan that is customized to their facility. Many food safety plans are associated with incoming ingredients, as well as process steps, to include when receiving to a new facility. When discussing hazards associated with process steps, consider hazards that the employees could intentionally or inadvertently prevent as well.

– Adam Richards, Gray Solutions

Implementing a new quality program or enhancing current programs involves a strategic and multifaceted approach that takes into consideration production and maintenance planning, proactive schedules, documents and training procedures. This strategy should also include design for reliability, employee training and validation of skills and abilities in EHS and QC protocols.

– Eric Robertson, Life Cycle Engineering

Implementing a robust food safety and quality system is critical for any food processing facility, especially for startups looking to scale up their production. A great starting point would be to align with regulatory frameworks like FSMA. Preventive controls in the U.S. and EFSTA preventive controls in Canada. These regulations provide a solid foundation for creating a QC program that addresses food safety and quality through preventive measures, hazard analysis and critical control points.

– Taylor Lacy, Nexgen Food Safety

Implementing an effective food safety management system can be challenging but is essential in the operation of a food processing facility. It requires a dedicated team and support from senior management. This process involves planning, budgeting, management involvement and ongoing performance monitoring. In all different prerequisite programs, some third parties like Diversey can offer services and dedicated tools to assist new startups.

– Kim Timmerman, Diversey (FSEDG)

To determine what organisms to test for, food processors need to understand what organisms are of risk to their processing environment, incoming raw materials and finished products. They also need to understand industry regulations as some tests are regulated and required. Food processors have what you consider their raw material suppliers test for, hire a private consultant, perform independent research, such as the die-off studies, consult with their method vendors or third party labs, understand their customer testing requirements—and last, history may determine what tests are implemented, adds Simmons. "For example, let's say you join a company, and they indicated that in 2010, they had a Bacillus cereus outbreak in their RTE product. It is very likely that they will have implemented a Bacillus cereus specific test for that product on their CoA."

An important part of Diversey's training emphasis will extend to food safety and hygiene. Diversey, a Solenis company, provides online to "Hygiene Academy," which is a cloud-based learning environment for food and beverage professionals, and is certified by the Continuous Professional Development (CPD) Certification Service. The academy provides essential, application, process and specific microbe control courses. Image courtesy of Diversey, a Solenis company

As far as solely relying on raw material suppliers' Certs, this is not a good practice, says Simmons. "The results listed on the CoA from a raw material supplier are a representation of the specific while it was still in their controlled plant environment. Often, it does not represent the product after it has undergone shipping and transport. Whenever time and temperature controls are out of the processor's control, verification testing is crucial. The good is to request Certs from raw material suppliers, it is also best practice to test all incoming raw materials as they are your risk as soon as they arrive in your facility. All these questions should be addressed when developing a food safety program with an adequate risk assessment."

When testing for bacteria, it is important to swab framework, adjacent walls or equipment, floors, drains, ceilings, or anything else in the area that could cross-contaminate, says Simmons. Pathogens are not uniform. The frequency of testing is driven by the severity of risk, as well as the results. If you keep getting listeria hits on a specific drain, you're likely going to test at a high frequency, but also increase the cleaning regime for that drain as well. For adjacent areas that rarely have positive swab results, you're likely going to swab them more infrequently. For a new facility since everything as if it were dirty and new to Listeria, Salmonella and Enterobacteriaceae. Once it is clear that the environment is clean, you'll want to swab areas adjacent to the positive hits to figure out exactly where the issue is drawn from. You can adjust the frequency as you collect more data and understand the likelihood of positive results." ■

Resources:

[1] "Review of the Notice of Suspension Brian's Meat," USDA, July 31, 2020, PDF download

[2] "Food Defect Levels Handbook," FDA Website

"Hazard Analysis and Risk-Based Preventive Controls for Human Food: Guidance for Industry (Draft Guidance)," FDA, January 2014, 412 pp. PDF download

"Key Facts about Preventive Controls for Human Food," FDA, PDF download

"Recalls & Public Health Alerts," USDA (FSIS) Website

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Raising a Higher-Quality Mushroom Product

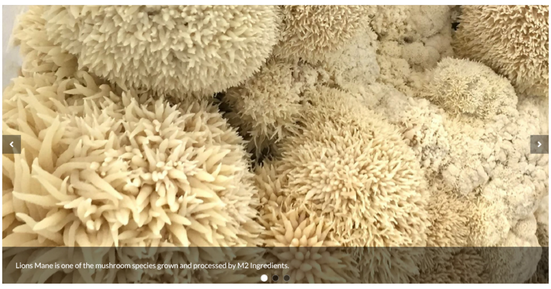
Viewers of a reality show may have seen farmers grow mushrooms in a bunker, but the true reality of growing quality mushrooms is far more complex.

M2 Ingredients' headquarters and production facility is located on the California coast. All images courtesy of M2 Ingredients

BY DERRICK TEAL

THREE OF THE FOUR MEMBERS OF MY HOUSEHOLD ARE A LITTLE BIT OBSESSED with Clarkson's Farm on Amazon. For those who are unfamiliar with the show, it follows the exploits of British media personality Jeremy Clarkson—formerly of such programs as Top Gear, which I also watched—as he tries his palm-on-face hand at farming. While we laugh at his general ineptitude, we do appreciate that he wants to do things "the right way" with ecological approaches like regenerative farming and wild farming. We also like that he attempts to use every bit of property at his disposal, such as an old WWII bunker to grow mushrooms. And while an old bunker might make for great reality TV, California-based M2 Ingredients felt it needed something a little more advanced for its mushrooms.

Founded in 2010, M2 Ingredients is a producer of certified organic, whole food mushroom powders with the full spectrum of bioactive compounds to support daily health, sports performance, recovery and cognition. Its growing and production operations are carried out at the company's headquarters along the California coast in Vista, where a recent expansion allows M2 Ingredients to put all of its indoor farming and post-production processes under one roof—enabling true vertical integration and full chain of custody from spore to finished product.



Lions Mane is one of the mushroom species grown and processed by M2 Ingredients.

M2 Ingredients' 155,000-sq.-ft. facility was designed to provide the ideal conditions for mushroom growth and for the company's proprietary solid-state fermentation process. In this process, mushrooms are grown on organic oats—a healthy and clean food that is particularly suited to mushrooms. The oats are hydrated and conveyed into a specialty growing bag which is sealed after sterilization and planting. The mushroom mycelium enzymatically digests and converts the oats into mushroom tissue, and the entire bag is then dehydrated and milled into a powder, with the only waste being the growing bag.

The facility more than doubles M2 Ingredients' existing capacity to meet the increasing consumer demand for functional mushrooms. This was achieved while reducing water consumption by 50% compared to the previous process by utilizing new hydration equipment. The hydration process is also now more consistent and allows for as-needed modifications to the growing substrate which could have an impact on the finished product. A steam system has been incorporated to provide heat for the autoclave and dehydrators.

Automation has been incorporated in a number of areas. For example, the loading, dicing, dehydrating and milling of grown mushrooms is completely automated, and the bulk bag-filling line is semi-automated. All of the processes have specific SOPs and "recipes" developed for each of the 10 different mushroom species grown in order to optimize the final product and to provide consistency from one batch to another.

Attention to Detail

"One of the most important benefits of this facility is the increased number of growing rooms for our mushrooms and our ability to change the growing conditions in each," says Sandra Carter, founder and CEO of M2 Ingredients and Om Mushroom Superfood. "Our Park Center facility houses multiple growing rooms where the temperature, humidity, light and other environmental attributes can be dialed in to meet the specific needs of each mushroom species. Our in-house mycology team worked closely with our contractors and engineers to help develop the blueprint and approve the designs and equipment. The result is a facility that produces a large number of different species with an improved ability to monitor and control the important actives that contribute to the efficacy of our finished product."

The facility more than doubles M2 Ingredients' existing capacity to meet the increasing consumer demand for functional mushrooms.

Carter says that harvest takes place once the yield and product composition requirements are met. M2 Ingredients' proprietary dehydration process is designed to retain the natural bioactive compounds responsible for functionality in the finished product. Once that is completed, milling takes place to reduce the product particle size. Final product testing for both QA/QC attributes and active constituents specific to the various species of fungi is completed prior to packaging.

Quality control at M2 Ingredients is of particular importance given the relative ease which mushrooms can assimilate environmental contaminants.

"Our DNA-identified mushroom strains are maintained in cryogenic storage and handled in our in-house mycology lab for expansion into production," says Carter. "Our quality team manages environmental swabbing, moisture meters, CO_2 testing in grow rooms, temperature controls and utilizes special instrumentation to measure particle size and moisture to ensure that we continue to meet our stringent quality standards. In addition, our team manages all organoleptic evaluations and gluten testing in-house. We utilize third-party labs for specific testing of heavy metals, pathogens, yeast and mold, and other raw material measurements such as pesticides."

Fungi are unique in the world of botanicals and other plant-based ingredients because they are bio-accumulators, which means they absorb what's in their environment. This fact is why M2 Ingredients places such high standards on its environmental and quality controls.

"This is partly what makes fungi so amazing, but also why you must be careful consuming mushrooms without knowing where they are sourced and how they are grown," Carter says. "Our state-of-the-art facility is BRCGS AA-rated—a global food safety standard which meets and exceeds the FDA requirements. We are also certified by the Department of Agriculture, the Department of Public Health and are 100% Organic Certified, Gluten Free and Kosher. Our controlled growing environment and clean substrate ensures no pollutants, pesticides or heavy metals will compromise the final product."

Future Planning

The company has a longstanding relationship with a group of farmers in Canada from which the certified organic oat-growing substrate is sourced, and testing is done to ensure that the oats are free of pesticides and gluten with a low concentration of heavy metals.

Those suppliers are met with each year to go over forecasts for the following year, but M2 Ingredients keeps both key raw materials and finished product in stock at all times to respond quickly to customer needs. Since all of the company's storage and shipping is done from the Vista location, an extensive amount of warehouse space was necessary.

Carter says that the floor plan and design of the facility allow for a future increase in both farming and production capacity. "Our major pieces of processing equipment are able to more than quadruple our output. Additional growing capacity can be added to meet capacity increases in a relatively short period of time." **FE**

Standards from sanitation to climate controls and everything in between are high at the facility to produce the highest quality product.

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Guidance for the Voluntary Qualified Importer Program Updated

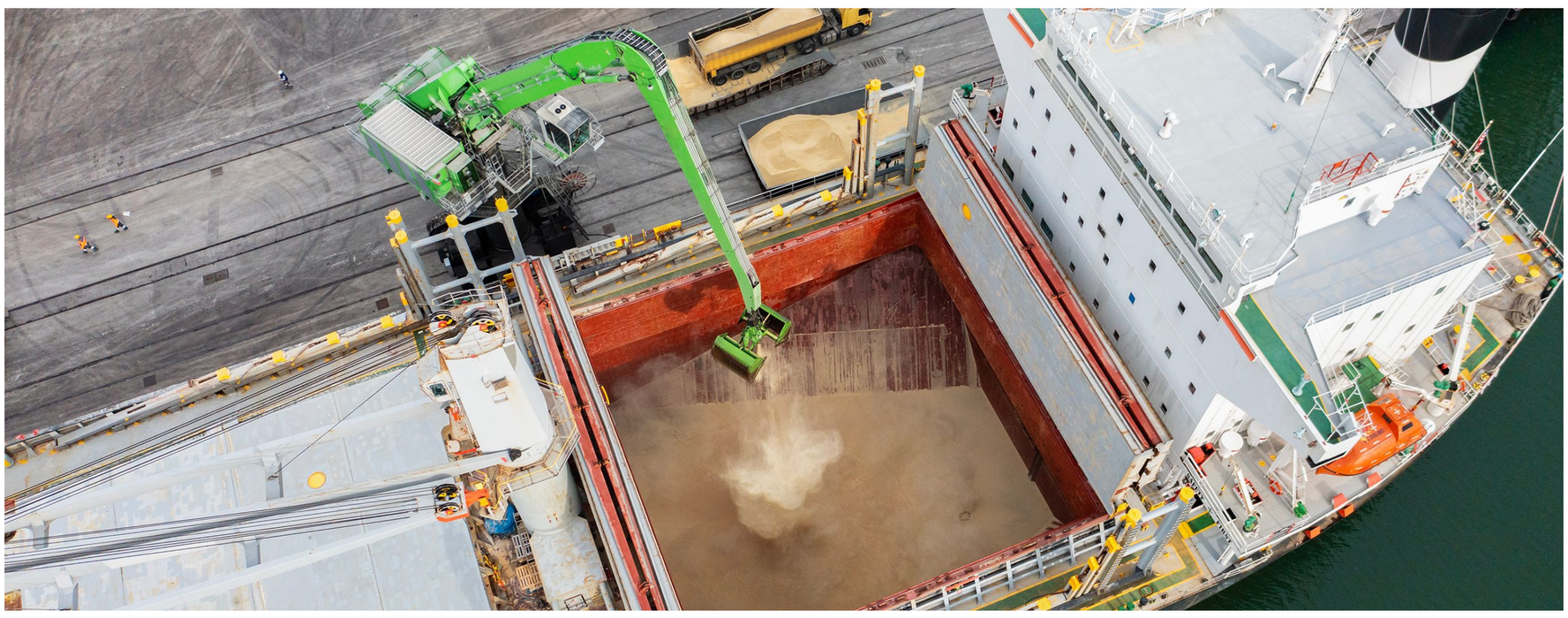

Photo courtesy of Getty Images Plus / bfk92

The FDA is implementing a revised inspection approach, strategically designed to optimize program efficiency by leveraging other oversight activities, which may reduce user fees.

The U.S. Food and Drug Administration (FDA) released guidance with revisions to the FDA Food Safety Modernization Act (FSMA) Voluntary Qualified Importer Program (VQIP). VQIP offers importers who achieve and maintain a high level of control over the safety and security of their supply chains expedited review and importation of human and animal foods into the U.S. These updates are intended to streamline processes, enhance flexibility, and elevate the overall efficiency of the program.

Through the updates, the FDA is implementing a revised inspection approach, strategically designed to optimize program efficiency by leveraging other oversight activities, which may reduce user fees.

Additionally, participants now have the flexibility to add new foreign suppliers and foods to their existing program throughout the fiscal year, allowing them to access more benefits through their program. To support participants in obtaining a facility certificate from an accredited certification body under the Accredited Third-Party Certification Program (TPP), the FDA is also extending the deadline for submitting the notice of intent to participate and application.

Expedited entry through VQIP incentivizes importers to adopt a robust system of supply chain management and further benefits public health by allowing the FDA to focus its resources on food entries that pose a higher risk to public health. These updates, which are effective immediately, build on feedback from stakeholders to support and streamline the process for participation.

All interested food importers can take advantage of the benefits of VQIP, which can include:

- Streamlined importation processes, saving food importers valuable time and resources;
- Avoiding unexpected delays at the point of import;
- Reduced storage costs, enabling food importers to optimize their resources efficiently; and
- Recognition as a responsible importer committed to food safety and security. **FE**

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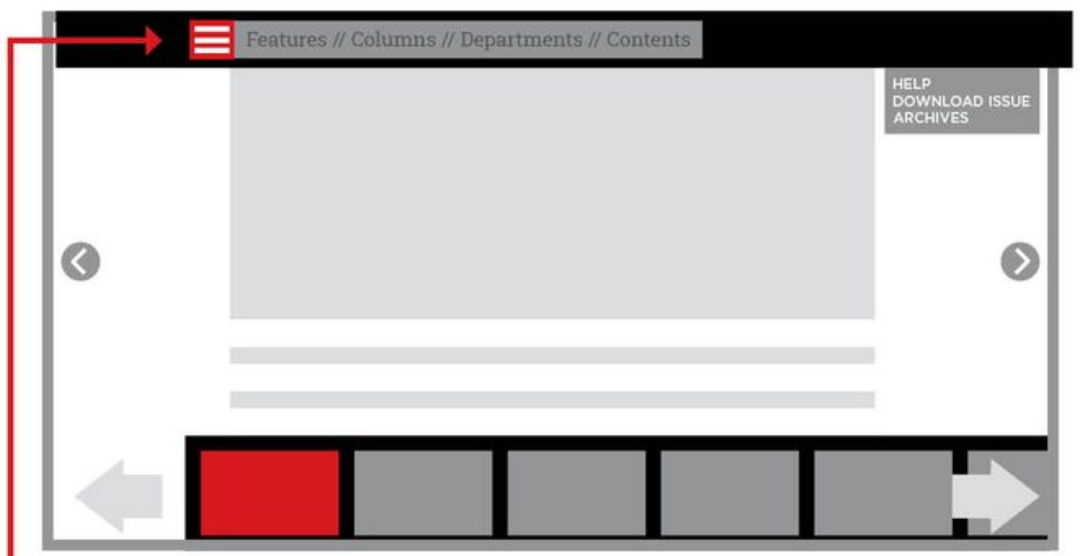

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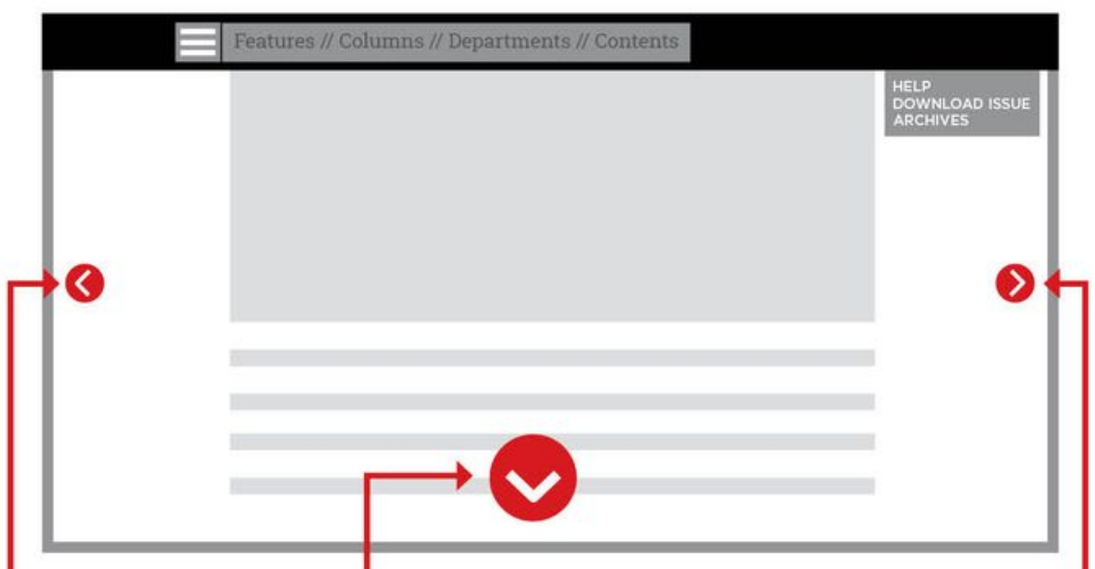

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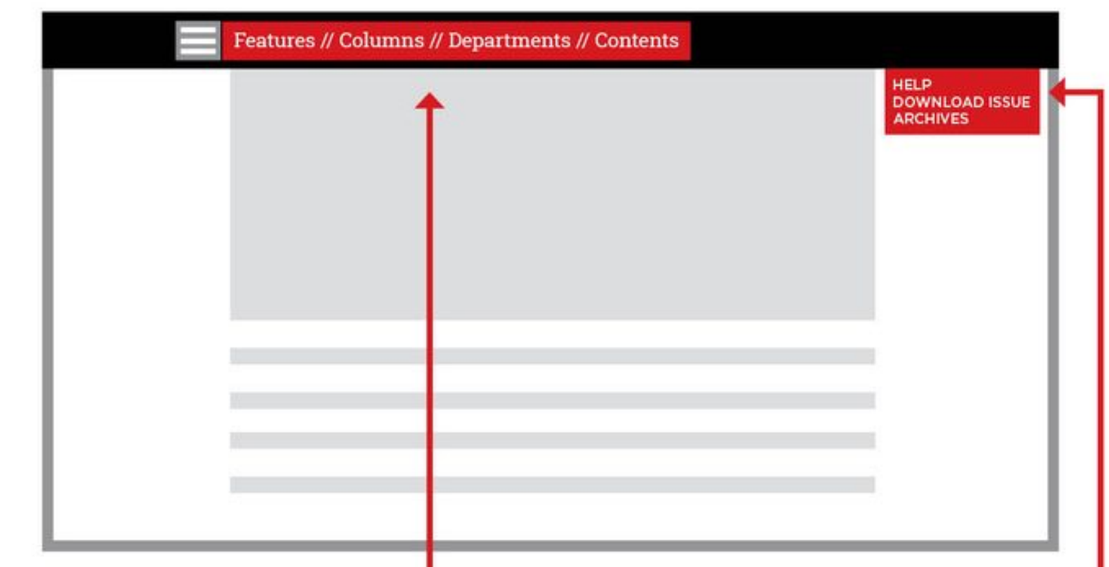

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