Novolyze

Smart Process Control:

Maximizing Operational Efficiencies (OEE) and Reducing Costs in Food Processing

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# The increasing costs of being in the food business

The food business has always been competitive. The industry is facing various challenges, including meeting consumer expectations, dealing with extreme weather events, facing workforce shortages, overcoming regulatory barriers, managing limited product shelf lives, and adapting to the rise of online marketing channels. In addition to these challenges, the industry is grappling with rapidly increasing production costs. Therefore, changes are necessary to retain market share and maintain profitability.

Changing consumer tastes have seen the most prominent food companies lose out to smaller and newer companies for several years. According to Information Resources, Inc (IRI) data, the leading packaged food and beverage companies struggled to maintain market share despite boosting their sales numbers during the pandemic when consumers stocked products and ate meals at home.[1] Direct internet and social media sales also accelerated demand for new food items.

In the supply chain, volatility in weather patterns and external shocks have negatively impacted raw material availability and the stability of farmgate prices. As a result, the ability of industrial farms to grow food reliably and guarantee supply has been under pressure.

In the factory, the pandemic has amplified recurring labor shortages, making hiring or scheduling production over time challenging. Suppose workers are already not available during standard operating hours. In that case, businesses incur even more costs to hire for weekend or overnight shifts, more so when workers get sick and need to quarantine. Supervisory-level workers also have new expectations for remote and flexible work. Starting and stopping machines based on labor availability is not a viable solution, as energy prices in the United States have experienced their most significant increase in over forty years. Furthermore, unnecessary changeovers and the subsequent fine-tuning period significantly increase electricity consumption, making this approach less practical.

Adding to the mix of all the inflationary drivers, the U.S. Food and Drug Administration (FDA) has published compliance dates for the rules forming the foundation of implementing the Food Safety Modernization Act (FSMA). Thus, a defined set of expectations and more stringent oversight is now a concern for many food manufacturers.

1   https://www.iriworldwide.com/en-us/insights/publications/2022-cpg-market-review-and-outlook
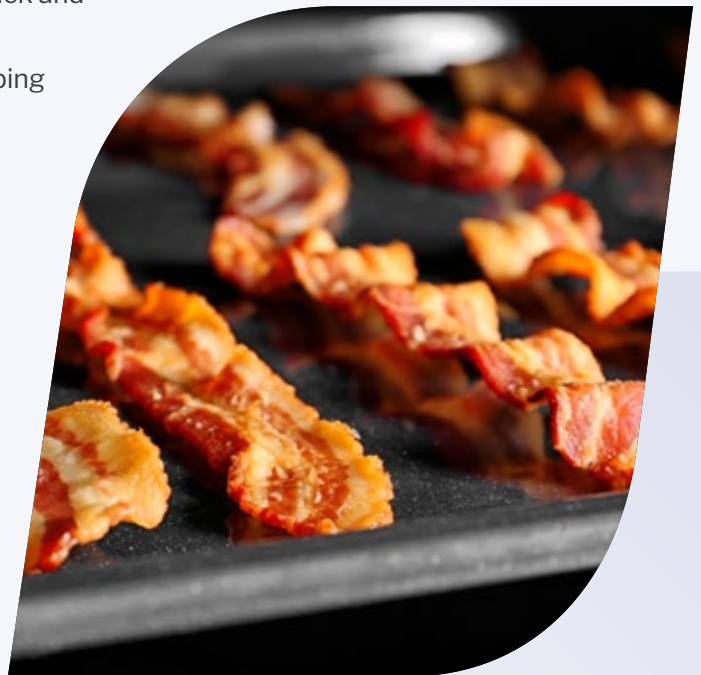
Process controls prove regulatory compliance

Lethality refers to a food processing step's ability to eliminate harmful microorganisms, such as bacteria, viruses, and parasites, that can cause foodborne illnesses. Part of the FSMA requirements and those set forth by the European Food Safety Authority (EFSA) mandate that certain types of manufactured food products undergo treatments affecting specific lethality levels. Implementing process control systems during these critical manufacturing steps helps fulfill the specified lethality requirements.

For example, thermal processing, such as canning, involves heating food products to achieve predetermined temperatures and holding them at that state for a defined period. The lethality of the thermal process is determined by the combination of processing time and temperature, which must provide an effect sufficient to destroy harmful microorganisms. Data from the temperature control system can be used to validate that lethality requirements have been met.

High-pressure processing (HPP) is a food safety method that involves subjecting food products to high pressure to destroy harmful microorganisms without heat. HPP commonly processes food products such as juices, meats, and seafood. The use of process control during HPP is an excellent example of how process control can ensure regulatory compliance. By monitoring and adjusting pressure parameters during HPP, process control generates data that can be used to verify whether lethality requirements have been met. Making HPP an effective way to demonstrate compliance with food safety regulations.

To prove regulatory compliance, manufacturers must present evidence that the required lethality prescribed by law has been achieved as an outcome of the critical processing steps unfolding as planned. Thus, documentation of process performance is a vital pillar of a robust food quality and safety system.

Process controls define process performance

Process control is a structured methodology in a factory environment that determines whether operating inputs and the corresponding outputs are within specific critical parameters. This approach enables the detection and correction of issues as soon as possible, with the end goal of manufacturing the most number of usable products using the least resources, thereby improving efficiency and maintaining quality. It is a versatile way to assure quality in production and is used in industries as diverse as chemical processing, food production, and pharmaceutical manufacturing, among others.

In the food industry, process control pilots the production processes in real time to ensure that the final product is high quality and, more importantly, safe for human consumption. Process control is critical to guarantee compliance, as the food industry is subject to strict regulations and standards.

Where have process controls proved helpful in the food industry?

Here are three examples of how the food industry has effectively implemented process control for critical stages in the manufacturing process.

1 To make cheese, manufacturers use process control in the fermentation stage. By closely monitoring the pH level and temperature of the food substrate, they ensure that the final product develops the desired flavor while preventing harmful bacteria growth.

2 To produce cookies, manufacturers use process control to ensure the dough is mixed, proofed, and baked correctly. High-quality cookies are consistently produced by monitoring the temperature, humidity, and proofing time.

3 In cooking sausages, process control guarantees that the products are cooked to the correct temperature during the prescribed amount of time to eliminate harmful bacteria such as Salmonella and E. coli. By monitoring the cooking process using temperature probes and a timer, the products are deemed safe for consumption.

What to do when my process is not performing well?

Most of the time, factory processes operate as they were designed. Yet, sometimes, when too many unexpected outcomes are observed, the urgent task is to find the reason driving the irregularity and implement corrective actions. It sounds simple but is more difficult in practice since there are many reasons why the process is not working well!

One way to rapidly address the issue is to be ready with a list of the top ten reasons why a process is not working as expected. The people closest to and most familiar with the process should provide the reasons. The list then becomes a starting point to guide the current investigation. The designated problem-solving team needs to understand the root causes, detail the inquiry results, lay out the recommended corrective actions, and champion a product disposition for management sign-off.

For shop floor troubleshooting to be constructive, there needs to be a management information system that reinforces a good understanding of process control, readily makes data available for investigations, and tracks the implementation of corrective actions.

Process controls keep costs in check

Process controls combat increasing production costs because irregularities are spotted earlier rather than discovered later when final products fail in one or more quality measures.

Implementing corrective actions as early as possible avoids unnecessary processing, delays, rework, and product waste.

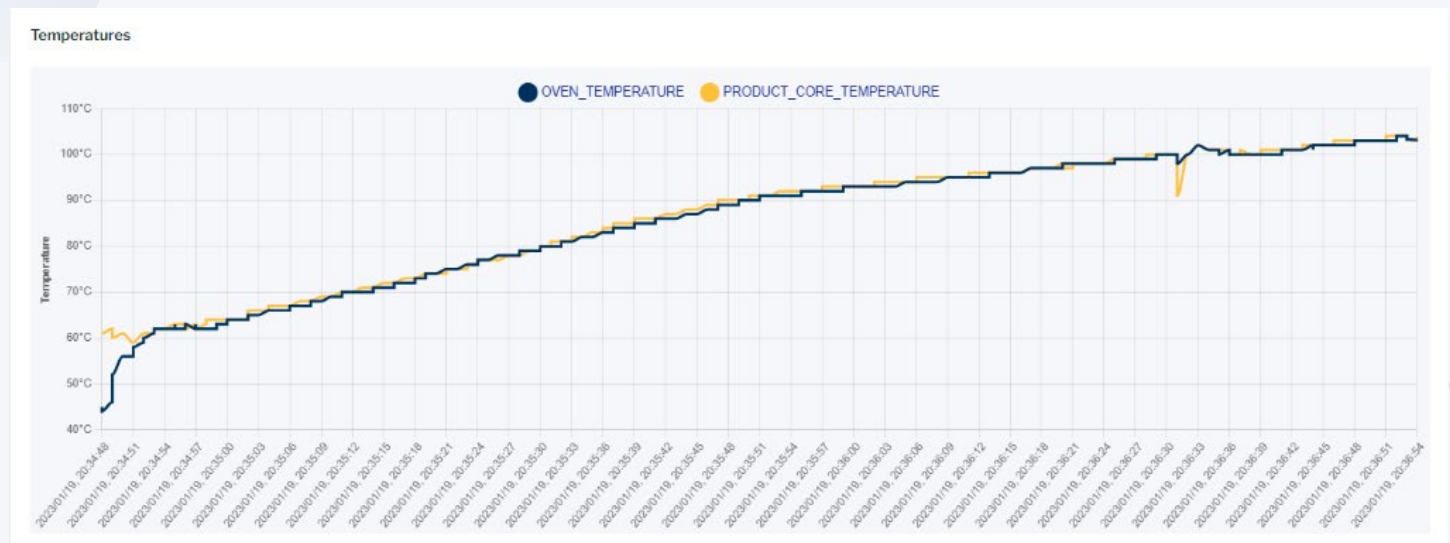**Photo description:** Visual representation of nonconforming product batches

Photo description: Dip in product core temperature (yellow line) indicative of potential processing issues

Where might process control investments translate to immediate returns?

A solid business case for process controls is adding them to cold storage areas or production chains requiring defined operating temperatures. In the case of highly perishable items such as meat and dairy products susceptible to bacterial growth, manufacturers keep the temperature of raw materials and finished products at a predetermined range to prevent the growth of harmful bacteria. Following the prescribed temperatures leads to energy cost savings and reduced waste due to spoilage.

Reducing raw material waste is significant savings for high-value food products such as beef patties, processed steaks, sausages, chicken, and other animal proteins.

I am already familiar with my critical processes. Why should I define my safe operating limits?

Safe operating limits are the ranges of values within which the process parameters should be kept to achieve a required level of lethality. It is essential to define them because they determine production performance, which in turn impacts actual factory capacity and operating profitability.

> When the market demand shifts or significant regulatory hurdles are on the horizon, there is merit in revisiting the current safe operation limits.

Manufacturers discover safe operating limits empirically by analyzing historical data, modeling the effects of different operating conditions, and leveraging expertise. In addition, manufacturers must integrate a risk assessment approach when defining safe operating limits, i.e., the constraints of the current set-up and the risks associated with alternative operating conditions and testing the retained limits under controlled conditions. Finally, setting safe operating limits requires knowledge of industry standards and practices to remain relevant for the target market and coherent with regulatory expectations.

Use 'just-necessary' treatment levels to cut costs

Setting 'just-necessary' treatment levels means manufacturers meet safety and quality goals while incurring minimum processing costs and avoiding wasted production effort. Like safe operating limits, the right amount of treatment considers historical data, modeling, process experience, risk assessment, testing, and regulatory demands.

Once defined, careful monitoring and ongoing analysis are needed to ensure that the safety and quality goals are consistently being achieved. Manufacturers may use periodic evaluations like acceptance sampling or real-time adjustments to process variables to maintain desired safety and quality levels.

If real-time process adjustments are to be implemented, there needs to be a timely feedback loop between target and actual process parameters as they impact output results. This is entirely possible using the appropriate sensors and a machine learning layer that anticipates the resulting output characteristics based on the input parameters and process performance. In this way, manufacturers can continuously optimize for 'just-necessary' levels of treatment and avoid costs due to over- or under-processing.

Use a cloud-based platform to manage change internally

As mentioned, food companies are facing many external challenges requiring solid organizational capabilities to maintain competitiveness and satisfactory levels of profitability.

One way to empower management is by providing a data capture system and centralizing the relevant data in an accessible platform to prove that regulatory requirements were fulfilled. Automatic documentation of process performance demonstrates that the steps providing the required lethality have unfolded as planned. This will dramatically reduce the workforce resources and paperwork needed to provide evidence of compliance upon request. An embedded data capture system also builds in traceability and minimizes production interruptions to pull together disparate documentation when questions about product safety and quality arise.

If critical processes present performance gaps, deviations can be captured in near real-time, and root causes can be immediately investigated, reducing plant downtimes. Further down the line, corrective actions can be tracked until acceptable completion. All these measures minimize rework and reprocessing, thus minimizing costs.

What data should I collect during processing?

The data to be collected during processing depends on the manufacturer's specific challenges and objectives in setting up a smart process control platform.

It is essential to have data on the actual performance of the process to simplify and streamline regulatory compliance. In addition to regulatory compliance, historical data helps identify performance trends, conduct statistical analysis, and detect process deviations for continuous improvement. As the costs of computing and storage have decreased, it is becoming increasingly feasible to implement a structured data collection program that includes information on environmental conditions. Such a program can provide additional insights into process improvement.

Air quality is one example of an environmental factor impacting product quality and safety. Airborne particles like dust and microbial contaminants may be better understood to implement better control systems. Humidity is another impactful environmental factor for food processing operations. High humidity levels can contribute to the growth of bacteria and mold, leading to food spoilage and contamination.

In addition to installing air and humidity sensors, having a better understanding of how environmental factors evolve will help create optimal processing conditions and improve the quality and safety of the final product.

Food product processing naturally generates many data types like temperature, pressure, flow rate, pH, moisture content, etc. While each one of these data points may impact food processing operations, industry benchmarks and science-based models are needed to identify significant effects and interactions among independent variables.

For example, milk's temperature and pH significantly affect the final product in a dairy product like yogurt. Similarly, the storage environment's temperature and humidity significantly affect the product shelf life in meat processing. Thus, understanding how these variables fluctuate and having the tools to adjust when undesirable variations happen will lead to more consistent quality products.

Novolyze provides a purpose-built platform for food processing that leverages process controls in an effective risk management and cost control program.

I don't want to disrupt current operations. What can Novolyze do for me?

Indeed, there is little benefit in disrupting current operations by implementing initiatives on multiple fronts without a defined roadmap. A third-party resource like Novolyze can identify and seize opportunities for improvement without disrupting your current set-up.

Our team uses a proprietary gap assessment methodology to analyze specific areas of your organization's food safety systems, including the elements required by the Global Food Safety Initiative (GFSI) audits. Combined with leading benchmarks from industry best practices, you can rapidly focus on the most promising improvement areas, whether in the production processes or the validation and verification systems.

The resulting findings report may then build a case for distinct interventions, including additional food safety and quality investments where needed. By extension, we can estimate a return on investment from your programmed investments in sustainability initiatives.

In short, Novolyze can help your factory leadership team make informed decisions on the available competitive options to assure product safety, quality, and sustainability.
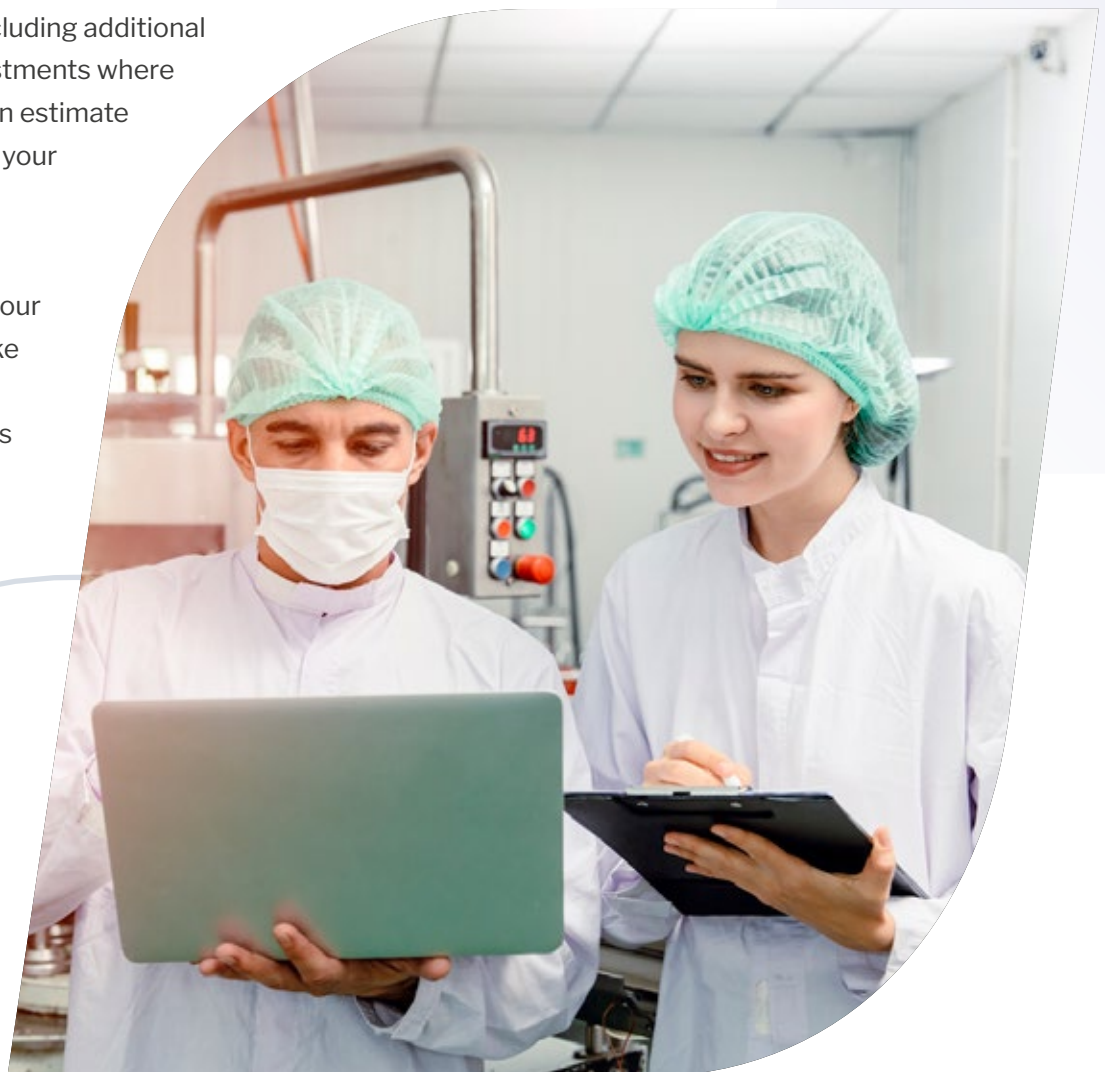
Success metrics from a global meat processor

The following result achieved by a global meat processor illustrates the value unlocked by the Novolyze process control platform.

Taking one plant and focusing on the cooking process's performance, Novolyze investigated their steam ovens, sous vide machines, and smokers. Before working with Novolyze, they could cook around 5,400 batches per year. With Novolyze, they increased the cooking process's output to 5,800 batches while guaranteeing food safety by adequate heat application.

HERE IS AN OVERVIEW OF THE RESULTING EFFICIENCIES.
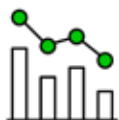
Time savings
3,488 hours

Operational Equipment Efficiency (OEE) increase
7.3%

Waste reduction
80%

Additional product throughput
$5.1M in customer cost

Given the pressure on agricultural products and energy prices, there is no better time to review your factory processes, rationalize heat treatments, and minimize raw material waste.

Where there are defined returns, introducing process controls on the most impactful processing steps according to a phased roadmap developed with a trusted specialist is a winning recipe for risk management and cost control.

> **Novolyze can estimate similar success metrics for your organization based on industry experience and proprietary optimization models. Book a meeting with one of our experts!**

Invest in a phased implementation with a trusted specialist

While industry benchmarks are helpful indicators, organizations and companies are distinct entities. Novolyze produces tailored roadmaps that outline the steps of a phased implementation to address your observed challenges and constraints. This is what a Novolyze Value Assessment service can do for you.

The Novolyze Value Assessment service can be obtained as a standalone program to identify the lower-hanging fruits in improving your factory operations.

About Novolyze

Founded in 2012, Novolyze entered the food and beverage market to help companies enhance their food safety and quality performance. Offering numerous application-driven, tech-enabled solutions, Novolyze is here to help food and beverage companies unify data, deliver actionable insights and enable real-time decision-making.

To learn more about Novolyze's IoT and cloud-computing solutions,

Request a demo today

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