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WHITE PAPER

Leveraging Emerging Technology in Confectionery and Snack Manufacturing

Manufacturers face an imperative to fill vacated roles and boost productivity in the wake of labor shortages, even as input costs climb. With a tough labor market likely to persist, making use of emerging technologies will be vital to economizing on labor, controlling costs and building a long-term competitive edge.

Confectionery and snack plant managers have just navigated some of the most harrowing years imaginable. Three years since the COVID-19 pandemic began, pandemic-related disruptions linger within the manufacturing industry. The year 2021 brought the "great resignation," a dramatic manufacturing workforce reduction with causes and consequences that still are not fully understood. Did people leave the workforce simply because of a shift in lifestyle preferences? Or were employees relocating down the street to secure a lucrative signing bonus at another employer? Whatever the root causes, manufacturers face the pressing task of finding people to fill vacated roles while the economy continues to rebound. Even as the unemployment rate has fallen, many manufacturing job openings persist, and long-term factors like an aging workforce suggest that it may be difficult to attract and retain talent for years to come.

Adding to the industry stressors, inflation reached a cluster of densely interconnected global supply chains. Not only is labor more expensive, but so are ingredients, energy and finished goods. Data from Burns & McDonnell projects shows that prices for construction equipment and materials have gone up an average of 25% since the pandemic began. Faced with higher input costs across the board, manufacturers are pushing their teams to make up the difference by achieving substantial year-over-year productivity gains.

In this context, leveraging emerging technologies will be critical for confectionery and snack manufacturers to stay competitive, boost production capacity and offset labor shortages. This paper explores some of the most critical technologies for this imperative and how they can help manufacturers navigate the shift to processes that rely on fewer, more-skilled employees. Finally, we examine a methodology that can help manufacturers get the most out of their new technology investments.

A Challenging Labor Market, With More Trouble on the Horizon

COVID-19 caused massive disruption to the labor force, and many of the resulting changes are not temporary:

- 4.2 million people left the labor force between March 2020 and July 2021.
- 2.4 million Americans decided to retire early.
- Manufacturing was hard hit, with 578,000 jobs lost during 2020 alone.

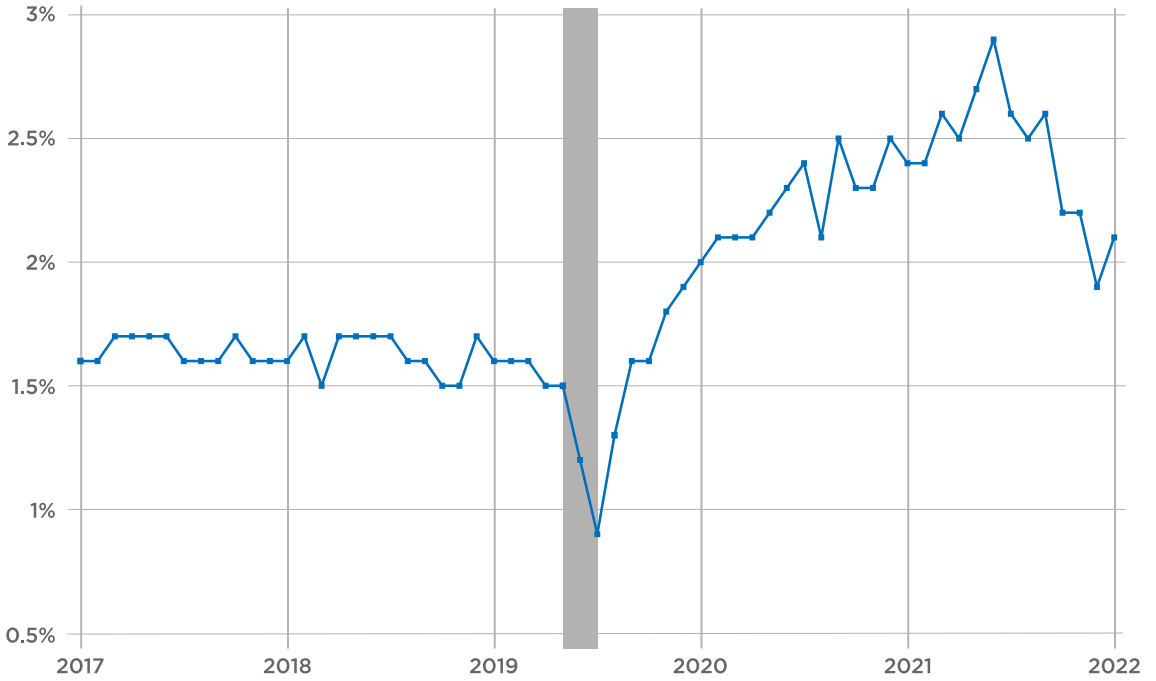

***Figure 1:** Job quits rate for selected industries, October 2017-October 2022. Shading represents recession. Source: U.S. Bureau of Labor Statistics.*

During the pandemic, the quit rate peaked at historic levels, and while it has partially recovered, resignations remain notably elevated. Employers run the risk of having inflated training costs for new employees, while hiring and training delays may cause broader business setbacks and stalls.

The great resignation created an acute talent crunch, and longer-term trends suggest that manufacturers will continue to face a challenging labor market for the foreseeable future. The workforce is aging, with a quarter aged 55 or older, according to The Manufacturing Institute. The pandemic also caused a sustained disruption to higher education. Between spring 2020 and spring 2022, total enrollment across all levels of higher education dropped from 17.1 million students to 15.9 million. As of May 2022, undergraduate enrollment was 9.4% smaller, or 1.4 million students fewer, than before the pandemic. The data suggests that while the pace of decline has abated, total enrollment is still falling. While the consequences of this enrollment dip are not yet fully understood, it could exacerbate a tough hiring market for skilled manufacturing workers. Tight labor market conditions are not expected to give way anytime soon; another study by The Manufacturing Institute suggests that U.S. manufacturing will have 2.1 million unfilled jobs by 2030.

This cluster of interrelated challenges for the labor market is having a direct impact on manufacturers. The Manufacturing Institute reports that 93% of manufacturers had unfilled positions within their companies for which they were struggling to find qualified applicants, and 89.5% said they have increased compensation to remain competitive in their pursuit and retention of employees. Meanwhile, U.S. manufacturing remains mired in a long-term productivity downturn. Industry Week reported in 2021 that "The U.S. economy has been in a productivity depression for more than a decade … [F]rom 2010 to 2019, labor productivity growth in U.S. manufacturing fell. It was the first time since the BLS started measuring this in 1988 and likely the first time in American history." In 2022, U.S. worker productivity experienced the biggest year-on-year decline on record.

Technology Offers Critical Stress Relief

Adding to the challenging operational environment for confectionery and snack manufacturers, macroeconomic factors place added stress on efforts to recover from the COVID-19 pandemic and its resultant waves of disruption. Inflationary pressures have led the U.S. Federal Reserve and other central banks to raise interest rates, increasing the cost of borrowing. With inflation in 2022 reaching its highest point in 40 years, these macroeconomic headwinds mean that simply ramping up labor or capital expenditures is not an option.

As confectionery and snack manufacturing facilities seek to address this challenging operating environment by boosting their productivity levels to the desired margins, they can build an important foundation with the expanded use of analytics and new process technologies. Projects can start small as teams evaluate technology and get a sense of its value.

A variety of examples follow, demonstrating how emerging technologies can be leveraged to streamline different operational areas. Many of these solutions could be suitable for both large and small manufacturers.

Plant Automation Foundations

New automation technologies that have matured over the past five to 10 years provide critical capabilities for confectionery and snack manufacturers working to navigate post-pandemic headwinds while building a strong foundation for long-term competitiveness. Technologies that have long been considered experimental have quickly emerged as economical solutions in widespread business use, and now is a great time for manufacturers to take a second look at solutions they may have dismissed as experimental or overly costly in past years.

How can you assess which approach to automation will offer the greatest return on investment (ROI)? You need to have the data; plants with the right systems can track and measure virtually any operational variable. Sensor and computing technologies have advanced significantly, and many facilities have opportunities to dramatically expand the digital integration of their operations. Faster, more ubiquitous computer networks help digital processes run smoothly while providing the data needed to support continuous improvement. Leveraging a system such as AVEVA PI System, Ignition IIoT or Rockwell Automation's FactoryTalk can help manage this process. These technologies are critical for rapidly and accurately determining the root cause of operational chokepoints, collecting and analyzing the associated data, and determining a solution.

These tools offer the insights needed to streamline workflows and economize on labor, working up from individual tasks to complex processes using the same automated solution. Begin by measuring key variables such as cycle times for each process in the facility. This data can be used to assess the performance of key processes and whether their inputs are functioning as designed. Data collection is instrumental to identifying the times and situations in which a process is not meeting its intended parameters. More granular cycle time data can help drive continuous process improvement and assess the impact of potential process changes. For example, when filling a mixer, are all requisite streams arriving in time for all products being produced? What if a new milk powder is bridging, and therefore dosing takes three times as long?

Maintenance issues are another area where foundational data gathering can uncover opportunities for operational improvements that can drive substantial value. For example, manufacturers should gather the data to quantify how many times a valve can be operated before it fails, and how much it costs if the line goes down. This data is critical for balancing the risk of failure against the cost and savings of proactive part replacement. In general, the cost of preventive maintenance is 10% of the cost of breakdown maintenance, and leveraging the data needed to make preventive maintenance truly predictive has the potential to unlock enormous value.

Once this foundational data has been gathered, it can be aggregated into dashboards that help translate analytics-based insights into actionable operational intelligence. By putting critical, role-specific data at the fingertips of decision-makers throughout the organization, dashboards help all personnel benefit from more granular insights. Moving forward, this data should be used to inform decisions on where to invest capital and operational resources.

New Automation Technologies Large and Small

The term "automation" can conjure images of massive robotic assembly lines, but it is important to bear in mind that effective automation solutions can range from autonomous vehicles to small-scale process automation tools. While full-scale automation requires more substantial investment — and offers even greater potential savings — semi-automated solutions can offer an avenue to labor cost savings without a large upfront capital outlay. They can begin driving value without the same level of intensive planning required by full automation and can function as proofs of concept for broader, long-term automation initiatives.

As one example, Keyence offers an artificial intelligence–based solution that uses a 3D-vision system for sorting and scanning. Its robotic systems can be used for the automation of routine work such as assembly, de-palletizing and machine tending. Even in a facility that is not ready for full-scale automation, automating select workflows can eliminate chokepoints, boost throughput, and shift skilled labor time from monotonous tasks to work that requires human judgment.

Virtual Reality-Powered Planning and Verification

Solutions that utilize virtual reality (VR) have rapidly advanced from expensive and clunky to economical for widespread business use. VR-capable computers have decreased in price, and headsets now cost around $300, thanks to greater commercialization, while wireless connectivity makes deploying these systems far easier.

Why use VR? Consider the difference between viewing a two-dimensional plant blueprint versus a dynamic and malleable blueprint in 3D. Operators immersed in a 3D environment can more easily spot issues that would be difficult to recognize "on paper" (or a traditional monitor). More advanced VR setups with hand tracking even enable

operators to physically manipulate virtual items (e.g., simulate product movements). VR can be a great option, for example, to verify the fit of a new solution before investing the full amount needed to develop and implement it at scale.

Automated Material Handling and Warehousing

Advancements in robotics, vision systems and machine learning have opened up a number of automation use cases, both in the warehouse and in general material handling applications. Robots are now used in a wide variety of "piece-pick" order fulfillment applications. Robots offer speed, flexibility and adaptability; line changeovers can be as simple as changing out a vacuum gripper.

"Cobots" are robots designed to work safely in close collaboration with humans. Since their introduction in the early 2000s, cobots have been successfully deployed by manufacturers across a range of applications. One of the most mature applications is case palletizing; OEMs and integrators are developing cobot systems that can be deployed out of the box and set up in a matter of hours.

Automatically guided vehicles (AGVs) are another example of a key automation-enabling technology reaching maturity after years of experimentation. This concept has been around since the 1950s, but these vehicles' capabilities have dramatically expanded in recent years. AGVs are now capable of operating as truly autonomous mobile robots (AMRs) by leveraging technologies such as lidar and vision sensors, which enable reliable, safe operation even in a busy, dynamic and ever-changing environment like a warehouse or factory floor.

AGV/AMR systems can be combined with automatic storage and retrieval systems (ASRS) to automate virtually the entire end-to-end workflow in a warehouse. Crane-based ASRS systems have been around since the 1960s, when they were developed to manage heavy pallet loads. In the years since, this technology has been honed to accommodate smaller, lighter loads at much higher speeds. With advancements in equipment, sensors and software, these systems are now able to work with an increasingly wide range of loads, delivering improved accuracy and throughput compared to traditional manual operation while saving labor costs.

Completing the warehousing workflow, automated truck loading systems are capable of increasing trailer loading capacity through a given dock by 200% to 300%, using cameras to scan pallets and route them to the appropriate vehicle. This capacity boost can reduce both the number of docks and the labor required to support shipping operations.

Use a Vertical Startup Methodology to Optimize ROI

A manufacturer cannot expect a successful startup for a new technology initiative if the project kicks off the week before the technology is expected to be deployed on the line. The first key to capitalizing on new technology investments is to begin detailed work defining how systems will be employed on the floor while technology scope points are still being developed. This practice helps see that new technologies are tailored to solving specific business problems and avoids situations in which an investment becomes a square peg forced into a round hole. Operational problems should inform technological solutions, not the other way around. The second key is to establish ownership of this implementation process at the plant level. Without buy-in from plant leadership, the process will fail. A corporate leader cannot simply visit a plant and generate the same level of buy-in and commitment to change. Key stakeholders from the relevant facility should be involved in the planning process from its inception to build knowledge and ownership.

A vertical startup methodology can be a great way to plan for successful investments in new technology. "Vertical" refers to a key point in the adoption curve of new technologies: the speed at which the technologies achieve full productivity after the initial implementation phase. The goal, after a vertical initial ramp-up period, is for new technologies to achieve a stable "glide path" on which they can continuously improve over time for optimal ROI. By contrast, an implementation that fails to hit goals early can lock technology into a suboptimal path that leaves value on the table.

By achieving a vertical startup phase for new capital expenditures, manufacturers can reduce time to market for new products, boost overall throughput, and let new technologies begin reducing labor and cost pressures sooner rather than later, all while maximizing long-term returns and accommodating customer demand on schedule.

Conclusion

With challenging market conditions seeming to become a "new normal" for confectionery and snack manufacturers, now is an ideal time to begin establishing a formal strategic process for evaluating and implementing new technologies. Doing so successfully will reduce cost pressures today while safeguarding long-term competitiveness. By shifting the onus of the manufacturing labor force toward fewer, more skilled employees, automation technologies can also help mitigate the risk of future COVID-like events or other serious labor market disruptions.

The technologies discussed here are just a few examples, but they illustrate how new technologies can help manufacturers begin paving a safe path through stormy labor markets. To get started, conduct a thorough gap analysis, assessing each area of your operations to begin evaluating which efforts could generate the greatest rate of return for your company. As your manufacturing business conducts this analysis, consider not only the immediate value of lower labor costs, but also the long-term strategic potential of pivoting away from reliance on a large pool of unskilled labor that has become increasingly transient.

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