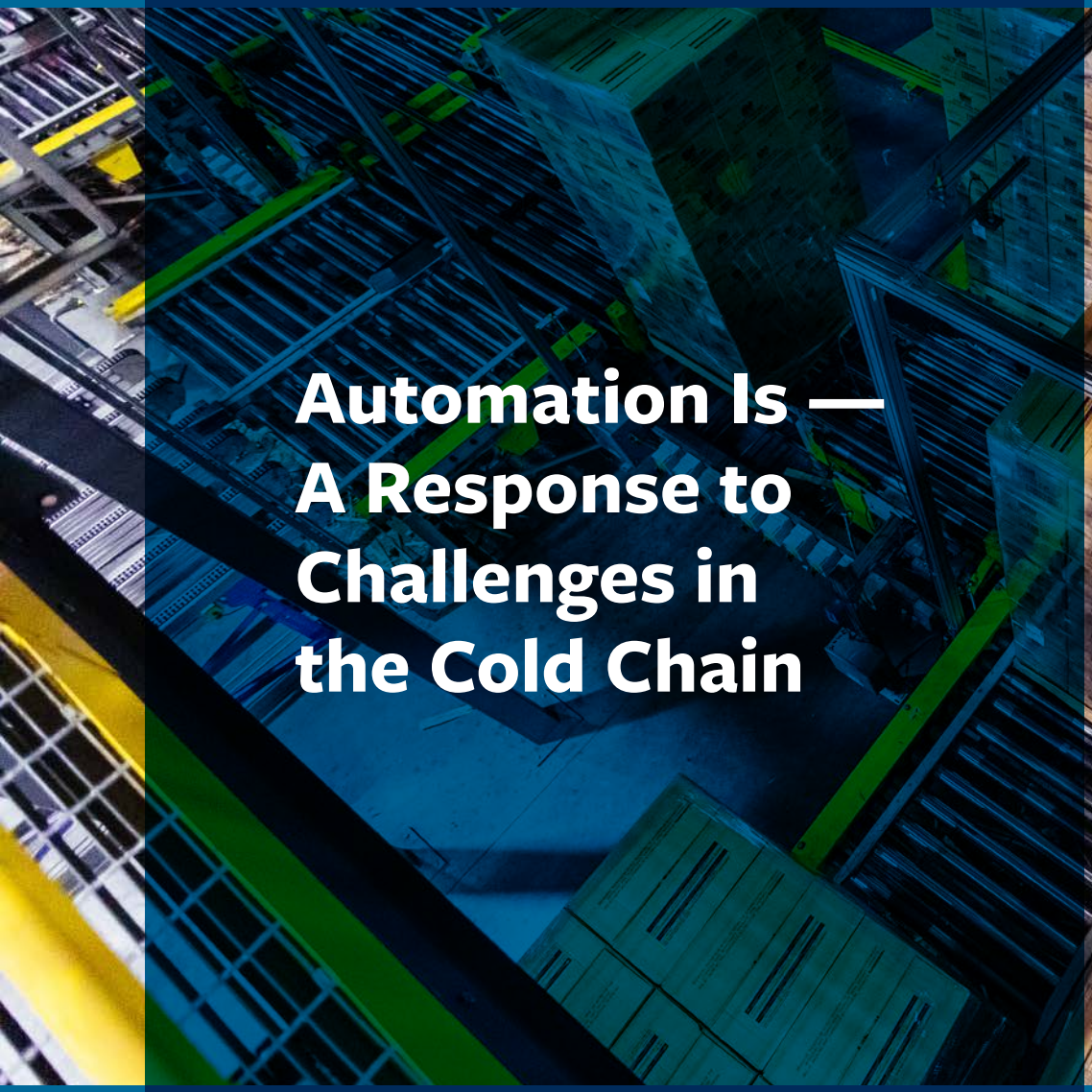
Lineage®
Reimagining the
World's Food Supply Chain



Automation Is — A Response to Challenges in the Cold Chain

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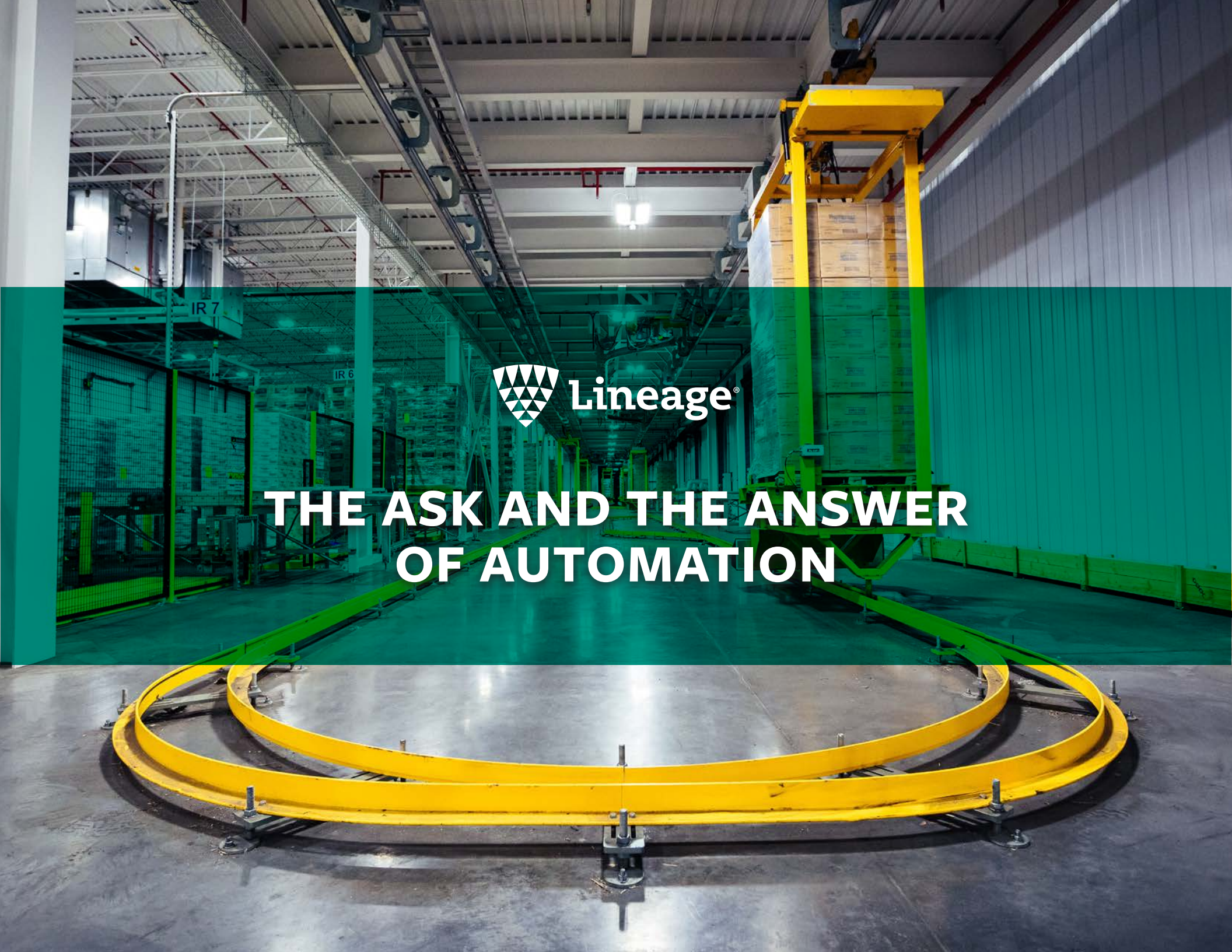
INTRODUCTION

Today's cold chain economy is under greater pressure than at any other time in our history. The pandemic injected volatility and accelerated the already-present need for change in our operations. The food supply chain industry rose to the occasion, working through restrictions and navigating disruptions to continuously ensure food gets to consumers around the world, safely and efficiently. But factors such as unpredictable labor shortages, shifting delivery models, sustainability mandates and increased transparency around food safety are outpacing traditional practices. Fortunately, as an industry, **the solution** to many of these issues **can be found by making an investment in automation and artificial intelligence (AI)** and weaving them into traditional operations.

However, incorporating technology into existing workspaces isn't a plug-and-play process. There are many considerations that can complicate adoption if they aren't approached with clear intentions. Some of these include understanding how new technologies partner with existing technologies, mitigating the risks of securing and prioritizing investments and navigating new relationships between employees and technology.

At Lineage Logistics, we've developed a clear and effective approach to incorporating automation and tech into our global network. In this piece, we will outline how automation, IoT and AI can be used to address some of our industry's biggest challenges and what businesses need to consider when navigating this significant evolution.

Lineage believes in the benefit of having this conversation. As we continually seek out best practices, provide a safety-first culture for team members and strive to provide flawless service to our customers, engaging in an open dialogue and learning from each other's successes is the best way to meet our main objective: transforming the food supply chain to feed the world.

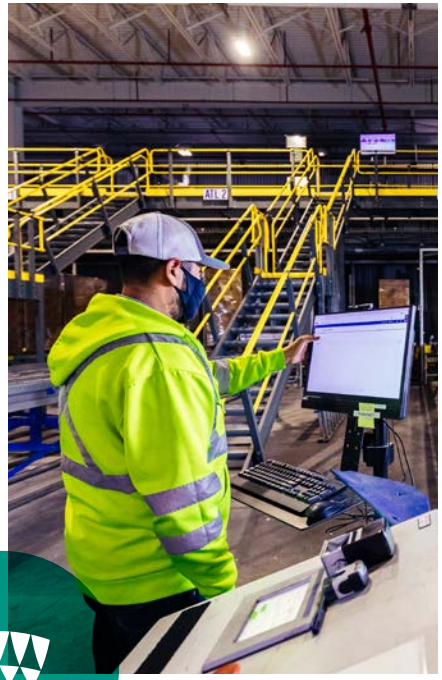

Lineage®
THE ASK AND THE ANSWER
OF AUTOMATION

Automation Is — A Solution for the Current Labor Market

CHALLENGE 1

Labor Shortages and Volatility

> **THE GLOBAL JOBS GAP** is expected to reach **75 MILLION THIS YEAR** as employers around the world struggle to find labor post-COVID-19 (*ILO, 2021*).



More than **HALF OF EMPLOYEES GLOBALLY** responded to a recent survey by saying **THEY'D QUIT THEIR JOBS IF NOT GIVEN** post-pandemic **FLEXIBILITY IN HOURS AND DAYS** (*EY.com, 2021*).

Labor growth has fallen behind economic growth.

As the worldwide economy attempts to recover from the devastating effects of COVID-19, the number of workers actively seeking employment isn't keeping pace (Ey.com, 2021). Between the United States and the European Union, it is estimated that 12.2 million people lost their jobs in the first three quarters of 2020 (Bennett, 2021). Millions of displaced workers are not returning to the post-pandemic workforce for several reasons, including safety concerns, childcare and wage demands. In an economy that has the momentum to recapture pre-pandemic economic highs, this labor shortage could not be happening at a more inopportune moment.

U.S. government preliminary jobs data for April showed that **TRANSPORTATION AND WAREHOUSING EMPLOYMENT DECLINED BY 74,000 JOBS** during the month, following gains in February and March (*Anthes, 2021*).

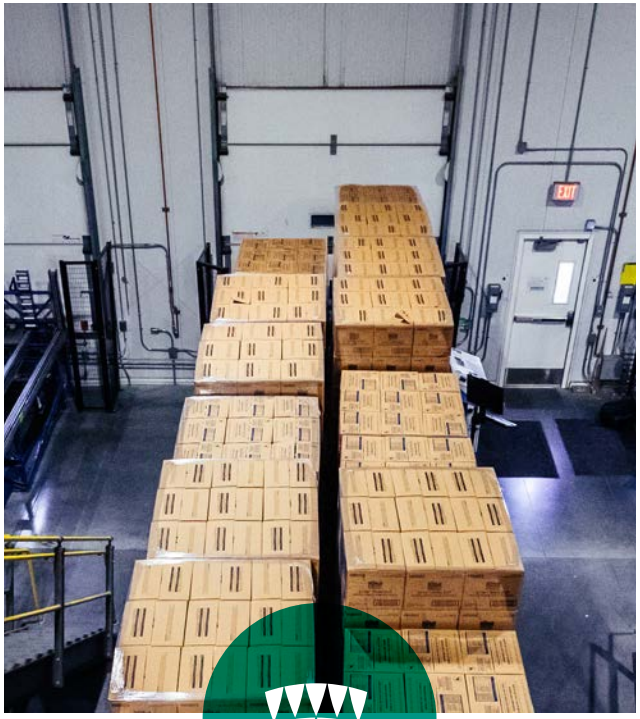
Labor unpredictability is now commonplace.

The only predictability, as it applies to supply chain labor at this moment, is unpredictability. Attempts at maintaining a "rightsized" labor force can be regularly disrupted by unpredictable forces, which can overwhelm any supply chain. And as soon as one is adequately staffed, labor needs seemingly dip. Ultimately, finding and managing the labor necessary to meet fluctuating demand can be quite difficult.

62% of companies **HAVE LIMITED VISIBILITY** of their supply chain, and **15%** only **HAVE VISIBILITY** on production (*GEODIS, 2017*).

As we've observed with recent cycles of panic-buying, nobody knows when the next geopolitical or climate-driven demand on the supply chain will pop up. Consumers tend to be less brand-loyal with the ability to comparison shop online and with easy access to customer reviews – whatever product subject to social media buzz today can end up sitting in a warehouse tomorrow. Consumer demand-driven changes in labor requirements continue to be a challenge.

"Subject to ever-increasing **GEOPOLITICAL AND CLIMATE-DRIVEN DISTURBANCES,** uncertainty will only increase. (*Forbes, 2017*)."



A SOLUTION TO THE CHALLENGE

Creating labor and workflow agility through real-time insight.

Automation and other data- and software-driven technologies allow players in the cold chain to stay current and proactive by identifying demand signals and staffing accordingly to inform rapid operational decision-making. Intelligent labor – or operations that are tracked, analyzed and adjusted in response to real-time data – is now essential in today's warehousing environment.

It's imperative to not only find the instrumentation for measuring tasks on the floor but to have the processes in place to make the data actionable. With this enhanced real-time visibility, warehouse operators will be able to see where they can reallocate their labor force on the spot to fulfill more orders each day.

Automation also allows for an agile workflow by shortening the time for any specific task. Therefore, when disruptions occur, warehouse teams can focus on solving them, knowing that previously longer, manual processes will still flow properly.

A MANUAL WAREHOUSE that requires **450 EMPLOYEEES**
requires only **170-180 WITH AUTOMATION.**

Lineage Link – Keeping available labor as efficient and safe as possible.

Launched in 2020, Lineage Link® – a fully integrated platform that provides unprecedented supply chain visibility and intelligence – is a game-changer for supply chain professionals looking to rapidly respond to demand fluctuations, new safety protocols and the resulting limitations on labor.

Elliott Wolf, VP & Chief Data Scientist, explains how:
One of the primary sources of waste that manifested during COVID-19 panic-buying was the rapid shift from restaurants to retail (grocery), which resulted in a lot of spoilage. The supply chain couldn't move fast enough to repackage or reroute the material, and product rotted in the interim. Suppliers were also forced to limit on-site staff, as well as interaction with transportation staff, to follow social distancing mandates.

To answer this challenge, we launched our customer experience platform, Lineage Link. Lineage Link helped customers navigate sudden shifts much quicker by giving them access to real-time insights they needed to seamlessly reengineer their distribution networks. Drivers were requested to download the Link app, which made it possible to track and report on their progress and allowed them to check in and work through docking and storage with as little in-person interaction as possible. The platform also allowed our schedulers to work remotely and provided our carriers and customers self-service options. By introducing self-service options, Lineage Link allows our customer care team to focus on exceptional customer service, and the added visibility that Link can provide on all inbound and outbound activities allows the care management team to more effectively plan labor, which is increasingly a scarce commodity. In the future, Lineage Link will allow our warehouse team members and customers to act more strategically and operate more efficiently.

Automation Is — Keeping Up With Demand

CHALLENGE 2

The Cold Chain in the Era of Instant Gratification

> **THE COVID-19 IMPACT** on the economy hastened the arrival of a part of our industry that had **PREVIOUSLY FELT MORE NICHE** than essential.

As product variety grows, so does the complexity of the cold chain.

Americans consume roughly the same amount of food and beverages as they did five years ago. What has changed is the number of options. Take yogurt, for example. There are now almost twice as many types of yogurts available as there were five years ago, which means there are twice as many options for retailers to stock.

In our world, SKU proliferation has necessitated a fundamental shift in pallet picking. The demand for variety has shifted product movements from full pallets to a higher rate of mixed-SKU pallets.

2015 saw an **18.5% INCREASE** in the **NUMBER OF SKUs** handled by the average warehouse or order fulfillment operation (*Michel, 2015*).

An explosion in consumer choices means rethinking how we deliver.

The COVID-19 impact on the economy hastened the arrival of a part of our industry that had previously felt more niche than essential: The mainstream acceptance and consumer demand for same-day and two-day delivery by giants, such as Amazon, Walmart and Target, brought to the forefront an expectation for instant gratification – an expectation that accelerates all aspects of the food supply chain to accommodate expedited delivery.

E-commerce and direct-to-consumer are now major channels of demand. Changes in shopping behaviors have increased throughput requirements of the upstream warehouses due to this abundance of product choices as well as delivery method choices (e.g., in-store shopping, curbside service, direct to consumer, meal kits, etc.).

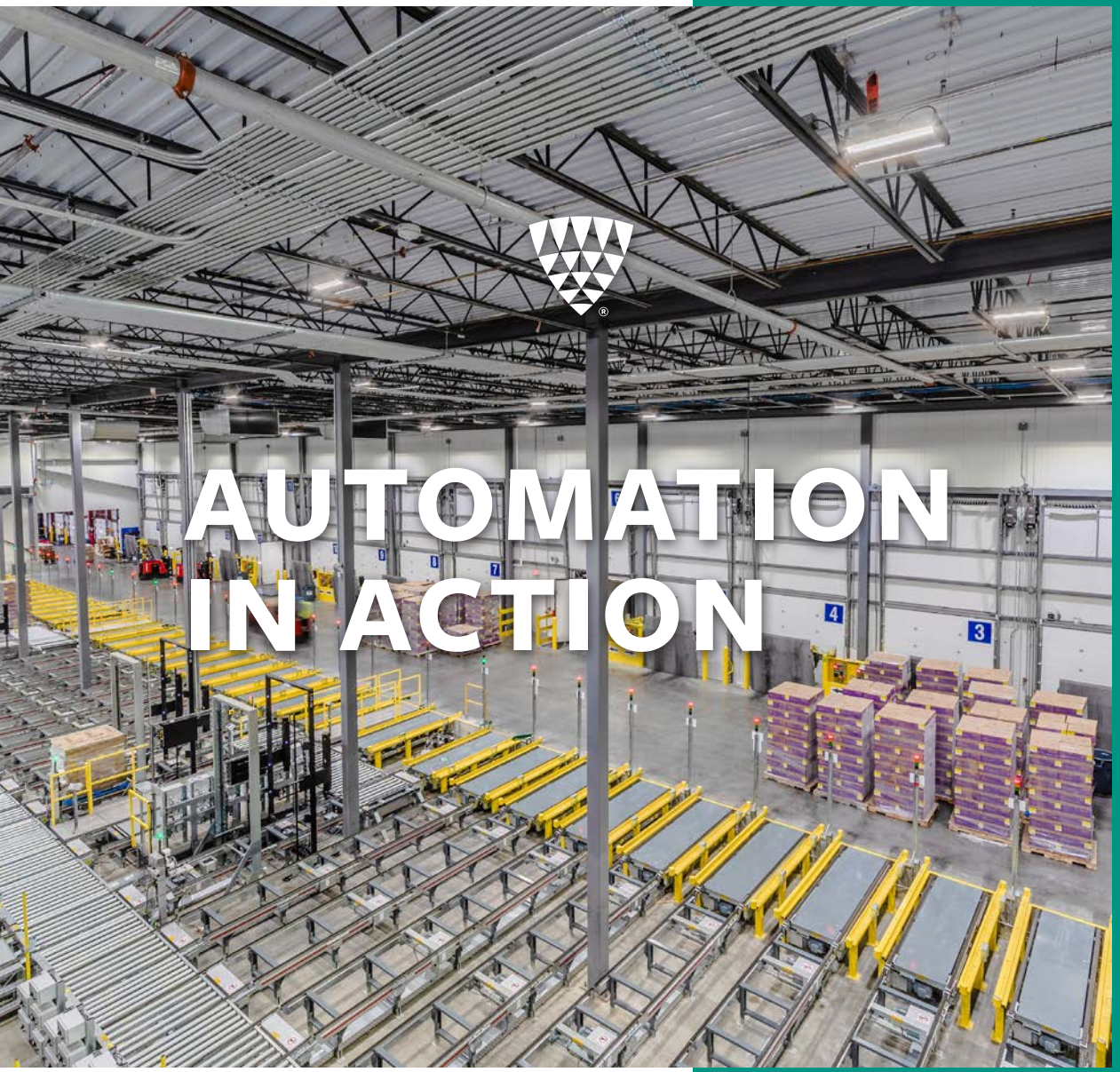
This complexity is being passed on to the end-user: the grocer. As direct-to-consumer grocery mechanisms, such as app-based delivery services, force the back rooms of retail stores to operate as mini distribution centers, stores now need more and more frequent and varied deliveries.

A SOLUTION TO THE CHALLENGE

Using autonomous layer pickers.

Before automation was incorporated into the rainbow pallet-building process, a worker would drag a pallet through a warehouse and manually pull every single box from source pallets. The introduction of automated layer pickers allows a facility to automate up to 96% of the volume shipped through the warehouse. With automated layer picking technology, rainbow pallets are created by robotically removing layers of single SKU pallets to create multilayered full pallets.

WALKING AND MANUALLY PICKING ORDERS can account for **MORE THAN 50%** of the time associated with picking (*Cocozza, 2019*).



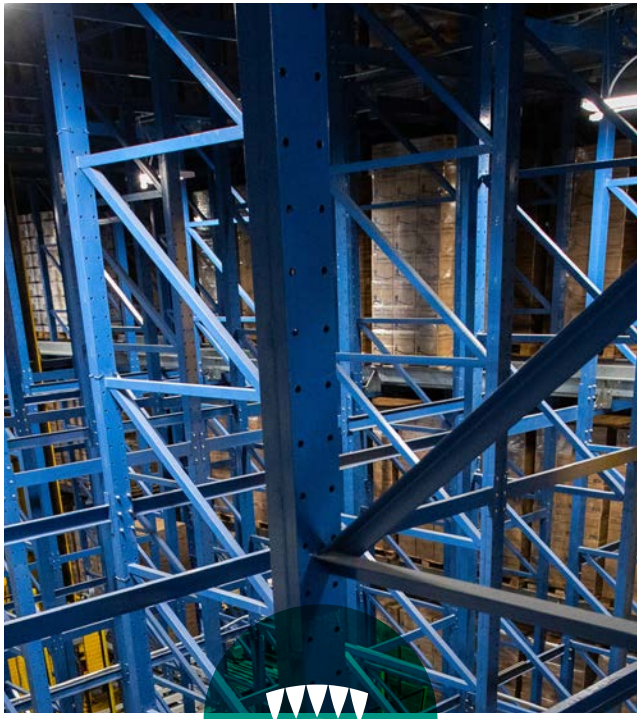
AUTOMATION IN ACTION

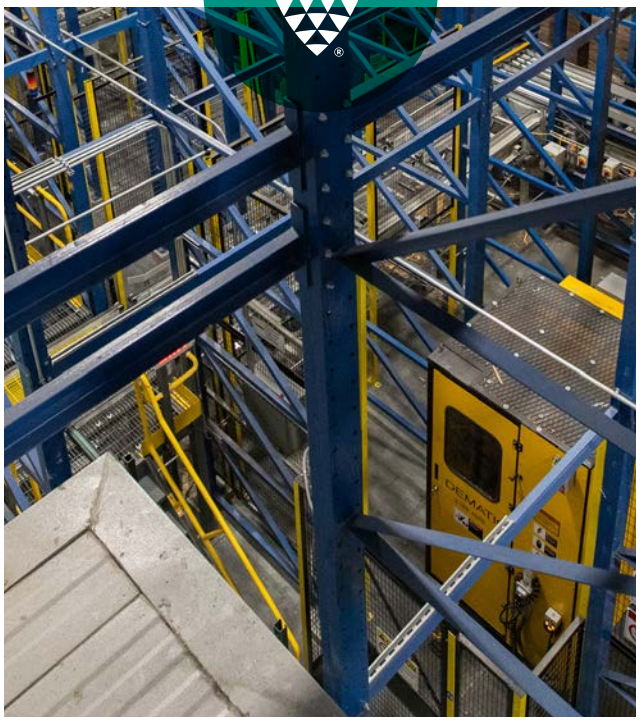
The fully automated warehouse.

A large regional distribution center for several customers, our Allentown, Pennsylvania, facility moves approximately 200 trucks of product in and out daily, encompassing nearly 4 million pounds per day. As vendors have added more choices/SKUs to their offerings, and consumers have become more specific in their orders, growth in order variability has significantly increased the amount of case picking or partial pallets needed to fulfill orders.

To alleviate the stress of this new demand, we are implementing automation in high-throughput areas of the warehouse. More specifically, we are installing a layer picker machine and multiple automated guided vehicles (AGVs) to reduce the amount of labor utilized in the case picking function.

The layer picker and the AGVs will work as part of the overall inbound/outbound flow of product, but the loading and unloading of trucks will continue to be done by humans on material handling equipment. The automation will come into play as AGVs will retrieve inbound pallets from staging areas on our dock, will put/pull pallets into/out of racking, will feed the layer picker with the needed product and will place outbound pallets in staging areas on the dock. The layer picker will help to reduce the pressure of unpredictable labor markets and fluctuating consumer demands.





A SOLUTION TO THE CHALLENGE

Doing more with less.

Last-mile storage is physically shifting the supply chain landscape.
As e-commerce continues to explode and more consumers gravitate toward direct-to-consumer service, the last-mile storage facility is quickly becoming a more integral part of the food supply chain. These warehouses are often built vertically in densely populated urban areas where traditional, large footprint distribution centers would be impractical and cost prohibitive. Automation removes those limits by utilizing programmed lifts that are built into the design of the warehouse.

AUTOMATION IN ACTION

The sky is the limit.

Currently, the tallest Lineage storage facility stands 140 feet tall. Normally, our manually operated warehouses are approximately 35 feet tall due to limitations imposed by forklifts and fire protection. With the automated designs, the facility can store approximately five times as much inventory as a manual facility with the same footprint.

Automation Is — Greening the Food Supply Chain

CHALLENGE 3

Sustainability and Energy Efficiency

> According to the **WORLD RESOURCES INSTITUTE**, global annual **GREENHOUSE EMISSIONS** have **INCREASED OVER 40% SINCE 1990** – a number that's continuing to grow (*Ge and Friedrich, 2020*).

Sustainability is now a central social tenet.

Earlier this year, President Joe Biden called for cutting U.S. greenhouse gas emissions by 50% to 52% by 2030, on the same day the country rejoined the Paris Agreement. This is a signal to businesses in the United States – and around the world – that sustainability and energy efficiency are more important than ever. Bringing it closer to home, the call to action for the supply chain community is clear – we need to take action and promote environmental sustainability, reduce carbon footprint impacts and drive a greener supply chain.

81% OF SUPPLY CHAIN COMPANIES are **MORE FOCUSED ON SUSTAINABILITY TODAY** than they were three years ago (*Coyote Logistics, 2020*).

According to the World Resources Institute, global annual greenhouse emissions have increased over 40% since 1990 – a number that's continuing to grow (Ge and Friedrich, 2020). The cold chain industry owes sustainability transparency to our consumers, our partners and to future generations. Working together to collectively reduce the industry's carbon footprint continues to be a critical global agenda item, and we are uniquely positioned to make dramatic impacts on the environment.

Recognizing our emissions impact.

Key drivers in multiple sectors of the global economy and the world's population are demanding change – and the cold chain industry understands that it needs to do its part. A recent study found 81% of supply chain companies are more focused on sustainability today than they were three years ago. And as the Massachusetts Institute of Technology reported in a 2020 study, this shift is partially due to pressure from key supply chain stakeholders that we apply additional efforts toward sustainable operational practices and join the global demand to go green.

The expected result: Supply chain professionals will be a driving force behind the development and execution of their companies' sustainability programs, searching for ways to create efficiencies and reduce emissions.

And automation is core to our commitment to energy efficiency and sustainability.

A SOLUTION TO THE CHALLENGE

Building up instead of out.

Outside of the freezer, automated processes decrease the amount of heat entering a building. At a manual warehouse, an entire forklift must pass through the doors, but at an automated warehouse only a pallet must fit through the doors. In addition, a taller building reduces the heat entry via the roof relative to the product it stores. Such a decrease in heat infiltration decreases the demand on the refrigeration system itself, directly decreasing the energy cost. It further allows the warehouse to maintain the temperature for a longer time, increasing the benefits of flywheeling. Building up instead of out not only reduces our physical footprint but can also reduce our energy usage.

Implementing environmental sustainability and greatly reducing the cold chain's carbon footprint are essential components of the cold chain's future. By taking a closer look at time-tested practices and infrastructure, and investing in technology and talent to improve them, we can work toward a greener food supply chain.

AUTOMATION IN ACTION

Measuring efficiency by degrees.

Conserving energy and achieving efficiencies across our global operations are passions at Lineage Logistics. In our never-ending quest to conserve energy, our Data Science team examined a time-tested practice known as flywheeling to see how it could be improved with a more technology-driven solution.

Flywheeling leverages the frozen contents of a freezer to maintain the optimal temperatures without electricity. During off-peak hours, the warehouse cools products well below their required temperatures. As the facility enters peak hours, the power used to cool the products is greatly decreased as the food's own temperature is used to keep the food within accepted temperatures. Typically, a manual process relies on humans to "turn things off" during peak times. So, the team asked itself how it can take control of the process by making the process automated without a significant investment.

Over the course of three years, Lineage's Data Science team developed a *patented algorithm* that combined machine learning with AI to predict and inform scheduling and energy-related decisions, leading to a significant reduction in its energy intensity and year-over-year energy reduction – staying true to its commitment to reduce waste across its network. The result: Lineage was named a *Better Practice Awards* winner in 2021 by the U.S. Department of Energy for a third consecutive year, recognizing our outstanding energy-efficient innovations.

Automation Is — Achieving Food Optimization

CHALLENGE 4

Food Waste and Safety

> The **FOOD AND AGRICULTURE ORGANIZATION** of the **UNITED NATIONS REPORTS** that nearly **$1 TRILLION OF FOOD IS LOST** or wasted every year worldwide.

Moving from middleman to the last line of defense.

Traditionally, cold storage warehouses have functioned as upstream stops on a long journey ending at grocery and retail stores and ultimately, the consumer. The buffer between production and consumption distributed responsibility of food safety between all parties involved in the product's journey. The growth of business-to-consumer (B2C) direct delivery companies, however, circumvents traditional supply chain workflows and shifts direct customer contact further upstream. These days, a front-line worker at a warehouse could be the last line of defense for somebody's dinner.

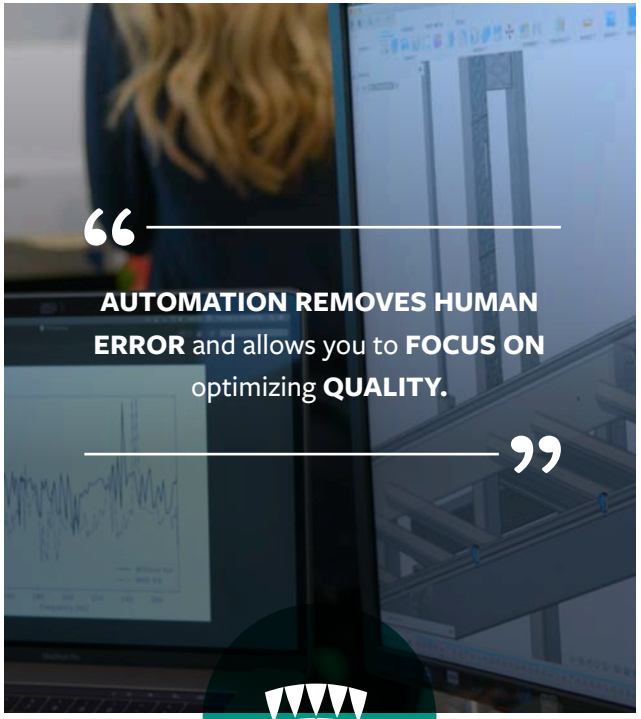
> Now, what we do impacts somebody at their home. There is no middleman. We have to have **THE HIGHEST LEVEL OF EFFICACY AND ATTENTION TO DETAIL** because we're the final quality check.
> *– Dr. Stephen Neel, Lineage Logistics Director of Food Safety*

Doing our part to reduce food waste.

There are many factors that can cause food waste – from spoilage and disruptions in temperature regulation to package damage. Even relatively small differences in temperature can mean a big difference in the quality of perishable foods. Maintaining the quality of perishable foods is difficult, especially when multiple players are handling and moving the product. Lack of visibility and human error are the two most common causes of food spoilage during transportation, processing and storage.

According to the Boston Consulting Group (BCG), **THE AMOUNT OF FOOD WASTE** created in the supply chain will rise by **1.9% ANNUALLY FROM 2015 TO 2030.** You may think this is a small growth, but when put into perspective, the current **1.6 BILLION TONS WASTED EVERY YEAR** will **INCREASE BY 30.4 MILLION TONS** (*Abecasis, Alexander, Meyer zum Felde, Pralle, 2020*).

The Food and Agriculture Organization of the United Nations reports that nearly $1 trillion of food is lost or wasted every year worldwide. This figure includes food wasted by retail chains or consumers along with food that is lost, damaged or expires as it makes its way through the supply chain. It's enough food to feed nearly 2 billion people. There are 1 billion undernourished people in the world (UNWFP, 2021). Optimizing the cold chain and dynamic routing can simultaneously decrease waste and undernourishment (*Leonard, 2019*).



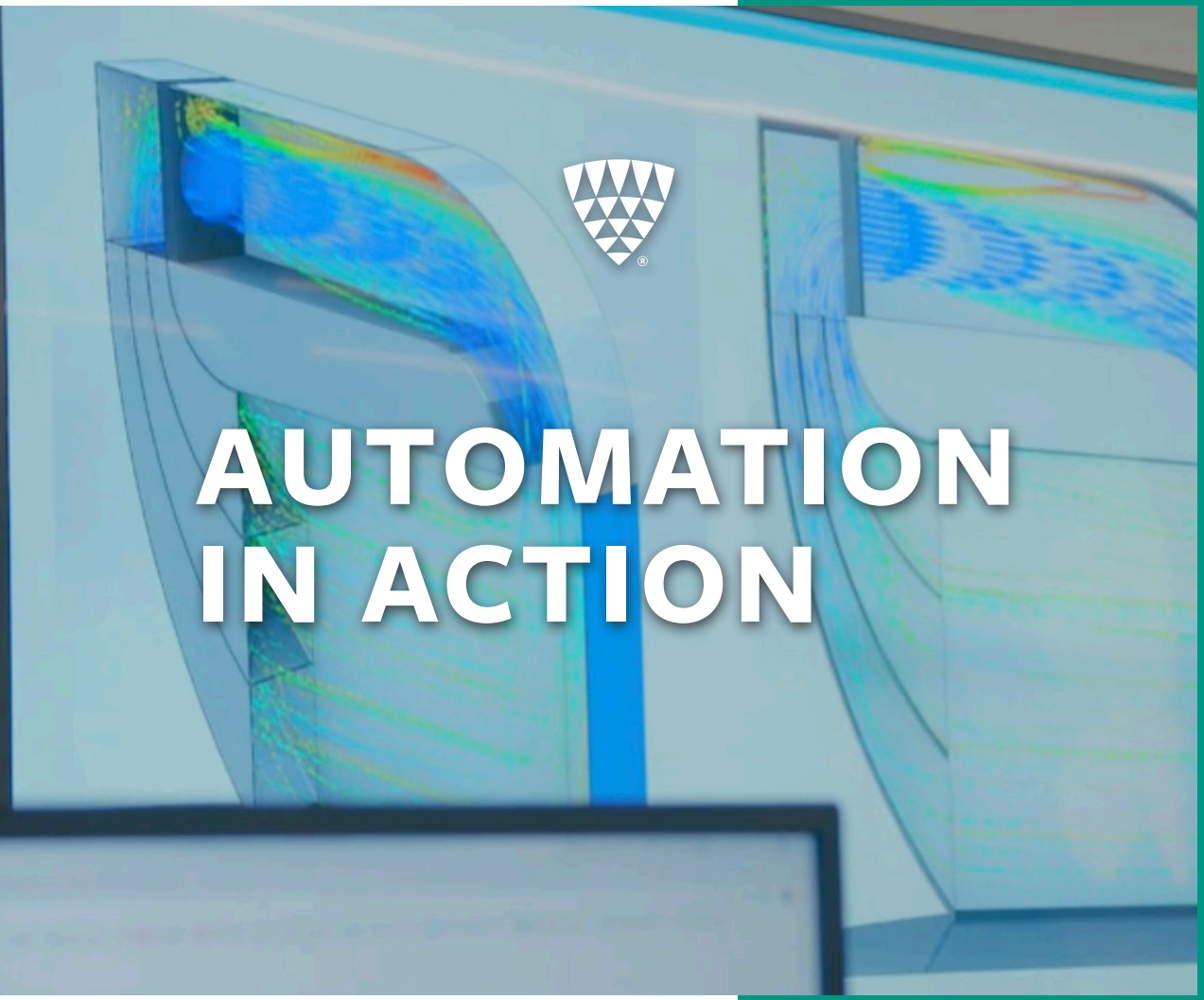
A SOLUTION TO THE CHALLENGE

Optimize food quality and minimize waste with automated, yet agile, workflows.

In the food supply chain, maintaining fundamental compliance through the entire food journey is the primary goal. From there, companies need to decide between merely meeting the minimum standards or going above and beyond, developing best-in-class practices of combining quality and maximization into food safety.

Automation in both decision-making and material handling enables best-in-class practices. Computers can make decisions on the basis of more factors and more information than a human ever could and provide traceability that human decisions cannot. Automated material handling systems put the pallet exactly where the control systems direct it; there is no possibility of a pallet getting lost if it’s been placed by a robot.

Automation removes human error and allows you to focus on optimizing quality. Maximizing quality requires understanding thermodynamics, biology and our customers’ products. Data collection, data analysis and automation ensure that the highest quality of food is available to consumers, while surpassing standard industry guidelines.



Blast freezing line.

Blast freezing, the energy-intensive process in which freshly produced perishable goods are safely and rapidly chilled to below-freezing temperatures to retain freshness, is a critical part of the cold chain process. Blast freezing is what makes food frozen prior to storage and shipping.

Lineage's Data Science team has studied and improved the existing blast freezing designs throughout its portfolio. By utilizing techniques, such as computational fluid dynamics (CFD) and finite element analysis (FEA), we have created and patented new blast freezer designs with improved freezing airflow, which results in higher product freeze quality and enhanced energy efficiency. The newer designs are able to freeze products in as little as half the time of a traditional blast freezer while still being 20% more energy-efficient. Getting perishables to the correct temperature in half the time is just one of the ways that Lineage is maximizing quality.

Lineage's advancements in blast freezing have not gone unnoticed. We received the *Department of Energy's Better Plants Better Project Award in 2020* as a result of this research and implementation. (In addition to the same awards in 2019 and 2021 for different energy-related innovations.)

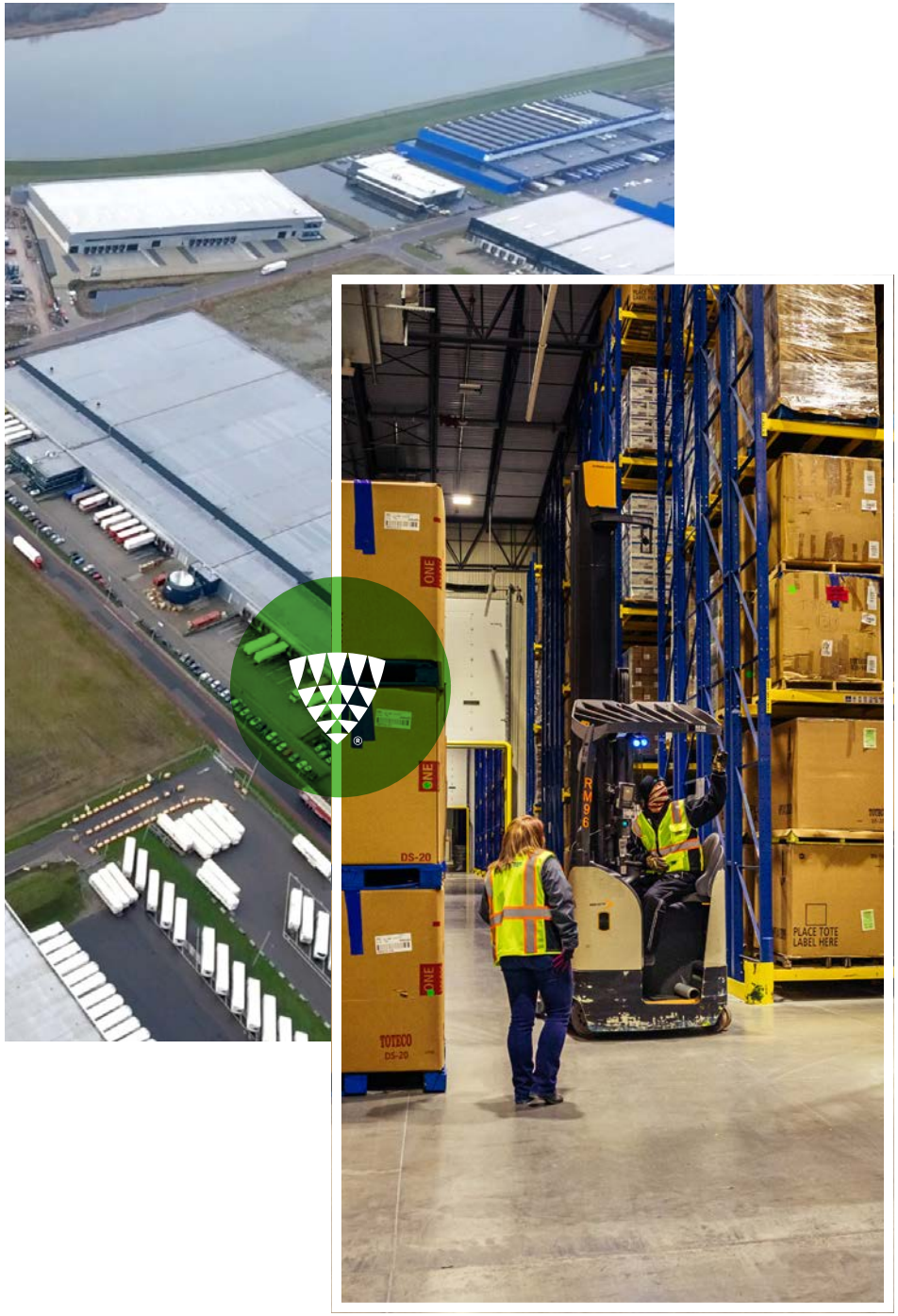
Achieving food optimization through automation.

The evolution of the cold chain increased the prominence of the warehouse worker; she or he is front and center as the last line of defense between the consumer and potentially harmful food. Changes in the food supply chain increase the stakes for the cold chain; it must ensure food safety and maximize quality.

We must elevate food safety standards while simultaneously reducing food waste. From an industry and humanitarian viewpoint, the amount of waste in the cold chain adversely affects economies and communities around the world. Eliminating waste in the cold chain is an essential step toward a more sustainable future.

The most direct path to achieve food safety and food optimization while concurrently reducing food waste is through automation. Automation is essential, not only for the efficiencies that it brings to the industry but to also continuously improve food quality. As consumer demand escalates and changes in ways that provide fewer buffers between the producer and the consumer, weaving in automation with traditional warehouse operations is the only answer for safely keeping up with demand.

NAVIGATING THE COLD CHAIN AUTOMATION REVOLUTION



OUR MISSION EMBRACES AUTOMATION

At Lineage, our mission is to reimagine the global food supply chain to eliminate waste and help feed the world. It's an ambitious but necessary pursuit – one that requires big, bold ideas and a willingness to attempt concepts that have never been tried before in the cold chain.

Across every section of our business, we're defining and implementing best practices. From creating the world's largest temperature-controlled facility to being awarded 15 U.S. patents, we're setting the standard for automation and algorithm implementation throughout the cold chain. Getting here was no accident. Sharing a vision across our global network has helped us collectively see the future of an automated cold chain. This same vision will guide us going forward. As we continue to honor our commitment to feeding the world, we pledge to maintain these principles:

- We will continue to invest in our current and future team members and infrastructure.
- We will never stop trying to improve our processes.
- Through data analysis and algorithm refinement, we will make breakthroughs in material handling.
- As demands on the cold chain evolve and increase, we will succeed in adapting to these changes.
- Being bold and innovative is at the core of who we are, and we will continue to lead with those values.

With this foundation in place, let's now discuss how we can implement automation into any warehouse environment.

Making automation a reality.

Transitioning from manual to automated systems requires a combination of research, planning and imagination. The effort to integrate automation into a supply chain is considerable and may feel foreign to your organization. At Lineage, we've experienced firsthand the shift in thinking that automation requires – at all levels of a company – and have coalesced some key insights and considerations for success.

Automation begins with people.

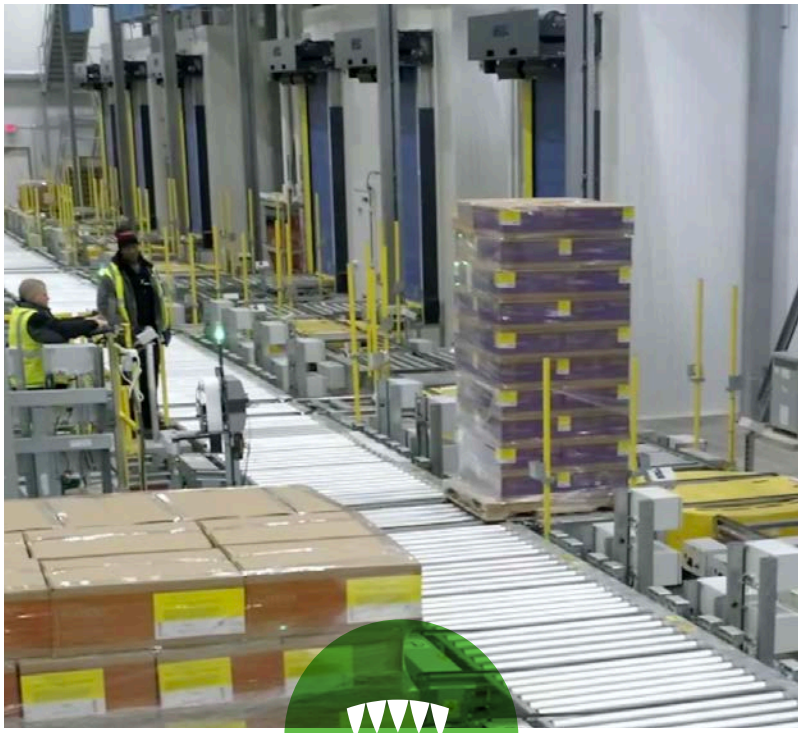
Before making the decision on where and how to begin your automation investment, it's important to start reshaping team members' preconceived ideas of what an automated work environment feels like. In general, people are resistant to change, and introducing automation into an environment that traditionally relies on manpower may be met with a dose of skepticism.

It's important to help employees understand early on how automation will help them in their roles. Automation greatly reduces the time spent on "clipboard" tasks – tasks that often lead to errors and increased work – to free up time to properly tackle challenges and uncover new opportunities.

In the cold chain, automation reduces employees' time spent in hostile environments such as freezers and coolers. It respects their motion by only asking them to brave an industrial freezer when we really need them to move inventory.

> **HUMANS ARE AND ALWAYS WILL BE THE HEART AND SOUL OF ANY OPERATION** – it's just how they interact with technology that will change.
>
> *– Sudarsan Thattai, Lineage Chief Information Officer*

After laying the foundation for automation within your people and culture, the next step is choosing and implementing systems that are right for your particular needs. Based on our research and industry-leading practical experience, we've identified three considerations to take into account when making those choices.



CONSIDERATION 1

Automation Isn’t Binary

Automation is never “one size fits all.” And not all automated warehouses are built the same. Understanding your customers’ needs and organizational outcomes are essential to adding the right amount and types of automation to your facility. Among the numerous beneficial aspects of automation is the amount of flexibility it allows on your warehouse floor. While individual aspects of automated systems are designed to do one specific task, the concept of automation allows for countless combinations of individual tasks to enable large-scale applications. Fundamentally, there are three broad approaches to automation as it applies to integration into the cold chain.

The fully automated warehouse.

The fully automated warehouse is a facility run by large scale, fully integrated robotic systems, outfitted with numerous cranes and rows of conveyors for inbound receiving and pallet building. While there will always be a supervisory human component in any facility, 95% of our fully automated warehousing is no-touch.

These new warehouse builds, combined with our algorithms and software, allow for major increases in storage density, throughput and capacity. As a benefit, these facilities are not encumbered by the height restrictions that forklifts impose on manual warehouses. Taller building heights provide flexibility in where we can locate a warehouse, including heavily populated areas.

AUTOMATION IN ACTION

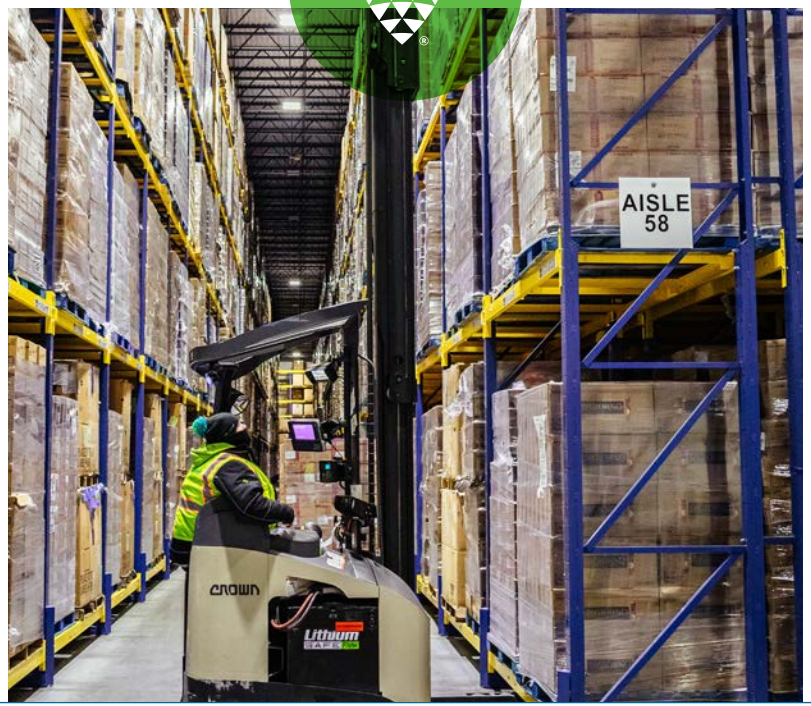
Bergen op Zoom

With a throughput of 5,500 inbound and outbound pallets per day and a maximum storage capacity of 180,000 pallets, our Bergen op Zoom, Netherlands, facility provides a glimpse into the future of cold chain automation. For its size, Bergen op Zoom only has 15 forklift drivers per shift.

The Bergen op Zoom facility came into being as a result of our relationship with a European commodity producer. Coordinating with our partner, we developed an electronic data interchange (EDI) that, when married with our warehouse management system software and then received by our I-point (inspection point), allows for a fully automated process from inbound truck to outbound truck.

We achieve such incredible throughput with approximately 100 team members, including one process controller. Acting essentially as a warehouse air traffic controller, the process controller is responsible for ensuring that the thousands of pallet positions on the expansive system of conveyors throughout the warehouse are synchronized properly. When a disruption occurs, it's the process controller's job to ensure that there's no delay for the customer.

As automated processes scale and can build from other processes, Bergen op Zoom will one day be able to increase the overall storage capability to 280,000 pallet places. Dedicated buildings such as the Bergen op Zoom facility can apply customized automation, specifications, designs and workflows based on a customer's specific needs. The design specifications of a dedicated facility are a much less speculative exercise.



A mixed-mode approach.

Not all organizations can afford to invest in building new, fully automated structures. Retrofitting existing buildings with different modes of automation offers many of the same benefits at a lower cost. Mixed-mode automation is a combination of human-dependent tasks with an automated component. Mixed mode can help warehouses struggling with labor and throughput issues by automating processes without disrupting overall operations.

Successfully designing mixed-mode automation requires looking at every task and every workflow as a programmable function. Regardless of the human or automated component, workflows can be mapped out and synthesized through this process. The right software can determine functions that are greatest served by converting to an automated process.

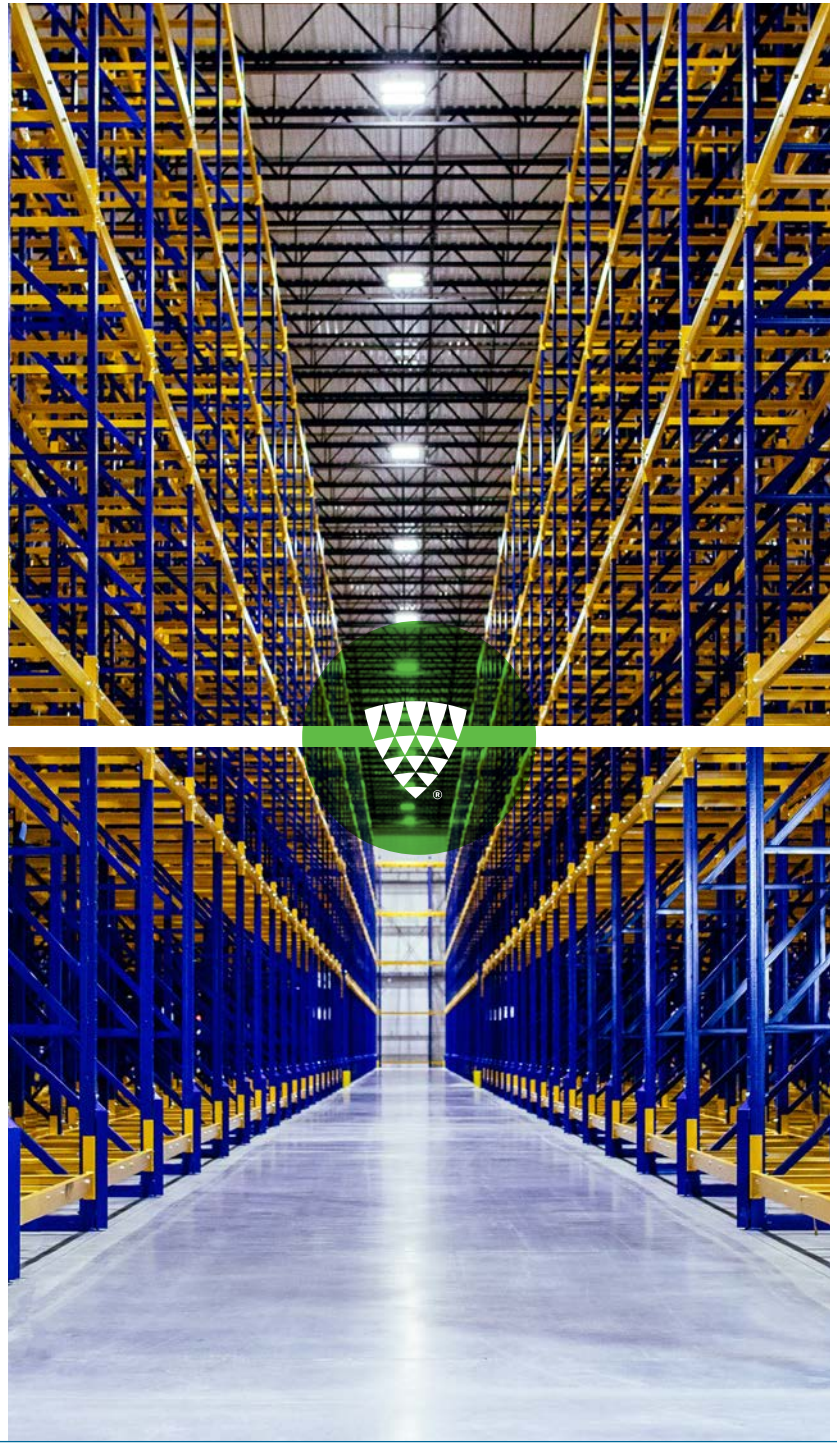
Allentown, Pennsylvania

As a testing ground for mixed mode, Lineage decided to reengineer a section of our Allentown, Pennsylvania, facility. As a large regional distribution center for several customers, Allentown moves approximately 200 trucks of product in and out daily, encompassing nearly 4 million pounds. per day. In addition to the impact of labor shortages felt across the industry, customers have added more choices/SKUs to their offerings, and, in turn, consumers have become more specific in their orders. This growth in order variability has significantly increased the amount of case picking or partial pallets needed to fulfill orders.

The case picking function is traditionally a very manual and very slow process that consumes a great deal of labor. To alleviate the stress of new demands, we are implementing automation throughout the warehouse. More specifically, we are utilizing a layer-picker machine and multiple AGVs (automated guided vehicles) to reduce the amount of labor utilized in the case picking and full-pallet movement function.

The layer picker and the AGVs will work as part of the overall inbound/outbound flow of product. Humans on MHE (material handling equipment) will continue to load and unload trucks. AGVs will automatically retrieve inbound pallets from staging areas on our dock, put into and pull pallets out of racking, feed the layer picker with the needed product and place outbound pallets in staging areas on the dock. The layer picker will replace the human element of case picking for tens of thousands of cases each day.

By implementing select automated capabilities, we anticipate numerous benefits, such as reduced labor hours, improved safety, improved quality and improved customer service. We also expect to minimize the errors caused by incorrect picking of product. Lastly, with a consistent automation presence, our fluctuations in service should decrease as we are less at risk of labor shortages driving decreases in service.



Selectively adding to existing processes.

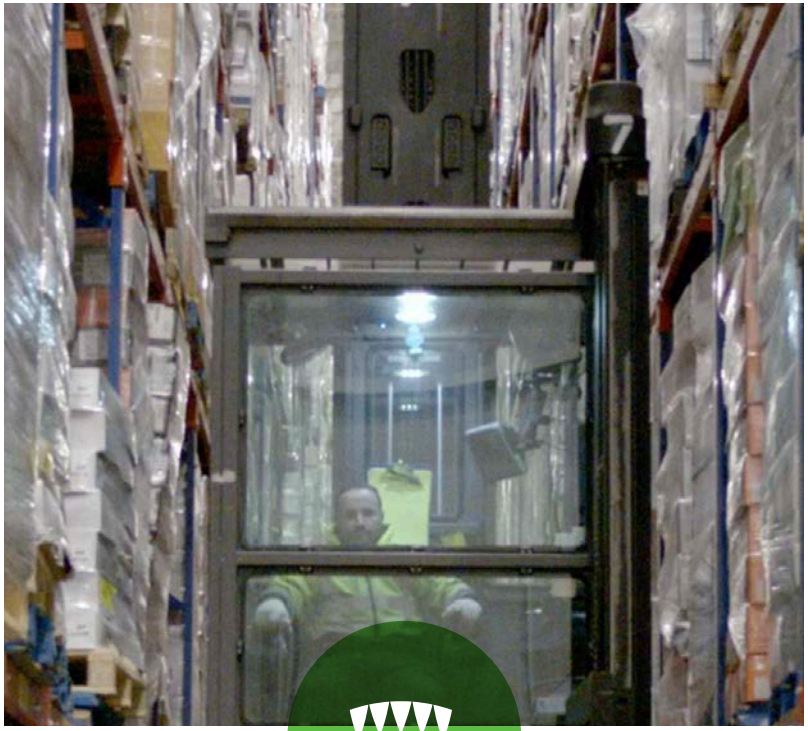
Automation levels (i.e., the amount of automation in a warehouse) are set based on the tasks that need to be done. Those tasks are dictated by the customers being served, so automation designs need to be built to anticipate customers, market needs and supply chain movements.

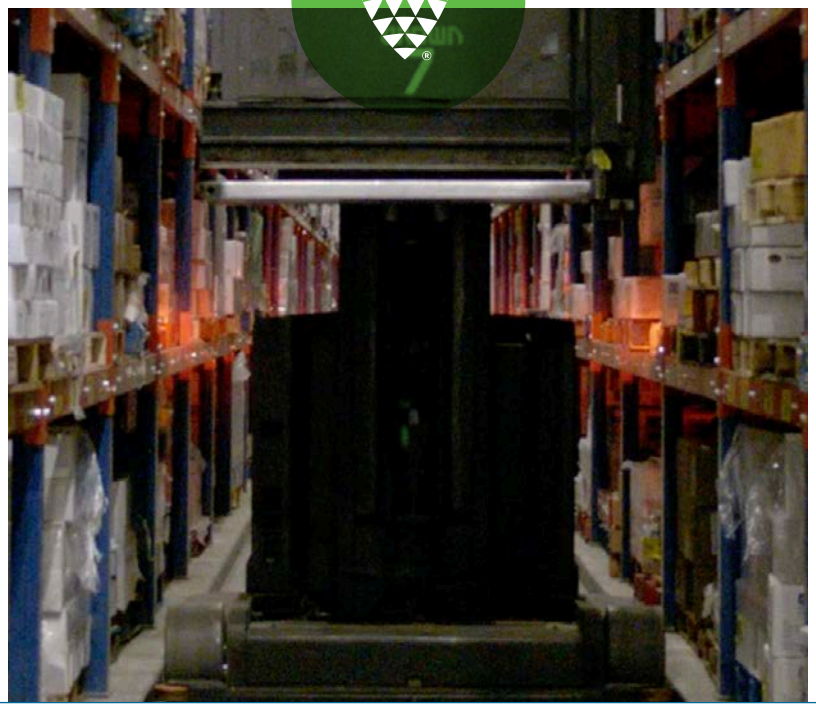
Any automated application ultimately reduces workflow. In an automated work environment, at a moment's notice, we can lessen automated functions; but technological capabilities and equipment capacity constrain our ability to add functions. Traditionally, more work simply meant more labor, but with automation, there's a ceiling. There are only so many moves per hour that a given set of hardware can perform; so, before implementing any automated process, we need to understand the workflow and limitations.

> There is a lot of **AMAZING TECHNOLOGY** out there, and we are not letting the constraints of older buildings stop us.
> *– Caitlin Voegele, Lineage Senior Manager, Data Science Strategy*

CONSIDERATION 2

Combining the Human and Technological Elements of the Cold Chain





Automation and the introduction of technology is often a sensitive subject, as it comes with the perception that it replaces people and jobs. This couldn't be further from the truth. Even with the introduction of automation, our team members play a crucial role in delivering food to people across the globe.

There is, and will continue to be, a human role in automation. Automated facilities increase the throughput compared to the manual predecessor. With increased throughput, more labor is required to handle the increase in planning, maintenance and facility oversight. Ultimately, automation will change how an organizational chart will look, but humans will remain critical to workflow.

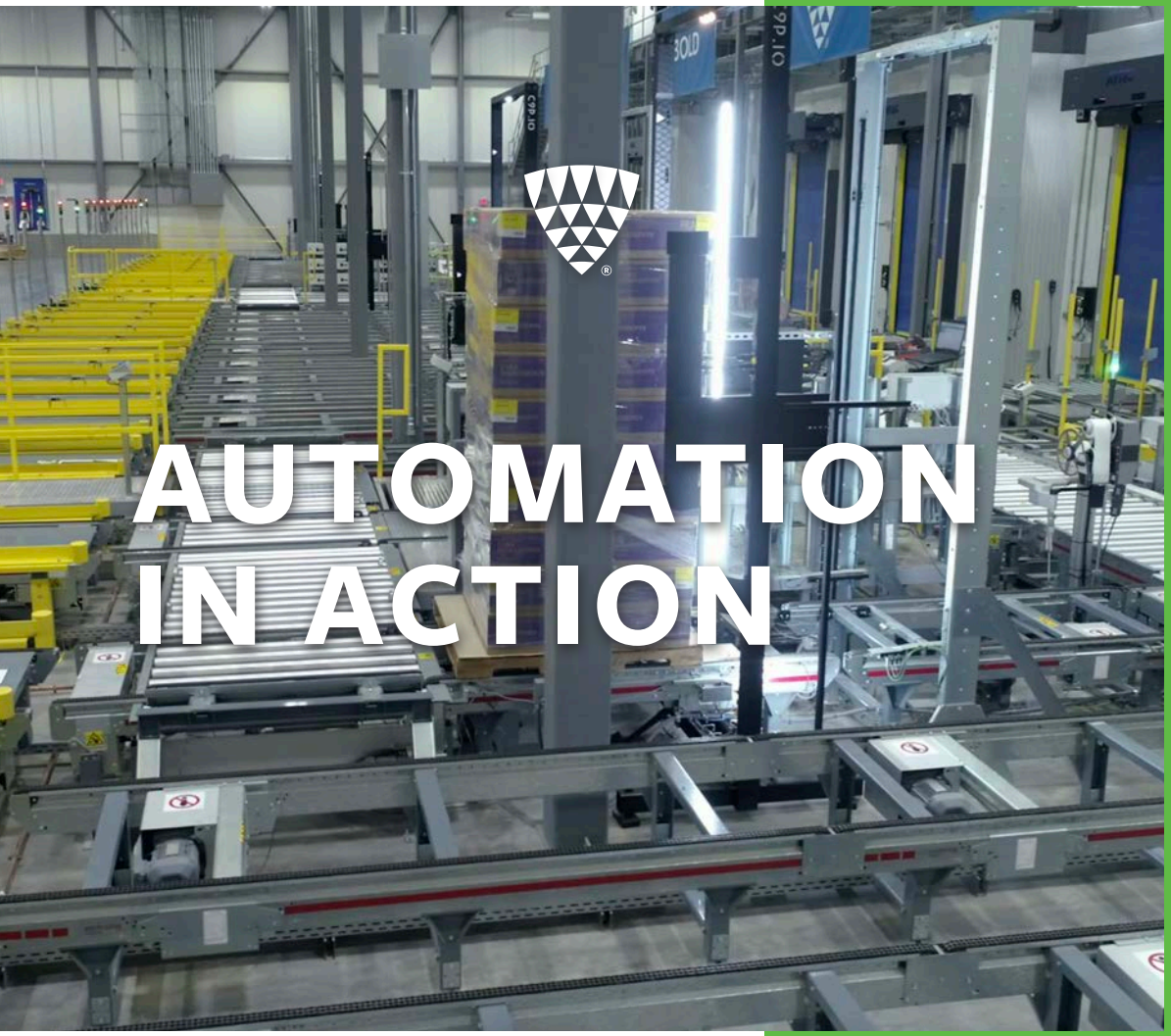
Demonstrating automation with empathy.

Automation in the cold chain isn't always about doing more with less – it's also about helping to maximize the impact of our team members' talents and efforts. By eliminating or greatly reducing the time-consuming but essential parts of the cold chain process, automation frees up our people to focus on our customers and deliver an even higher level of service, as opposed to spending non-value-added time in harsh (-10 F) environments.

While automation enhances productivity throughout a facility, it's also a benefit in times of urgency. When time-sensitive product is en route and a major throughway is blocked or a snowstorm blankets the East Coast, your team members who were previously ensnared in numerous hands-on tasks are now free to help determine the next course of action. This gives team members a truer sense of purpose within the organization.

When we deploy intelligent decision-making algorithms and mixed-mode automation, processes become more efficient and reduce the time employees need to spend in the freezer. One can assume there is a correlation between the hardship of working in cold storage and the higher turnover numbers we see in our industry. By respecting team members' time and helping keep them out of the freezers, we hope to retain a greater percentage of our team members.

Automation that empowers and lessens the stresses associated with the cold chain is the essence of empathetic automation.



Lineage Eye – Scanning for optimization at every step

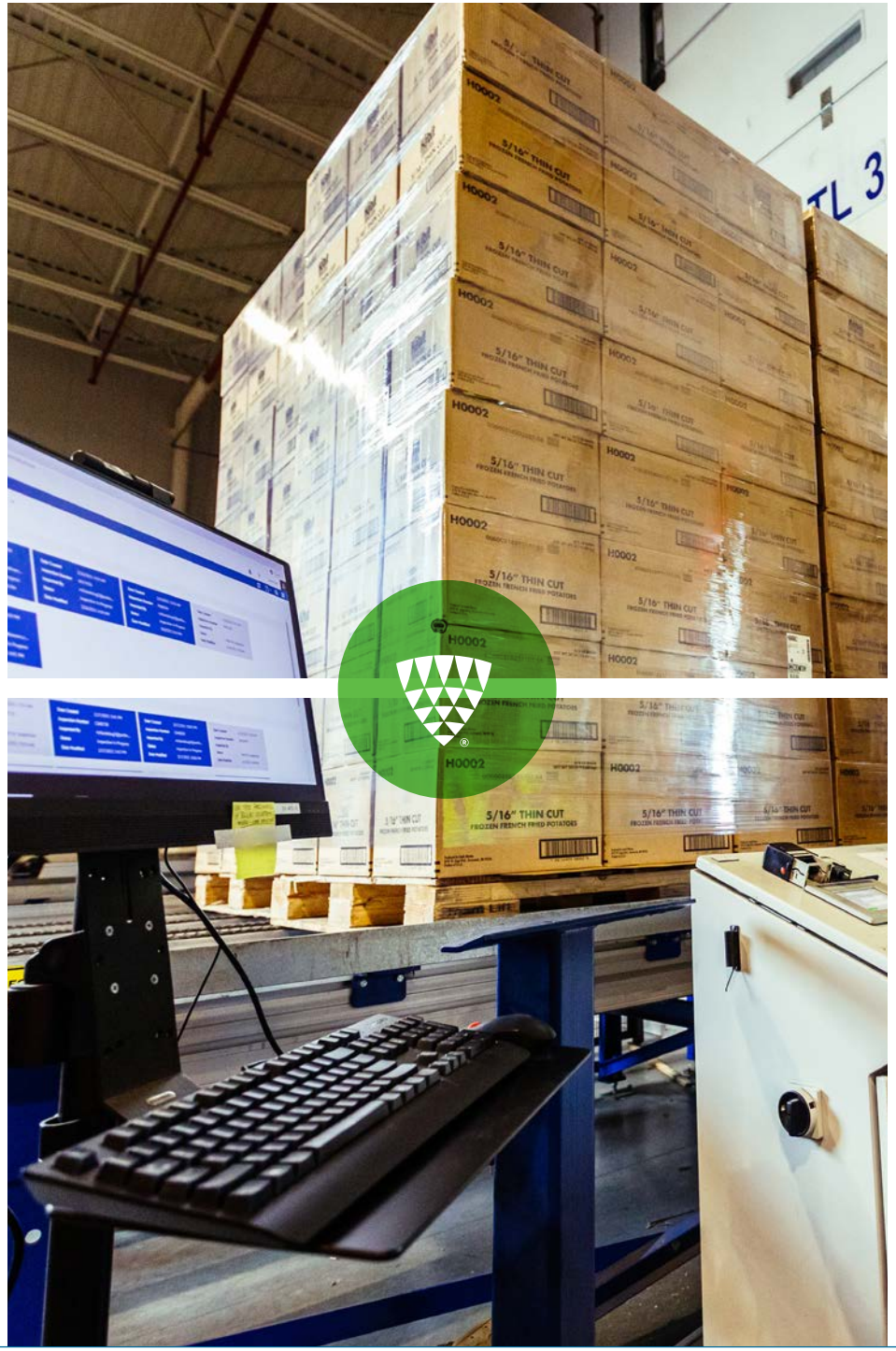
Traditionally, the process of checking for damaged food has never been an exact science. As our network continues to expand and the pace at which food moves through warehouses continues to increase, keeping comprehensive details on every single item of inventory becomes a critical focus.

As the stewards of our customers' inventories, we must always know what we have. Using proprietary computer vision, the Lineage Eye automates the receiving process, including inbound pallet sizing, case counting, SKU and lot determination. It inputs answers to important questions, such as: What item is this? Who owns it? How much of it do we have? When does it expire?

Humans traditionally catalog inbound inventory to capture the headline data. This takes labor and requires space. The Lineage Eye identifies it automatically by using these recent breakthroughs in computer vision.

Technology helps optimize job performance.

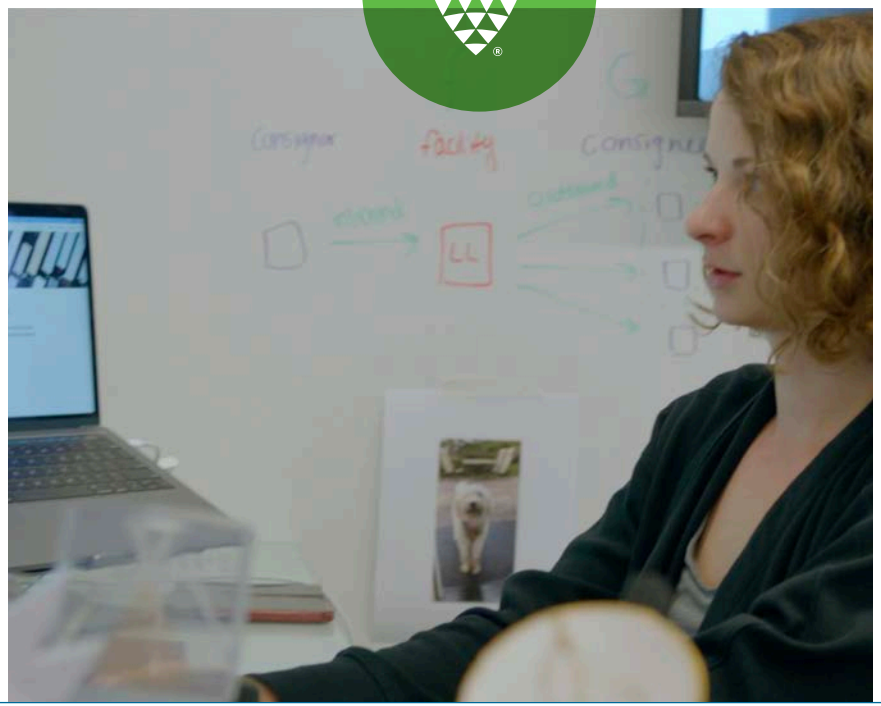
In automation, the algorithms each take over one discrete decision. When these decisions are combined to "oversee" the movements of an entire warehouse, the algorithms take many more considerations into account than any human could. Take, for example, Lineage's algorithm, Janus. Janus selects which dock door a truck should use when loading or offloading. It does so to minimize the distance that inventory coming from or going into a truck must travel, while minimizing cross-traffic between forklifts. There are millions of ways to unload 26 pallets in various spots on the warehouse floor. Janus always makes the right choice.



Optimizing operator efficiencies.

Our MHE localization (or forklift tracking) highlights how we leverage technology to improve operations and forklift operator efficiency. Placing tracking on a forklift to locate where the equipment is in a warehouse becomes stored data. Over time, we'll gain workflow analytics and can make more efficient choices on work distribution.

Now, the long-term goal is to start visualizing/mapping out warehouses (like a video game) with stereoscopic vision technology. The vision technology allows us to locate each piece of equipment in an environment while simultaneously mapping the environment. The net result is that we can dispatch the forklift in real time – we can even prompt the operator to turn around and get inventory if they are passing by an immediately needed pallet. We use the data from the vision systems to create 3D models of buildings and guide forklift drivers in 3D to exactly where the immediate need is located. Ultimately, it will allow the team to provide turn-by-turn directions in a warehouse, shortening our new team members' learning curve.



Building a work force of tech experts.

All business sectors rely on technology, yet it seems the need for tech experts far exceeds the talent available in the marketplace. Reports indicate that while tech job postings have increased over 30% in recent years, the available pool of tech talent is not keeping pace. Competition for tech talent in the upcoming years will be significant (English, 2021).

The people managing the automation process – such as process operators, automation technicians and maintenance technicians – will need to be versed in the tech world, even if these positions are not traditionally considered tech jobs. With the substantial labor shortages already existing in the tech sector, the recruitment and development of talent is a critical component when implementing integrated automation.

As Lineage continues to expand, Vice President of Engineering, Eric Krupa, realized that maintaining and cultivating this type of talent can be challenging.

> Whether you are a department leader or a tech, there is **A NEW LIST OF COMPETENCIES AND EXPECTATIONS**.
> *– Eric Krupa*

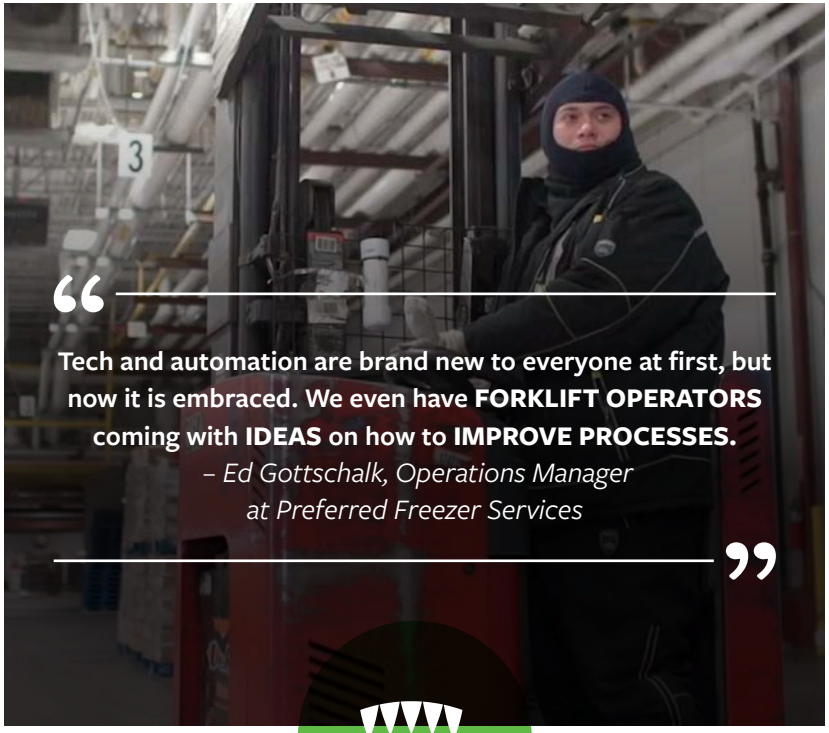
As an example, for every nine ammonia tech positions available with Lineage, only one tech holds the necessary skill set to fill the role. Examples like this exist throughout the organization. Internal training and retention are key to maintaining the consistent workflow throughout the business.

It takes a village to change a culture.

As the technology improves and evolves, it is essential to be proactive and collaborative in shaping the future of the cold chain. It is imperative that our team members are on board. We've found they want to help their teams discover the most efficient ways to automate their work environments.

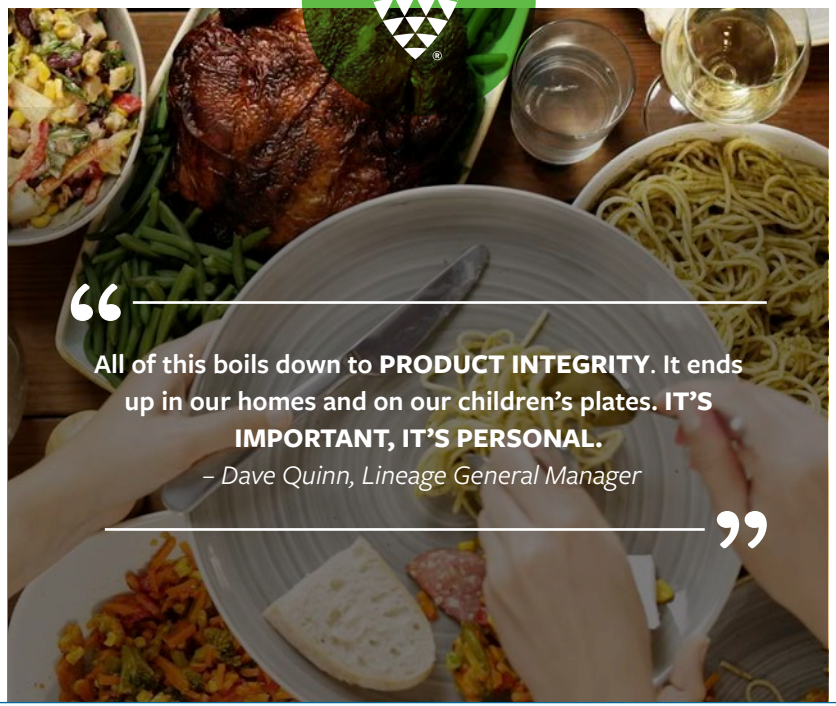
We will continue to need our team members to manage the automation process and collaboration from all parts of the organization – looking for more critical and proactive thinking.

Eric Krupa and his team (Engineering and Maintenance) have developed a two-tiered approach to tackle this need: Providing current Lineage team members training as techs while simultaneously creating an outside pipeline to fill these critical roles. The Lineage Engineering Program, while still in the developmental stage, will eventually link trade schools and tech schools with certified recruits to begin careers in the ammonia refrigeration field. This will help us fulfill our role as stewards of the global food supply chain.



"Tech and automation are brand new to everyone at first, but now it is embraced. We even have **FORKLIFT OPERATORS** coming with **IDEAS** on how to **IMPROVE PROCESSES.**"

– Ed Gottschalk, Operations Manager at Preferred Freezer Services

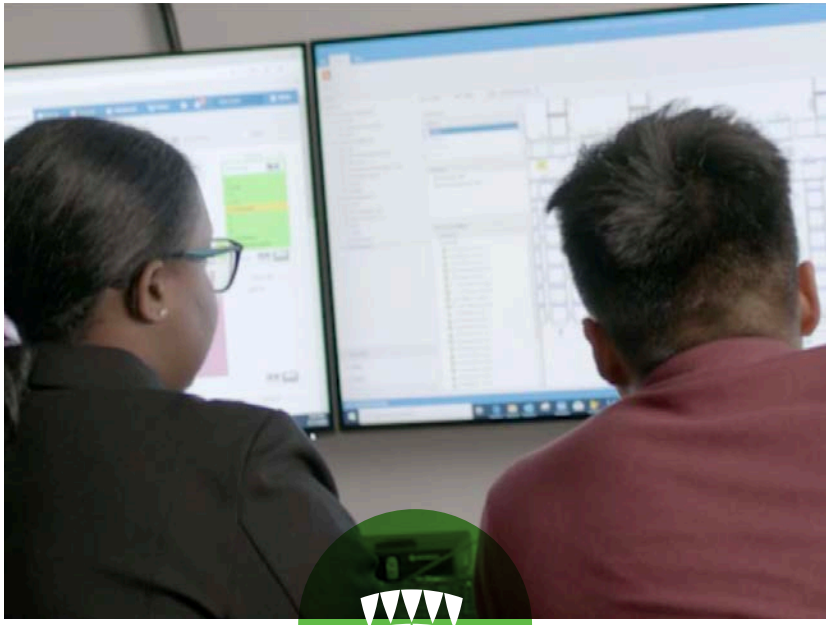


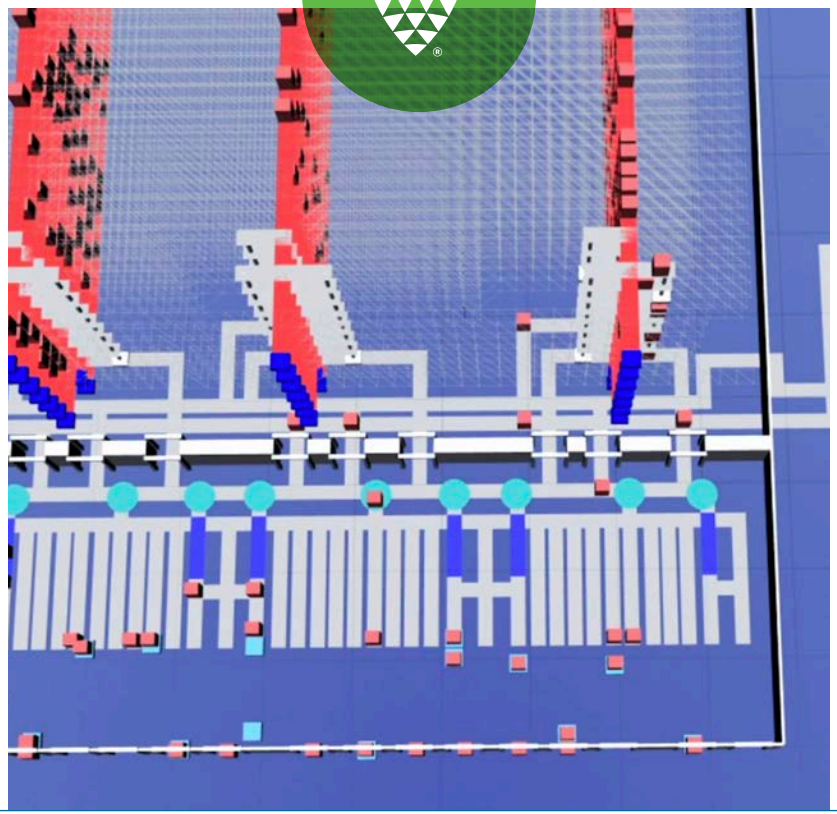
"All of this boils down to **PRODUCT INTEGRITY**. It ends up in our homes and on our children's plates. **IT'S IMPORTANT, IT'S PERSONAL.**"

– Dave Quinn, Lineage General Manager

CONSIDERATION 3

Software Is the Flexible Foundation to Future-Proof Your Automation Investment





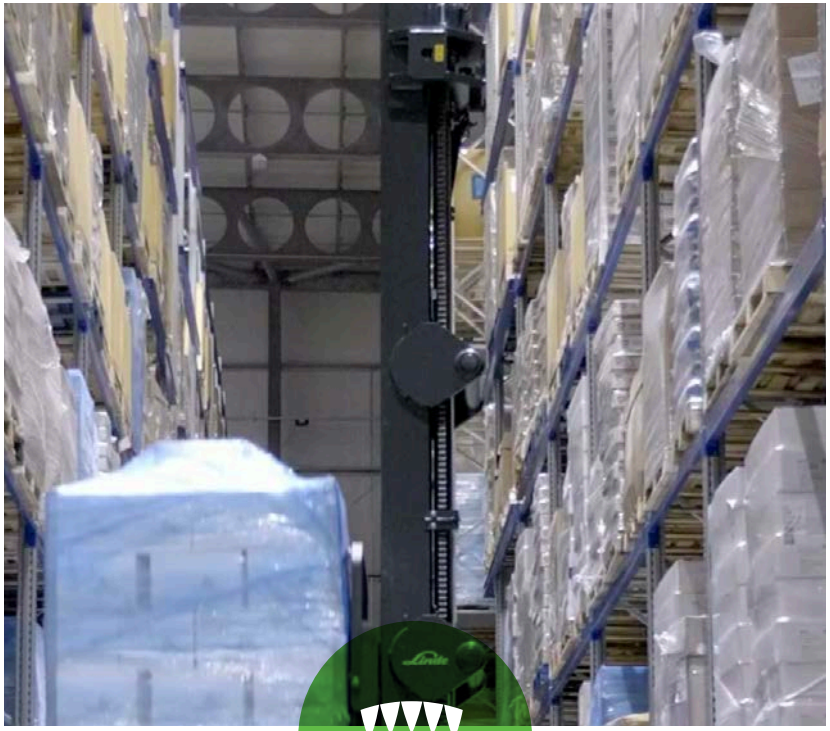
Everyone who has used home computers and cell phones is familiar with technology becoming obsolete. A consumer will buy a smartphone and a year later technological advances render a relatively new phone inadequate. The same principles often apply to the world of automation. How can your business afford to stay current in such a rapidly evolving landscape? By making software the soul of automation.

Every company in our industry owns hardware. Applying the right software mix is the game changer. The hardware, the freezers, cranes, racks and forklifts of a cold chain warehouse will last when properly maintained, but innovative software maximizes the throughput and flexibility of the equipment. Emphasizing software development and integration allows your business to adapt and to adjust for expansion as new customer demands or new products are introduced into the system. In the past, warehousing focused on the quality of hardware. Today, emphasis should equally focus on developing the software that programs and guides automated functions.

Software, data and design are the keys to our automation, but it's the algorithms that make everything sing together.

ALGORITHMS take a bunch of **SINGLE AUTOMATED STEPS** and **TURNS THEM INTO A DANCE.**

Our algorithms keep warehouses moving smoothly and make a specific decision for every movement throughout the warehouse – in real time. From what door a truck unloads to where pallets need to be stored based on how fast the pallets are offloaded to who grabs which task based on where that person's location is on the warehouse floor, algorithms determine everything. The data input optimizes the time and effort of the equipment and available labor.



Introducing Athena.

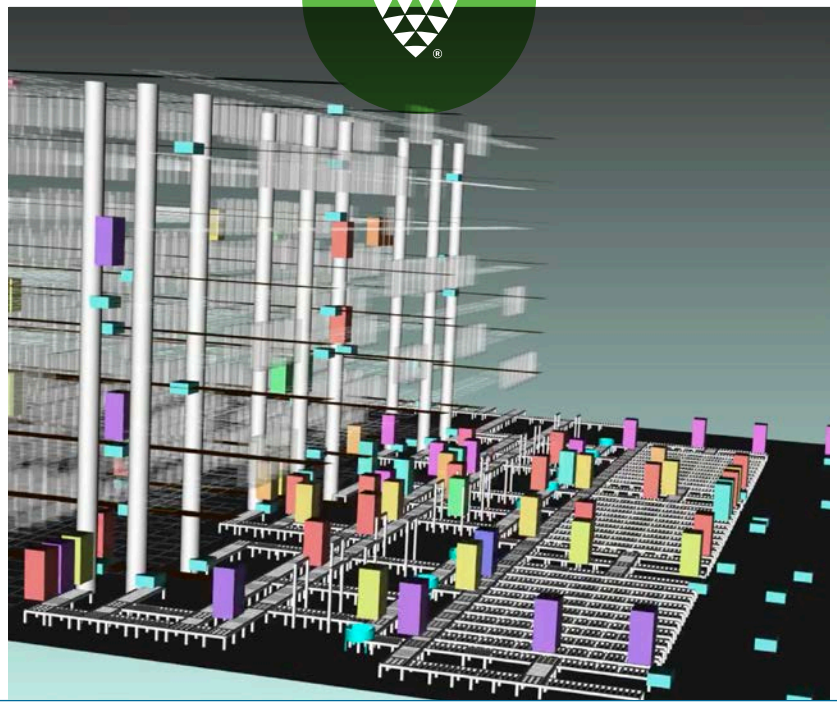
Athena is our patent-pending algorithm that analyzes every current task in a warehouse with the goal of minimizing the motion of warehouse workers and preventing congestion in the warehouse, while loading and unloading trucks on time. Via Athena, we create labor out of software. Armed with an overall moving blueprint of the warehouse, Athena acts as air traffic controller, determining which team members perform each task. Additionally, our new MHE localization technology provides Athena with the locations of all MHE units.

As each forklift is equipped with a screen, tasks are sent, in real time, to our team members. Athena's dispatch decreases in-bound put-away times, allows outbound substitution for increased convenience, task selection and dock door assignment to best align with the warehouse layout. Once a truck is on-site, Athena determines the truck order, duration-of-stay prediction, truck packaging, pallet building, pick line sizing and replenishment. As we thoroughly analyze Athena's data, we will continue to see improvements through the process of algorithm refinement.

AUTOMATION IN ACTION

Maximizing warehouse space.

In a multideep automated warehouse, how do we arrange pallets to minimize unoccupied space? In response to this question, Daniël Walet, a member of the Lineage Data Science team, developed an algorithm that rearranges pallets in storage to have less dead space in the rack. The result: a 4.0% increase in net storage capacity.

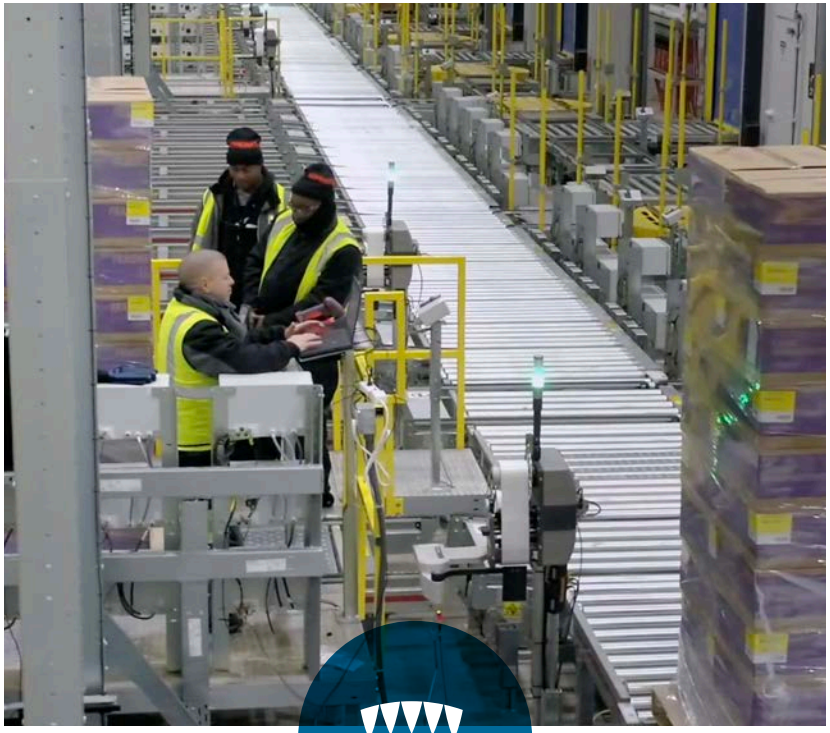


Software not only automates, but it also imagines.

Every algorithm operates in a physical system. At Lineage, we design that physical system for maximum performance and maximum flexibility using data and simulation.

A great example of how we implement software is Digital Twin. Using simulation software allows us to determine the success of a new warehouse's design before we pour any concrete. Countless simulations allow for the fine-tuning of design and the operating software as we work through the worst-case (COVID panic-buying, anyone?) scenarios over and over to test the limits of both. As the demands of every facility and customer are unique, the stress testing of each warehouse is a statistical, data-driven exercise. Algorithms and software are only as useful as the data that is entered. By being meticulous and thorough in the testing process, we open our new builds with the confidence that the facility will be able to handle anything the marketplace throws at it.

CONCLUSION



Our future is now. The future is automation.

We know the future of the cold chain lies with automation and its ability to transform our environments to meet every need of an ever-growing customer base. As we've noted, there are plenty of challenges facing our industry that aren't going away. From labor shortages and increased consumer demands to concerns about climate and sustainability, there is no shortage of opportunities to apply what we've learned to improve the food chain system. With the most forward-thinking data science team in the industry and team members who constantly look for ways to improve processes while simultaneously saving energy, Lineage stands ready to revolutionize the entire farm to fork process.

Succeeding in today's global cold chain environment requires serious consideration and implementation of automated and software-driven concepts and practices. With our advances in flywheeling, successfully launching our Athena algorithm, selecting the right Lineage facilities to convert into fully automated or mixed-mode warehouses, our entire organization continues to see the benefits of our investment in automation play out on a global stage.

This pivot from the traditional ways and methods of the cold chain demanded long-term planning and a serious investment of time and resources. We're committed to making these investments of time, engineering design, systems engineering and data analysis. Many of our pursuits have led directly to game-changing innovations, several of which are patented and some of which we've shared with you. It is our sincere hope that the entire cold chain embraces these advances, elevating our industry as a whole.

In closing, automation is in the details – the thinking and the execution. It's not just the huge buildings, it's everything in between. Understanding automation and thinking beyond hardware will allow everyone in the cold chain to benefit and advance our industry. But know this: The cold chain will always be a customer service industry and the automation and software we bring to the forefront is in service to our customers. It is a tool we will utilize to provide access to the highest quality and safest food for all people. With that mantra as our guide, we will continue to deliver for our customers, as Lineage companies have for decades, while reimagining the world's food supply chain.

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