

PASTA POINT OF RETURN

World's largest pasta production plant a showcase for integrated robotics and sustainable distribution

By Jim McMahon

Founded in 1877, family-owned **Barilla Group** is the world's leading pasta maker, with 45 per cent of the Italian pasta market and 35 per cent of the U.S. market.

Based in Parma, Italy, the company produces pasta in more than 160 shapes and sizes, selling its products in over 100 countries.

In addition to pasta, Barilla owns 16 other food brands—making the company the leading manufacturer of sauces in Europe; bread in France; crisp-bread in Scandinavia and central Europe; and bakery products in Italy.

Barilla's 29 production sites—15 in Italy and 14 worldwide—had annual 2019 sales exceeding US\$4.3 billion.

Although steeped in history, Barilla has also been on the cutting edge of technology in recent years.

Embracing the connected food movement, the Italian pasta maker is using the *Industrial Internet of Things (IIoT)* and analytics to provide traceability in its supply chain and transparency to consumers.

Its field-to-fork initiative tracks all stages of Barilla's food production—from local food harvesting to storage, processing, packaging,



Barilla's flagship pasta production plant in Parma, Italy, is the world's largest pasta products manufacturing site.



Barilla's Parma pasta factory and distribution facility currently employs a fleet of 120 laser-guided vehicles for all of its product transfer needs, essentially eliminating the need for traditional conveyors.



Supplied by automation experts E80, the LGVs used at the Parma plant incorporate innovative rooler-bed design to ensure efficient and safe roll-on/roll-off procedures.

distribution and, ultimately, consumption.

This supports initiatives of the **U.S. Food and Drug Administration (FDA)**'s *Food Safety Modernization Act* emphasizing food track and trace, quality and safety. Specifically worked with IT networking giant Barilla, in partnership with **Cisco Systems, Inc.** to create a prototype of a digital passport that takes the consumer on a journey—using a smartphone to scan a QR code on the back of a **Barilla** pasta box or tomato sauce jar—from where the specific product was grown to how it was processed and on to how it arrived at the store shelf.

An early adopter of sustainability practices, Barilla is constantly working on this means improving the efficiency of its production processes to reduce greenhouse gas (GHG) emissions, energy usage and water consumption.

Today, 68 per cent of electricity used in Barilla plants comes from renewable sources. Since 2010, Barilla facilities have reduced water consumption by 21 per cent and GHG emissions by 30 per cent.

Beyond manufacturing, promoting more sustainable agricultural and farming practices for all Barilla companies' strategic supply chains is a critical focus of its sustainability initiatives, with more than 3,000 farming companies worldwide are involved in various sustainable agriculture projects with Barilla.

The company utilizes only recyclable packaging materials from responsibly managed forests, and continually minimizes the quantity of packaging and distribution materials used, with 93-per cent Barilla's production volumes are manufactured in ISO 14001 certified production plants meeting global standards for ef-

fectiveeffective environmental management system.

In 2018, Barilla announced its plans to invest about \$1.3 billion over five years in modernizing its industrial assets to boost sustainability—by improving processes and technologies—and support innovation and geographic expansion.

A pivotal focus of this plan was transforming the distribution operations of its flagship pasta production facility in Parma into a showcase of *Industry 4.0* operation of integrated robotic processes and energy sustainability.

Initially starting as a bakery shop 143 years ago, the Parma the location has remained the center of Barilla's corporate headquarters since, as well as home to the company's largest pasta production and distribution facility.

Claimed to be the largest pasta manufacturing operation in the

world, the plant houses in a newly upgraded distribution facility, state-of-the art robotics, machine-to-machine communication, and IIoT networking—all integrated for optimized automation and streamlined throughput.

The distribution facility is not only an example of excellence in integrated robotics systems, but also for energy and environmental efficiency.

“The implementation of highly-automated flexible systems enables us to be absolutely suitable to the needs and the uses of the distribution facility, and this obviously implies a lower energy consumption,” says Parma plant director Alessandro Spadini.

“This is accented by the adoption of components that are significantly more efficient in terms of energy consumption and environmental impact, compared to our past systems,” he says.

“An essential part of this distribution project is having considered an overall and systemic integration of the project and not just single, discrete systems.

“Any distribution system that is not sufficiently flexible, that is based on a rigid scheme, will sooner or later become an issue,” Spadini points out. “The solution in trying to separate the various distribution processes—like high-density storage, transport of pallets, palletizing, stretchwrapping, and staging pallets at loading docks for shipping—comes from these processes ideally having flexible, adaptable solutions.”

As Spadini asserts, “The throughput flows and peaks that arise from just-in-time ordering and market shifts can only be managed optimally with distribution flexible solutions.”

To realize such an integrated-system and energy-efficient strategy at the Barilla’s Parma distribution facility, leading Italian automation systems integrator **E8o Group (E8o)** was selected to design, manufacture and install a solution.

Specializing in creating automated solutions for companies that produce fast-moving consumer goods, particularly in the food, beverage and tissue sectors, E8o (www.e8ogroup.com) has been a leading manufacturer of integrated-robotics systems for distribution facilities for almost three decades, with special expertise in laser-guided vehicles (LGVs), robotic palletizers and other end-of-line robotic systems. Having started developing the planning and distribution model simulations for the Parma facility in 2013, and continued with upgrades and expansions through to 2020.

Today, Barilla’s Parma distribution facility handles approximately 1,000 different packaged SKUs (stock-keeping units) within its product line, divided into dry and fresh product categories.

The 430,000-square-foot distribution facility is a fully automated, lights-out, 24/7/365 operation, equipped with 120 LGVs and 35 robotic systems working like clockwork with high-density AS/RS, palletizers, labelers and stretchwrappers. Combined, these systems handled over 438,000 tonnes of pasta in 2019.

“Keeping production going at the world’s largest pasta plant, while creating a complete distribution renovation, was a considerable challenge,” says E8o vice-president Vittorio Cavarani.

“It was achieved thanks to the great synergy and cooperation between Barilla and E8o,” he says, “but also because the integrated robotic systems are flexible and adaptable as changing throughput



The electric-powered LGVs used at the Parma facility use the proprietary Flash Battery lithium technology that ensures minimal recharging downtime and maintenance requirements.

and needs have required.»

Adds Spadini: “One of the main reasons that made us decide to move forward with this renovation for Parma’s distribution was the desire to get away from conveyors and adopt LGVs for pallet transport within the facility.

“Traditional conveying systems are sized for production peaks, and not flexible enough to manage variations in throughput, in terms of both flows and volume,” he reasons. “Therefore, pallet conveyor systems are typically highly inefficient.”

The 120 LGV systems supplied by E8o to the Parma plant fall into three types: those that carry a single pallet; those that carry two pallets at a time; and LGVs that carry four pallets at a time.

In operation, the LGVs interact with floor-positioned pallets and AS/RS induction stations, and picking up and dropping off pallets between receiving from manufacturing, palletizing, stretch wrapping, labeling, finished-goods warehousing, and staging locations for shipping.

The LGVs have roller beds that support the pallets, which allow efficient roll-on/roll-off procedure.

“An increasing number of manufacturers require 24-hour operation at continuous throughput,” says E8o president Enrico Grassi. “Parma’s LGVs have been designed to efficiently meet and exceed these requirements.

“The most recent automation developments in LGVs for pallet movement enable warehouse operators and plant production supervisors to optimize for system flexibility, modularity and scalability.”

The LGV’s laser navigation is based on target triangulation to keep the vehicles on course. Each LGV is equipped with a rotating laser which scans 360° around the vehicle for laser targets mounted on columns, walls and stationary machinery.

The reflections from these targets are measured relative to angles from the vehicle, and triangulated to allow the vehicle to determine its position.

This position is then compared to a CAD (computer-aided design)-type map stored in the LGV’s memory, whereby the system uses positive-positioning feedback in real time—computing algorithms hundreds of times per second.

With the steering is adjusted accordingly to keep the LGVs on track, it can then navigate to a desired target using the constantly updating position.

Even though this laser navigation can obtain tracking accuracy of about 0.39-inch, the Parma plant is currently reviewing the possibility of implementing vision navigation onto the LGVs, which uses cameras or lidars on-board the LGV to detect each vehicle’s surroundings and understand its position.

Introduced for use with LGVs by E8o, the lithium **Flash Battery** technology—developed by **Flash Battery Srl**—provides a higher level of performance than other batteries for industrial vehicles.

The Flash Battery technology uses the latest in lithium iron phosphate (*LiFePO₄*) chemistry to ensure low toxicity, well-defined performance and long-term stability. Having a very constant discharge voltage, *Flash Battery* technology allows the battery to deliver virtually full power until it is dis-



Robotic stretchwrapping in full swing at the end-of-line packaging area of the Barello pasta plant in Parma.

charged.

“Supporting the performance of Barilla’s fleet of LGVs and its Flash Battery technology, E8o’s Flash Data Center continually monitors and controls every battery of Barilla’s integrated system to ensure the LGV network maintains its battery potential in peak performance to maintain plant uptime and efficiency,” Cavirani explains.

“The control electronics in the lithium Flash Battery keep it balanced and efficient, eliminating the need for regular maintenance,” Cavirani says, pointing out that the LGVs only require a single lithium *Flash Battery* each, compared to two batteries needed with traditional lead-acid LGV applications.

Keeping all the LGVs running throughout the building at all times naturally requires state-of-the-art control technology, which is provided with E8o’s **SM.I.LE8o (Smart Integrated Logistics)** controls platform.

“Controls systems are fundamental for managing traffic inside Parma’s distribution facility,” Grassi states. “It is fundamental because these [LGVs] are mobile robots, and what enables them to be efficient is the SM.I.LE8o controls system, which makes sure that these robots are in the right place at the right time.”

As Grassi explains, *SM.I.LE8o* continually updates the positional status of each LGV regarding such factors as whether it is loaded or unloaded, emergency stopped or soft stopped, operating in manual mode, and battery level.

A simulation module simulates the LGVs in the system, while the graphical HMI (human-machine interface) gives the operator a graphical overview of the LGV locations in the system and monitors each in real-time.

According to Grassi, the *SM.I.LE8o* controls ensure the integrated and automated management of all systems by communicating with AS/RS, palletizers, wrappers and shipping staging locations.

“Operational flexibility is a key factor,” Grassi states, “not just in its capability to direct and manage the fleet of LGVs, but also in its expandability.

“We can have any number of automated guided vehicles can

be added to the network at any time the facility's production and distribution needs require."

Designed to Parma plant's production needs and seamlessly integrated with its LGV technology, the high-density warehouse uses E8o's AS/RS *Crane Store* systems of stacker cranes equipped with automatic product handling devices for double-depth storage.

Comprising six stacker cranes to support 47,000 pallet locations, the cranes can operate at heights of up to 130 feet—dramatically increase warehousing capacity—with minimal energy usage and maintenance requirements. An additional 50,000 pallet locations are utilized for LGV drive-in high-density low-bay storage.

One of the more striking features about the Parma warehousing operation is the absence of any wood pallets.

"Removing wood pallets was an innovative choice, at least for Barilla, and it came from an overall vision of an integrated vision of our supply chain," Spadini explains. "First of all, removing wood from production and many distribution areas means removing an element that may pollute the environment where we produce and package our products."

"But also, managing pallets without wood parts opens up the opportunity of handling and reprocessing of pallets in a completely automated way—improving efficiency and minimizing environmental impact."

Eliminating wood pallets is only part of the unique palletizing process at Parma, where robotic palletizing stations form cases in palletized configurations directly on the palletizers' platform, which are then moved onto LGVs and transported to other end-of-line process stations in the facility where, a pallet is inserted underneath prior to storage and shipping.

As Grassi relates, E8o designed and manufactured an automated pallet management system for controlling the large volume of pallets within a small footprint, while also ensuring that only pallets complying with Barilla's requirements are used in storage and shipping.

As with the other systems at play in Parma's distribution operations, its end-of-line stretch wrapping and labeling are also fully robotized and integrated with its LGVs and other robotic processes, whereby the high-speed stretchwrappers employ automatic wrapping head changeovers—eliminating the need to stop production.

"We can manage not only very accurately the use of our stretch wrap film, but we have also reduced film usage by almost 30 per cent, compared to our previous stretchwrappers," Spadini notes.

For their part, the robotized labelers are equipped with anthropomorphic robots that allow the application of labels on multiple sides and levels—ensuring optimal production flexibility.

The applicator arm is equipped with a camera to check the correct application of labels and the barcode readability, while using two printers make it possible to double the operating range and carry out reel changeovers without any production downtime.

Parma's control and identification of each case of products throughout the distribution facility is also managed by the *SM.I.LE8o* controls system.

Once cases and pallets leave the facility, the labeled identification provides a tracking mechanism



A long row of robotic palletizing workcells perform the unique pallet-less load stacking and layering around-the-clock without the use of any traditional wooded pallets.

for complete track-and-trace through the supply chain.

"For Barilla, traceability means providing the right information, correct information and timely information on all our products—from the moment we received the lots of raw materials to the moment we actually distribute and display our products on the shelves," Spadini states. "For us, full traceability is one of the main elements to ensure and guarantee our consumers the right to nutritionally safe products and also controlled products."

Says Spadini: "The Parma operation is a very large, and a very important production and distribution plant for Barilla in terms of efficiency and effectiveness."

"The key to maintaining its ongoing performance is the 24/7 Cloud-based predictive maintenance, which is monitored remotely by E8o," he adds.

"But underlying all this is a strong cooperation and a trusting partnership between Barilla and E8o," Spadini concludes, "which has enabled us to reach a high level of management of the plant and achieve our postulated goals."

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