

All the Small Things

Packaging and material handling applications are reaping the benefits of smaller, smarter and more efficient components

Matthew Jaster, Senior Editor

We begin with a quick shout out to the machine builder. They are tasked with designing machines that bring value to their customers, offer higher productivity, faster engineering, smarter components and less maintenance. According to Joaquin Ocampo, product manager at Bosch Rexroth, these customers would prefer electric cabinet reduction, fewer connection points, fewer components, faster installation, less wiring, easier testing and faster start of production.

The demands may grow during the design phase with customers asking for capabilities such as IoT connectivity, a faster build cycle and a final request to build a smaller machine that uses less floor space with more functionality than the older equipment currently on the floor. Once the machine builder has provided these capabilities they can typically expect a third itemized list of “additional features,” that need to be added last minute.

Machine design, as it turns out, is not for the faint of heart.

The Downsizing Directive

My first few years covering gears, bearings, motors, couplings and automation in this magazine could have been called *Super-Size Me*. Shop floor tours and trade shows featured large, versatile machine tools that provided big components for a variety of industries. These large components boasted more power, functionality and technology than smaller versions in applications where harsh environments came with their own set of production challenges.

This ‘bigger is better’ mentality didn’t last very long, however.



Bosch Rexroth's IndraDrive Mi provides cabinet-free drive technology.



Bosch Rexroth's IndraDrive Mi has for years now been working effectively in a wide range of applications that rely on maximum flexibility with minimum space requirements.

A funny thing happened on the way toward the Great Recession circa 2007-2008. The world started scaling back, energy efficiency became a hot topic and ‘less is more’ became the mantra throughout several different manufacturing sectors. This trend has continued—gaining momentum in recent years—with new energy requirements and smart manufacturing solutions.

It's really just a simple mathematical equation at the end of the day.

“Smaller products save on weight and can typically save on the cost of not only one component, but also the components that it interacts with on the machine,” said Jeff Nazzaro, motor and gearhead product manager at Parker Hannifin. “This can create a smaller footprint for the entire machine which would take up less space on the factory floor.”

Chris Moskaites, product manager—electromechanical solutions, Lenze Americas, agrees. “Customers are demanding more flexible machines and shorter development times. To support our OEMs and plant manufacturers, we offer modular and standardized software modules which are particularly important for the packaging industry and machinery standards such as *PackML*.”

Component Considerations

The factory floor isn't becoming a larger, more complicated mess of machines, personnel and management. On the contrary, we're scaling back, automating equipment and running entire packaging conveyor lines with our smartphones and/or tablets. Today, it's all about keeping it simple.

The challenge in creating a more compact, streamlined production cell is integrating the needed functionality to the equipment without adding extra costs.

“When developing smaller, more compact products, tolerances must be tighter to ensure proper form/fit, which adds costs in design, manufacturing and quality control,” said

Marchelle Forish, product marketing manager, Valves and Valve Systems Americas at Emerson.

“One of the ways Emerson addresses this challenge with R&D investment is with technology-leading tools such as 3D printers. Emerson also focuses on identifying and selecting high-quality, lightweight materials for valves and actuators. In development of AVENTICS brand compact valves, Emerson utilizes high-resistance polymer materials yielding compact sizes but still allowing for equivalent or higher flow and pressures than predecessor series.”

At Parker Hannifin, the challenge lies in fitting the embedded components into the housing as efficiently as possible while allowing the unit to meet thermal and EMI requirements, according to Linda Caron, global product manager for Parker Hannifin. “Ultimately, we want to add as many connectors as we need such as power-out options, optimize the space for functional performance and ensure the power density of the product is not compromised,” she added.

Moskaites at Lenze cites the physical limitations of the equipment and competitive pricing as two areas that pose obstacles. “We overcome these by providing the MF Series motors and our Smart Motor. The MF Series uses special windings, bearings, and seals. Its frame size is up to 2 sizes smaller, while offering more dynamic performance due to its lower inertia. Our Smart Motor is an application specific product for horizontal conveying that allows the customer to significantly reduce the size of their electric cabinet.”

Another challenge using smaller motor-integrated technology is showing how these components go in the machine without a cabinet at all.

“Our organization addresses these challenges by showing the benefits of using cabinet-free technology like the IndraDrive Mi, such as reduced installation effort, energy savings, a simplified design of compact machines, and a reduced complexity and wiring effort,” said Ocampo at Bosch Rexroth.

Greener and Leaner

The task of creating smaller and smarter components and systems means a greater emphasis on energy efficiency and green manufacturing.

Energy savings of products is a key factor in any new concept developed by Emerson, from the material and component selection to the final design focusing on reduced power consumption of solenoids and reduced pressure losses with optimal spool and valve housing design.

“Emerson strives to minimize material and energy consumption via optimized components and well-controlled processes. With the AVENTICS brand, Emerson provides engineering online tools for pneumatic system optimization and offers a variety of product features (as standard) which help minimize air consumption via reduction of actuator size or reduction of pneumatic pressure,” said Forish.

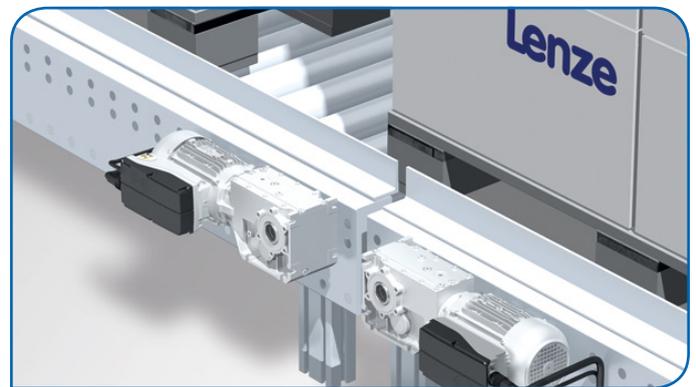
Parker Hannifin has always considered energy efficiency a staple of its vast product catalog.

“Considering we support the global market with Parker’s new product development we must consider energy consumption, testing, development standards and certification

requirements for many countries,” said Caron. “These will vary by country and by the market vertical served, but are part of our design specification process to ensure maximum market acceptance for all regional areas.”

With the IndraDrive Mi at Bosch Rexroth, the DC bus is shared among drives because the DC voltage, communication, and control voltage run in one cable. The architecture of the IndraDrive Mi is a line topology. “One motor connected to the next motor. If one motor is decelerating and another is accelerating the energy between them is used by the motor that is starting to move. This reduces energy loss and makes the system more efficient. The power supply can be a regen power supply that will put any excess voltage back to the power line,” said Ocampo.

Lenze also considers energy efficiency a large factor in product development. “We focus on the complete customer solution including the efficiency of the motor, gearbox and drive,” said Moskaites.



A smart motor drive solution provided by Lenze.

Smarter Machines

One of the significant changes in factory floor equipment today is the value provided by sensors, real-time monitoring and IIoT in general. It’s easier to scale back on technology when the smaller, compact version provides so much more immediate data.

“The IIoT allows real-time information to drive operations and decision making for the most highly optimized customers. It’s vital the required diagnostic and prognostic data is available as needed and is easy to obtain. Smart intuitive products allow our customers to run highly efficient operations with a just-in-time mentality. It takes some of the traditional troubleshooting and downtime away that in the past created wasted time and inefficiencies,” said Caron.

Moskaites says look no further than day-to-day monitoring capabilities as well as a machine that can detect life expectancy of the equipment. “The IIoT enables machine and plant manufacturers immediately to generate added value. On the basis of real-time data the availability, production performance and quality of the manufacturing process can be improved.”

This means providing real-time information that allows you to act in real-time as well, which means maintenance and repair is faster and OEE is improved, according to Allen

Tubbs, product manager at Bosch Rexroth. “If trends or conditions can be identified in advance, earlier on the failure curve, then action can be taken to prevent the failure thus skipping the downtime resulting from reacting to the failure instead,” Tubbs added.

Nathan Irvine, senior pneumatic application specialist, Americas, at Emerson said that the packaging and material handling industry is pressed to improve throughput and overall efficiency. “Smart manufacturing with real-time data allows for minimization of unexpected downtime via scheduled machine maintenance based on cycle counting, air consumption monitoring and other metrics of the pneumatic system, including, for example, monitoring shock absorber conditions in high-impact applications,” he said.



Parker frameless motors cut down on size and cost of packaging and material handling equipment.

The New Factory Floor

The Industry 4.0/IIoT platform is transforming the look and feel of the factory floor. It’s forcing machine builders and product designers to look at the space differently. Caron at Parker said that pneumatics have become much smarter in the Industry 4.0 space. It has forced manufacturers to rethink design. How can we add communications, connectivity, diagnostics, and prognostics and make it easy for the customer while reducing weight, space and cost from traditional product design?

Tubbs at Bosch said that software is playing a bigger part of the equation and pulling data off of machinery has never been software-friendly. “New product must communicate efficiently as part of their standard function. But we focus on creating solutions to harvest data off older machinery as well. Both new and old exist in every plant and you need data from both to have a complete picture.”

Factory floors are becoming more automated and more IIoT-ready, according to Forish at Emerson. “We are investing in IIoT-ready pneumatics to provide an enhanced layer of sensors and component performance data to enable

implementing these concepts.

She goes on to discuss the costs involved.

“Packaging and material handling costs are relevant. Emerson is constantly looking into possibilities to reduce packaging costs by using new materials, reducing package sizes and evaluating new machines and equipment to automate,” she added.

For Moskaites, the factory floor is changing because customers are demanding more capabilities. “Customers are also looking for ways to have increased control, but reduced effort in design, installation, and maintenance. Workforce shortages force our customers to look for solutions that are easier to implement. These factors play a large role in our product development efforts today.”

Handheld Technology

These development efforts include a greater emphasis on mobile technology. Lenze, for example, continues to build on its Blue/Green Solutions platform which analyzes system consumption between different possible combinations. “Our most recent geared motor combination uses smartphone technology to program acceleration time and switch to Eco-mode as needed,” said Moskaites.

Emerson implements QR codes on AVENTICS brand product to allow customers to easily scan with a smartphone or tablet and have immediate access to all documentation for that product.

“Emerson’s new CAT tool designed to measure pneumatic cylinder speed and cushion connects to smartphones via Bluetooth, allowing users to evaluate the deceleration curve on the spot of a cylinder. By adjusting the cushion screw on the cylinder, the overall cylinder speed and optimal/ideal cushion can be achieved. The final effect is reduced cycle time, improving the OEE of the machine,” said Franco Stephan at Emerson.

Bosch is always looking for ways to make data more accessible and transparent. “Part of that is creating ways to use standard data devices, like phones and tablets that everyone has in their pocket, to view and even collect data for quick and efficient analysis. This is leading us to implement web-servers in most of our products. This provides access through any standard web-browser, eliminating the need for special software or even specific apps to do diagnostics,” said Tubbs.

Caron at Parker added that access to embedded webpages that are easily accessible or remote access to diagnostic data is important to their customers. Remote access is often required where equipment is embedded into a machine or operating in a remote area.

The Next Wave of Products

The future of product development is hard to predict due to the changing market needs and the evolution of standards, all of our interview subjects will continue to embed smart functionality into their designs.

“Expect to see more network-based products and embedded safety components that are tamper proof,” Caron said.

The cabinet-free technology IndraDrive Mi, will be a part of smaller machines in the years to come, according

to Ocampo. “Machine builders will realize the needs of the market and the consumers and will find way to manufacture machines that are flexible and can be modified faster.”

Along with the trend toward more IIoT-enabled devices, Forish at Emerson said there will be greater use of wireless technology in packaging and material handling operating environments.

“New investments in software development and easy-to-access platforms to visualize machine performance on demand will be in greater and greater demand, which is why the AVENTICS brand by Emerson is focused on advancing smart pneumatics,” she said.

Forish also sees momentum growing toward standardization across all automated manufacturing to certain communication protocols and data collection platforms; this standardization is essential to accomplishing the vision of cloud-based IIoT manufacturing that has all components connected and communicating in real time, with smarter

analytics that enable new levels of productivity and flexibility in manufacturing.

Smaller, faster, and more flexible components appear to be the future. Now is as good a time as any to start thinking about how these trends may influence product design decisions moving forward. **PTE**

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Compact Requirements

With smaller, more efficient solutions in mind, *PTE* asked our interview subjects to describe a recent engineering challenge they helped solve for their customers. Here’s a brief rundown of some of the technologies they provided.

AVENTICS (Emerson)

A customer needed a small, compact, lightweight valve system to mount directly on mobile aggregate application equipment. With Emerson’s AVENTICS Series AV valve system, the customer eliminated 96 pneumatic components, 24 DIN electrical connectors, 24 terminal blocks, reduced the size of the electrical cabinet and reduced wiring and debug time, according to Forish.

“In another example, a customer required a very compact valve unit for an OEM application; this custom product was the basis for Emerson developing a new polymer valve manifold utilizing the AVENTICS cartridge valve and providing the smallest footprint while maintaining the flow levels this application demanded,” Forish said.

Bosch Rexroth

Machines with many axes can be a challenge for machine builders. An application that requires a total of 30 axis will have at least 60 cables from the cabinet to the machine—one cable for the motor feedback and one cable for the motor power. This is a lot of cable management, and a lot of connection points that can be loose or even not connected and cause startup challenges. In addition, the size of the cabinet and the AC unit to cool the units are significantly big. The weight of the machine is a challenge when it comes to shipping costs. The footprint of the machine also incurs costs when shipping.

“With the IndraDrive Mi, the motors are mounted on the machine and the cable management is much leaner. In-

stead of 60 cables coming out of the cabinet the application will only need four cables. The cabinet is reduced by 90% and the cable cost, labor cost, shipping cost, and weight are reduced considerably,” Ocampo said.

Lenze Americas

“Recently, our customer’s application demanded faster acceleration and greater inertia/speed control. Our approach was to start with a complete sizing and evaluation of the application using our design software. Our MF motor solved both criteria, while being more compact overall,” said Moskaites.

Parker Hannifin

Nazzaro at Parker said that the company was recently asked to provide a high-torque motor, with feedback device and brake, within a very small envelope as well as keeping weight to a minimum. “The solution was the design of a highly efficient motor which kept overall diameter and length as small as possible. A unique design had the brake assembly enveloped within the inner diameter and length of the motor. This innovation allowed us to meet the customer’s requirement which led to us winning the business,” he said.

In another example, Parker was asked to provide a network interface to Industrial Ethernet for a valve manifold that was more compact than the traditional off-the-shelf solution currently available. “With the help of 3D printing, we were able to quickly prototype a solution that will become a new design for other customers to also utilize. We were thrilled with the quick turnaround from engineering and the end result was a very clean looking, compact space saver!” Caron said. **PTE**