Food Preparation Robots Prove Their Worth
FOOD PREPARATION ROBOTS PROVE THEIR WORTH
How rising demand for faster food production is fueling the growth of food and beverage production robots.

By Linda Rosencrance

Fueled by today’s on-demand society, as well as the need to boost production and lower costs, the food and beverage industry is working to figure out how to operate more efficiently, improve customer service, and reduce labor costs.

As such, robots are beginning to turn up in restaurants, bakeries, grocery stores, coffee bars, and other locations as the industry deploys automation for food and drink preparation.

Although we’re still in the early days of using robots to prepare food, several interesting applications have received lots of publicity and investments, including Miso Robotics’ burger-flipping robot Flippy, Zume Pizza, and Spyce, a robotic kitchen, said Bob Doyle, vice president of the Association for Advancing Automation.

“But so far, in the applications I’ve seen, the robot can really only do one thing,” Doyle said. “Until a robot can do more . . . when it can not only flip a burger, but also put it on a bun, add the tomatoes, lettuce, ketchup, mustard and pickles and everything, and put the bun on top – and we’re a long ways away from that – we’re not going to be seeing those types of robots in many restaurants or anything in the foreseeable future.”

Nevertheless, the global food robotics market is projected to be $3.1 billion by 2025, in part driven by the growing demand to improve productivity as well as the increasing production of low-cost robots, according to a report from Meticulous Market Research Pvt. Ltd.

That number is even higher according to the Boston Consulting Group (BCG), which predicts that global spending on robots will hit $87 billion by 2025, mainly because of skyrocketing consumer demand.

“As people become more accepting of robots in their everyday lives – embracing everything from robot vacuum cleaners to telepresence workers
in the office – they will begin to demand more such products,” the report concluded. “This will attract more investment capital and drive further advances in robotics capabilities.”

Adding robotics to a business is a strategic decision, not just a capital investment, said Mel Wolfgang, a BCG senior partner and co-author of the report, in a statement. Organizations adding robots need to rethink and fundamentally change staffing levels, product mix, manufacturing footprints, and other aspects of their business models.

As the cost of the machines, even sophisticated ones, has fallen in recent years – dropping 40% since 2005 – more enterprises can use robots to take on repetitive, low-skill tasks, according to the BCG report.

“But besides replacing some human labor, robots can enhance the human staff’s productivity by working alongside them,” the report noted. “Collaborative robots or ‘cobots’ can do heavy lifting and perform precision activities more quickly than human workers can. By liberating workers from tedious, tiresome, or repetitive tasks, robots can improve not only the workers’ productivity but also their job satisfaction.”

The challenge for forward-looking companies is to figure out how to use robotics to be more competitive, the BCG report noted. This could mean identifying the place where a combination of human workers and machines delivers the biggest return on investment, or it may involve creating an entirely new business model, according to Wolfgang.

However, the high cost of installation and service charges of robotic systems are major challenges for the penetration of robotic systems in the food industry, the Meticulous report concluded.

INTERVIEWS WITH FOOD ROBOT MAKERS

Robotics Business Review spoke with three vendors using robots in food preparation to get their sense of the market as well as talk about their machines.

1. Henry Hu, founder and CEO at Cafe X Technologies Inc.
The company’s Robotic Coffee Bar is deployed in three San Francisco locations.
Q: Can you talk about where the market is today for robots in food preparation and where you see it headed?
Hu: We will continue to see increased automation in the food industry. Cafe X aims to create a future where humans and robots work collaboratively to deliver great daily food and drink experiences and provide new jobs that are of high productivity and therefore more fulfilling for employees.

Q: How does Cafe X’s Robotic Coffee Bar work? How does it work alongside humans?
Hu: Cafe X’s Robotic Coffee Bar is the world’s most advanced system for serving artisanal coffee, tea, and more. Utilizing an industrial robotic arm with a quirky personality, Robotic Coffee Bar is capable of consistently producing up to three drinks in under one minute. With the mobile app for iOS and Android, Cafe X provides a fast, streamlined experience for customers who order ahead when they are nearby and pick up their drinks within seconds of arriving.

By automating the highly repetitive tasks in the beverage making process, our team of coffee bar specialists, who work at our locations, can focus on coffee education and customer service,
similar to high-end retail, providing the best possible experience not only for customers who are getting beverages to go, but also for those who wish to stay.

Customers can order from the Cafe X mobile app and from on-site kiosks. Once an order is placed, the robotic arm immediately retrieves a cup and places it at an espresso machine. Upon completion, the robot arm moves the beverage to a waiting zone. Next, the customer enters a pickup code (displayed in the Cafe X app or on the display screen inside the machine) and the robot arm delivers the cup. The robot also waves and dances while drinks are being made and delivered, inviting people to engage in the process.

Humans are working alongside technology to create the best cafe experience possible. While the robot consistently handles drink production, Cafe X is able to provide a true third-wave coffee experience for customers through coffee bar specialists, passionate coffee experts who work on site, to provide excellent customer service and coffee education.

Q: What implementation issues/challenges did you (or customers) face with the robot?
Hu: The deployment of any robot in actual market conditions will always result in new learnings that will impact the product road map. It is critical to have a deep understanding of the user experience and have a process to systematically remove any pain points along the user journey. For example, after our initial deployment, we realized that customers did not want to receive text messages with their codes to pick up their drinks. We subsequently redesigned the user flow with that in mind.

Q: Can you offer some advice for companies that would like to deploy robots to help with food preparation?
Hu: Listen to and observe your customers. Develop an intimate understanding of NSF standards, and local food and health codes.
2. **David Zito, CEO, Miso Robotics**

The company’s Flippy robot has worked at Caliburger in Pasadena, Calif., and has prepared chicken fingers at Dodgers Stadium in Los Angeles.

**Q: Can you talk about where the market is today for robots in food preparation and where you see it headed?**

**Zito:** Today, we are being faced with the disruption of the $2 trillion grocery and prepared food industries. This year, UberEATS alone is expected to deliver $10 billion in gross bookings. Demand is on the rise, 63% of food bought from restaurants is through drive-thru, to-go and delivery.

By 2030 the food delivery market is predicted to be a $365 billion market. However, labor resources are on the decline – the industry has 150% turnover. While we have 3 million workers commercial kitchens today, the prepared foods industry over the next 20-plus years could require up to 9 million workers to fulfill orders – that’s 12 million more hands in the kitchen. We can’t meet the need for speed and we can’t keep up with quality if we don’t adapt.

As a result, the commercial kitchen stands to benefit from robot deployments. Automation can address the gaps in labor, increase output to meet demand, and ensure consistent, delicious bites through your entire meal.

More and more consumers are seeing the benefits of automation – having your food cooked by a robot will continue to reach a new level of comfort for eaters. Adoption will continue to increase, opening the industry up to new levels of applied artificial intelligence, such as personalized food options based on consumption habits or even health data.

**Q: How does Flippy, Miso Robotics’ kitchen assistant, work? How does it interact with humans?**

**Zito:** Flippy operates on a cloud-connected, autonomous cooking platform. We pioneered the full-stack software approach – offering
Miso See, which automatically identifies and locates food and tools via 3D, thermal, and regular vision; Miso Serve, which optimizes which tasks to perform and when to cook all the food as desired to increase efficiency; Miso Move, which enables reactive, real-time control to the kitchen assistant – ensuring safe, operational movements and cooking to take place; and Miso Support, which offers remote fleet management with real-time responses from humans.

Humans are key to the success of Flippy. Kitchen assistants are intended to improve the workplace experience for staff – operating as helping hands. Rather than focus on tedious, repetitive, and physically exhausting tasks, workers are able to better serve customers and focus on the more fulfilling aspects of their employment. The growing use of robots in commercial kitchens also opens the door for new labor opportunities for humans. Our kitchen assistant is paving the way for new jobs, such as robot tech chefs – making an industry with 150% turnover appealing again.

Q: What implementation issues/challenges did you (or your customers) face with Flippy? Can you offer some advice for companies that would like to deploy robots to help with food preparation?

Zito: When you deal with collaborative systems and operational enhancements, you have to adjust. For us, it was ensuring we continued to meet the volume demand with consistency and perfect taste. We learned a great deal from our Caliburger deployment and those takeaways were also ones we were able to apply when we rolled out the kitchen assistant at Dodger Stadium.
At Caliburger we have served more than 12,000 burgers and at Dodger Stadium we have brought fans more than 17,000 pounds of chicken tenders and tater tots in our first season. With the new season, Flippy is back in action at Dodger Stadium, and has already cooked up several pounds of fan favorites (see case study).

We’ve perfected grilling burgers, took on frying tater tots and chicken tenders with success, and now we’re making progress on pizza. We’ve been able to achieve this because our software continuously learns and is adaptive to new recipes and new cooking skills, giving restaurants more of an opportunity to efficiently scale. Looking ahead, we are also considering tasks beyond cooking, such as cleaning, as a possibility.

Our advice is to approach robotics with intelligence and to always consider the needs of your customer and business. You need the eyes and the brain – advanced software – this can power the robot to execute tasks for your commercial kitchen, safely, to be successful. You also need it to easily integrate into your current infrastructure, just as much as you need flexibility to be mobile and go where your customers are. Start thinking with mobility in mind.


Q: Can you talk about where the market is today for robots in food preparation and where you see it headed?

Wilkinson: At this point, most retailers are curious and testing. There is a consensus that robotics will be much more important five to 10 years from now than they are today. Now it’s a time of experimentation, trying to sort out what is hype and what is real. I think there’s a certain trying to calibrate what the response of the consumer is, balanced against what the response of their labor force is. So I think all of those are at play.
I know that we’re working with the top five grocers in the country, and they’re very intrigued with what we’re doing. And we have commitments from three of them to do testing with our equipment. They believe that by being involved in what we’re doing, they’re going to be learning so they can be better positioned for what they think is a trend that’s coming, which is micro-manufacturing.

So there is the sense that where we're moving is going to be much more important than where it is today. But I think that there’s also certain skepticism as to which things are more helpful than others.

Q: How does the BreadBot work? How does it work alongside humans?
Wilkinson: The BreadBot was specifically designed for grocery stores. It allows customers to know exactly where, when, and how their bread was made.

The day really starts at the end of the previous day. At the end of a production cycle, there’s about half an hour where the machine does self-cleaning, and an associate wipes down surfaces and cleans it up for the next day.

At that time, the associate loads the ingredients for the next day’s bread into the hopper and ensures that the yeast hopper is full. Then the calendar that’s been set goes into operation, or it can be overridden by the associate. And that may well mean that at 4 a.m., for example, the machine wakes itself up, heats up the oven, and starts the production for the day.
And two or three hours later, when people arrive, there's fresh bread already produced and more bread is in the process of being produced. So, during the course of the day, customers can pick up warm bread as it comes out of the oven, or cooled bread that they can take from the vending portion of the machine. The shoppers can put their loaves into a self-slicer, or they can pick up a loaf that the bakery staff has sliced and bagged and is there for them to take.

So basically other than associates keeping an eye on things and responding to consumer questions or needs, the unit takes care of itself throughout the day, unless it needs a refill of its supply. The BreadBot can bake 90 loaves on the hopper filling, or fewer, depending on how many the store wants to produce. So if they’re producing more, the machine will tell the associate, ‘Hey, I need more mix’ in order to make the rest.

Each BreadBot has a touchscreen with a visual display that allows store staff to monitor every aspect of the bakery. Employees can monitor important bakery functions, such as oven temperature, bakery status, the number of loaves made, and the time until the next loaf exits the mixer.

Each store is assigned a representative who will monitor the bakery offsite and work with the staff to answer any questions. If an issue arises, the representative is close by to help and make sure things run smoothly.

We have been in beta testing in several stores, but in terms of the production model and starting to roll out, that starts [soon].

Q: Can you offer some advice for companies that would like to deploy robots to help with food preparation?

Wilkinson: I think a part of it is certainly for vendors to make it easy for a store to adopt and test their use proposition. That way, a store doesn’t have to make a multimillion dollar investment before it discovers whether or not the robot [can get the job done]. The other thing that’s key is that a vendor should clearly identify the exact value it’s bringing to the store.

Customers should also look for vendors that offer [excellent] support. For example, because BreadBot is Internet-connected, we monitor the equipment for predictive maintenance, and for any issues
that are present. We also have the ability to tweak production as we’re continuously monitoring multiple machines in multiple locations in multiple environments.

We’re also communicating with the machine. So if there’s an issue, we can identify the solution to whatever problem they might have and obviate the need for a service call, or to coordinate a service call if it’s necessary.

OTHER COMPANIES USING ROBOTS IN THE FOOD PREPARATION SPACE

In addition to Cafe X Technologies, Miso Robotics, and The Wilkinson Baking Co., other companies are also using robots to handle food preparation, including:

➤ **Creator** – At its San Francisco-based restaurant, Creator uses robots and technology to bring a new dining experience to customers. The company’s autonomous robot cooks and assembles burgers to order. The components of the machine include 20 computers, 350 sensors, and 50 actuators that come together to form a robotic assembly line. After a guest places an order, the machine grinds and cooks the meat. Then as the burger is pushed along a conveyor belt, sliced-to-order toppings are added. The robot also cuts and toasts the buns.

➤ **Briggo** – An Austin, Texas-based specialty coffee company, Briggo is transforming the entire coffee experience by combining top-quality ingredients with mobile tech, cloud computing, and robotics. Customers can order ahead and customize their coffee and tea beverages using the Briggo mobile app or via touchscreen tablets at Briggo’s Coffee Haus kiosks. The drinks are crafted within minutes using Briggo’s robotic technology. Customers get a text when their orders are ready, and then they can grab their drinks. Currently, Briggo has locations in Texas and one in San Francisco.

➤ **Spyce** – With one location in Boston, Spyce prepares fast-casual “bowl” meals in its robotic kitchen. Customers select their ingredients from the menu and robots portion out and dispense those ingredients into cooking woks that cook the food in three minutes or less. With
the assistance of humans who load the ingredients into the machine, the robotic kitchen can make 200 bowls an hour. Spyce operates a commissary kitchen where humans prep the ingredients and get them ready for the robotic kitchen.

➤ **Chowbotics** – Sally, the Redwood, Calif. company’s food robot, can quickly create salads, grain bowls, breakfast bowls, and snacks with any combination of ingredients. Sally’s proprietary technology automatically dispenses measured quantities of up to 22 ingredients – refreshed daily – to create ready-to-eat meals. Customers can also fine tune the nutritional profiles of their meals by adding or subtracting ingredients. Sally can create between 50-100 meals before it needs to be replenished.

➤ **Blendid** – With locations in San Francisco and Sunnyvale, Calif., Blendid is a fully autonomous kiosk that houses a robotic arm, plenty of ingredient storage dispensers in freezers and refrigerators, a blender station, cup dispensers, and a water subsystem. After a customer places an order for a drink (drinks can be customized to users’ preferences), the robot, known as Chef B, uses its mechanical arm to dispense and blend ingredients, then pours the beverage into a cup and serves it.

➤ **Zume Pizza** – Founded in 2015, Mountain View Calif.-based Zume Pizza uses a combination of robots, predictive analytics, and mobile ovens to deliver pizza. In addition to its staff of pizza-preparing robots, Vincenzo, Zume’s “bake-and-take” robot, handles the dangerous task of taking pizzas out of the 800-degree oven hundreds of time per day and storing them on racks. Vincenzo bases its decisions on Zume Pizza’s proprietary predictive analytics to recognize which pie corresponds with which rack slot. Delivery drivers then load the racks onto the food delivery vehicles, based on the predicted demand of each neighborhood Zume Pizza serves.
CASE STUDY: LEVY RESTAURANTS TAKES MISO’S FLIPPY OUT TO THE OLD BALL GAME

This case study tells the story of how Levy Restaurants successfully deployed Miso Robotics’ Flippy to cook and serve fresh chicken tenders and crispy tater tots at Dodger Stadium.

SUMMARY

Hospitality company Levy Restaurants and its tech and analytics company, E15 Group, teamed up with Miso Robotics and the Los Angeles Dodgers to successfully test the first robotic kitchen assistant in a North American sports venue. The robotic assistant – known as Flippy because it was originally designed as a burger-flipping robot – worked alongside stadium employees to cook and serve chicken tenders and tater tots.

THE CHALLENGE

The constant challenge for Levy is to create the frictionless fan experience, and to make each and every fan’s experience the best it’s ever been, whether that’s in the food space or not.

“We find ourselves, our employees and our operations touch the fans probably more than anything else,” said Ulises Walker, vice-president of analytics at E15 Group. “And it’s one of those aspects of the experience that can make or break it.”

Levy understands that it can be particularly frustrating for fans forced to battle long lines to buy hot dogs or beer at the concession stands, missing significant portions of the action on the field. And it’s even more frustrating for fans if those hot dogs are cold and the beer is warm.

“It was maintaining the high level of quality that we’ve always strived for, but also really it was an increase in the throughput or increase in the rate at which we could produce food with that high level of quality that was the big attraction or the big shiny object for us in terms of pursuing robotics,” Walker said.
In addition, the demand patterns when folks are arriving at the concession stands and food outlets isn’t smooth – at halftime everyone jumps up and runs out there, Walker said.

As such, Levy wanted to be better prepared for those demand patterns, make some of the more tedious and repetitive tasks more efficient, and take the risk out of the sometimes dangerous tasks.

“If you can imagine, at a fryer is probably where some of the accidents might occur in our kitchen because the faster a human fry cook works, the more the employee is a risk for being splashed with hot oil,” Walker said. “The robot would be placed in charge of a task that was removing that risk, and it would also enhance our ability to produce food, so that was the key focus.”

THE SOLUTION
To reach its goals, Levy turned to Miso and Flippy in March 2018 because it was the only vendor that provided the type of robotic kitchen assistant Levy needed – a small form factor that could be deployed in an existing kitchen.

“We didn’t want to have to demolish back-of-the-house space,” Walker said. “We can just bring the robot into an existing kitchen, in most cases, and have it take over that cooking function. A lot of the other players in the space are essentially creating entire trailer-size pieces of equipment that you have to lug around or completely retrofit your environment to accommodate. So Miso provided a lot of benefit in that regard.”

Stationed in front of the fryer, Flippy assists with the frying process using its AI features – Miso See, Serve, and Move. Miso See enables the six-axis industrial robotic arm to properly identify and locate food, cookware and cooking utensils, Miso Serve equips it to make optimal cooking decisions in real-time, and Miso Move provides robotics control for safe and efficient grilling, frying and preparing food as assigned.
Each allows Flippy to assist with picking up baskets and placing them in the fryer, gently shaking baskets in the oil and monitoring cooking time, in addition to hanging baskets to drain excess oil, placing them at a designated station for temperature testing, and skimming the fry oil. This permits team members to dedicate more time to food preparation and assembly, as well as to improving the fan experience.

Levy worked closely with Miso to adapt burger-flipping Flippy to chicken tenders and tater tots. “They took our insights, but we definitely relied on them to execute on those and to say, ‘Hey, the robot has got to do XYZ for it to function at a high level in this space,’” Walker said.

Miso took feedback from Levy’s chefs and concession stand workers, determined the necessary features and functions, and implemented them quickly.

One of the challenges Levy faced deploying Flippy was merging the “human with the robotic” elements – a challenge that the company also overcame with Miso’s help, according to Walker.

“They did a great job of training. And our operations team at Dodger Stadium did a great job of defining roles and creating that standard operating procedure that defined this new process that was going to occur once the robot was in place,” Walker said. “We learned a lot from going through the process and I think the blueprint is now in place that we can leverage as we seek additional deployments in other parts of our business.”

All of that combined to produce a pretty effective implementation – not a trial-and-error, learn-as-you-go type of rollout, he said.

“What you have to do is start small, you pilot it, you figure it out before you launch headlong,” Walker said. “You start small, so you can stay nimble and then grow it from there.”

THE RESULTS
Levy piloted Flippy as a frying assistant from July 30 to the end of the 2018 LA Dodgers season – the Dodgers lost to the Boston Red Sox in the
World Series – at the Chick ‘n Tots stand in Dodger Stadium. Flippy helped stadium team members consistently cook and serve more than 10,000 pounds of fresh chicken tenders and crispy tater tots to Dodgers fans, producing up to 80 baskets of food per hour.

“We didn’t want to have to demolish back-of-the-house space,” Walker said. “We can just bring the robot into an existing kitchen, in most cases, and have it take over that cooking function. A lot of the other players in the space are essentially creating entire trailer-size pieces of equipment that you have to lug around or completely retrofit your environment to [accommodate]. So Miso provided a lot of benefit in that regard.”

RECENT RESEARCH

In its Restaurant 2025 report on the future of automation in the restaurant industry, tech giant Oracle noted that automation and robotics could play increasingly important roles in back-of-the-house restaurant operations, including food prep and cleaning, as opposed to providing front-line service.

As noted in this guide, restaurants where robots flip the burgers already exist, and Oracle’s research concluded that 49% of restaurant operators liked the idea of using robotics for food preparation.

Although robots will have their place, consumers will still crave human interaction when it comes to their dining experiences, according to the Oracle report. In fact, 50% of restaurant guests said being served by robots would not improve their experiences, and 40% even said they would visit a location less to avoid them. Only 18% said being served by a robot would improve the guest experience.
“In the future, automation is set to perfect efficiency, optimizing productivity and speed of service,” the report noted. “But in hospitality, the human touch will remain an essential part of the experience. Robots will tackle repetitive tasks such as cleaning and food prep, but will likely stay clear of meaningful guest encounters.”

The fact that robots are playing an increasingly larger role in how food is prepared seems to be OK with half of the more than 1,000 U.S. adults (18 to 60+) surveyed by Study.com in 2018.

Study.com asked participants whether they would trust an AI-powered robot to perform certain tasks. Fifty percent said they would let a robot prepare their food, while only 40% said they would want robots to take the place of salespeople in retail stores.

A study by the Center for an Urban Future found that the automation potential for waiters and waitresses is 77%, increasing to 87% factoring in workers who prepare food. This doesn’t mean that all these jobs will be automated; however, it is a clear indication that automation will continue to reshape the industry in ways that impact workers as well as change the customer experience.

CONCLUSION
As costs for equipment drops, using robots in the food service industry to prepare food is inevitable, as restaurants and other locations aim to lower labor costs and operate more efficiently. Consequently, companies involved in food preparation should aim to learn how automation trends can help their businesses.

However, it’s unlikely that robots will completely replace humans, especially in the restaurant industry where the relationship between customer and staff is very important. While a robot can complete back-of-the-house tasks, such as food preparation, faster and more efficiently than people, it’s the human interaction that makes a restaurant more attractive and more desirable.

Sebastiaan van de Rijt, the Dutch food entrepreneur in San Francisco behind fast casual eatery Bamboo Asia, agreed with that assessment.
At Bamboo Asia, chefs prepare all the food – a mix of Indian, Japanese and Vietnamese dishes – in one central commissary kitchen. The meals are then portioned into vacuum-sealed bags, shipped off to restaurants and prepared in temperature-controlled hot water baths known as sous vide machines. Van de Rijt said his company is also looking to deploy artificially intelligent automated chefs to staff these kitchens.

Van de Rijt said deploying food preparation robots in decentralized locations, such as his commissary kitchen or the back of a restaurant, works well. However, restaurants shouldn’t implement robots to replace the customer experience.

“That’s when I think you start taking away from what people expect out of the hospitality business,” he said. “It’s called hospitality business for a reason. And replacing the customer experience with robots is not always received the right way. So, I think that robots will definitely break through in the restaurant industry, particularly in the fast casual industry because that’s where it will work really well.”