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RESTAURANT 2025

emerging technologies destined to reshape our business

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Perspectives from more than 250 restaurant operators: anticipating consumer trends and seeking innovations that enhance guest experiences

The future is fast approaching. *Are you ready?*

For hospitality leaders, anticipating consumer trends and seeking innovations that enhance guest experiences are vital exercises that need to be practiced diligently. Now, more than ever – with the coming wave of disruptive technologies – taking these steps helps ensure success tomorrow.

To help in that pursuit, Oracle Food and Beverage commissioned *Restaurant 2025*, a major industry report surveying consumers and operators about emerging technologies destined to reshape our business. Together, their responses provide insights about these innovations, including anticipated rate of adoption, potential impact and related fears – real and imagined – that need to be allayed.

Among the topics *Restaurant 2025* explores: artificial intelligence, biometrics/facial recognition/3D imaging, robotics, voice activation, wearable technology, virtual reality, drones, and 3D printing. The report outlines the current status of each and forecasts its future use, and weaves in perspectives from more than 250 restaurant operators. It also incorporates in-depth interviews with chief information officers and chief technical officers.

The path forward undeniably will rely on technologies that make restaurants smarter, accelerate service and, most importantly, personalize experiences for each and every consumer. *With Restaurant 2025, it is our goal to help our industry embrace innovation and prepare for the future.* It will be here before you know it.

artificial intelligence

A field of computer science, artificial intelligence is the pursuit of developing computers that can simulate human intelligence – specifically, learning, reasoning and self-correction. Though the term was first coined in the 1950s, a seminal moment raising AI's profile in society came in 1997 when "Deep Blue," an IBM chess program, defeated the legendary champion, Garry Kasparov. AI technology varies greatly in sophistication – from automation and reactive machines that can analyze options and select optimal ones, to limited-memory devices (as found in autonomous vehicles), which can use past experiences to shape future decisions. But the recent surge in AI research coincides with the advent of big data. **AI's ability to identify patterns and glean insights from data – now available faster and in greater quantity and variety – yields advantages to almost any industry.**

Restaurant operators' top prediction for artificial intelligence: 60% said restaurant location planning using AI would be mainstream or in mass adoption by 2025.

Operators' other top uses for AI:

- Menu planning based on macro/micro factors
- Waitlist and capacity management
- Dynamic prep times
- Dynamic PAR levels
- Seating planning/forecasting

artificial intelligence continued

current status

AI is an umbrella technology with such broad applications that its impact already is being felt in multiple industries, including healthcare, finance and manufacturing. Its key elements are evident in almost all of the restaurant technology concepts discussed in this report. Indeed, AI is seemingly surfacing everywhere. According to various news reports: In Shanghai, China, KFC unveiled an AI robot capable of handling order changes and substitutions. And in New Zealand, Domino's Pizza tested an AI delivery service using a robotic unit – a three-foot-tall carrier with storage space for 10 pizzas – that drives autonomously within a 12-mile range.

future use

Many industry experts envision AI robots becoming integral members of the labor force, especially for positions involving low-skill, repetitive tasks. But the impact of AI extends far beyond the powering of robots. AI could transform menu creation into personalized nutrition plans, using health-related algorithms that factor individuals' DNA, current health status and food history. And although cost has been a barrier to date, **AI's superior forecasting should help restaurants better manage labor, inventory and operations.**

What the guests said:

- 36% said asking a virtual assistant about food and drinks would improve their experience, and 17% would visit more often.
- Only 9% said suggestions based on their digital footprint, e.g., Facebook would improve their experience, while 68% said they would find it invasive and 47% would visit less often.

voice activation/recognition

Voice-activation technology is exactly what the name implies: devices and systems controlled by the human voice. **Without the need to use switches, dials and buttons, voice activation affords simple, hands-free capability, freeing users to perform other tasks.** Performance of voice-recognition technology has improved significantly; in 1995, "word error rate" hovered around 43%, but now devices are considered to be as fluent as human speech. Indeed, such enhancements are reflected in the quick adoption of voice-activated digital assistants such as Google Home and Amazon Echo. The Consumer Technology Association projects total unit sales of these devices will double to 10 million in 2017.

Restaurant operators' top prediction for voice activation/recognition: 54% said gathering guest feedback by voice would be mainstream or in mass adoption by 2025.

Operators' other top uses for voice activation/recognition:

- Guest ordering by voice in TSR
- Guest controlling light/ambiance
- Payment by voice
- Guest recognition by voice
- Ordering food at home for delivery by voice

voice activation/recognition continued

current status

In 2014, Domino's Pizza announced it was the first in traditional and e-commerce retail to launch an intuitive ordering method: a virtual assistant, named Dom, who could take orders through simple conversation. Through the company's ordering app, Dom offers comments such as "Let's get this party started" and then proceeds to take your order. Adding the simplicity and convenience of voice activation was essential for Domino's, which relies on mobile and online ordering for approximately 40% of U.S. sales. At the time of the launch, CEO Patrick Doyle said: **"People who order digitally also tend to spend more and return with greater frequency because they like the convenience."** Some industry experts are dubbing 2017 as "the year of the voice." Supporting that claim, Starbucks is expected this year to update its smartphone app with voice recognition, and McDonald's is working with Microsoft to enhance its drive-thru experience with the technology.

future use

A natural extension of voice-activation in the restaurant industry is consumer payment. In fact, *Restaurant Business* reported in December 2016 that several San Francisco-area restaurants were testing a Google-supported system incorporating voice and face recognition. Upon completing their meals, diners would say, "I'll pay with Google" – triggering an identification of the consumer and charging of the appropriate account. **But in reality, the applications of voice activation know no bounds; virtually anything that can be turned on or off could be voice activated.** And with the infusion of artificial intelligence, voice-recognition technology could reflect human-like learning and reasoning skills – unlocking possibilities that can't even be imagined today.

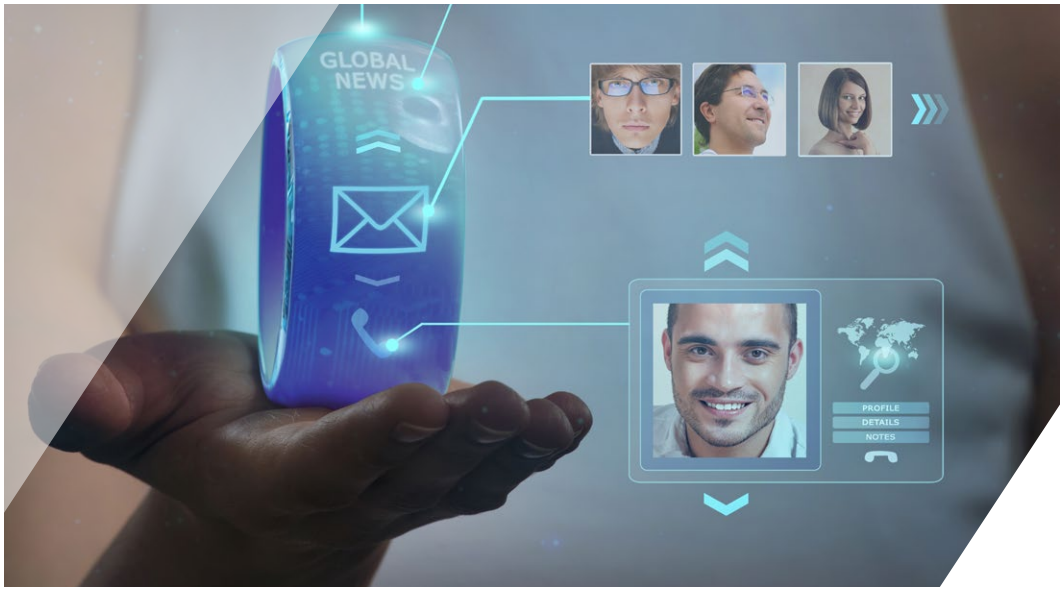
What the guests said:

- 38% said being able to adjust lighting/music in a restaurant by voice would improve their experience, and 22% would visit more often.

Voice activation/recognition source: Peter Romeo, "Starbucks to adopt voice recognition ordering," restaurantbusinessonline.com, (Dec. 8, 2016)

wearable technology

Thanks to the explosion of smart watches and fitness trackers, wearable technology or "wearables" are becoming as ubiquitous as cell phones. But the terminology encompasses all forms of electronic technologies or computers that can be incorporated into accessories or clothing and worn on the body. **That makes an array of objects, from watches to contact lenses to fabrics to jewelry, potential candidates as wearables.** Among their signature traits: Providing users with data-input capabilities and real-time access to information – all in continuous, convenient, seamless fashion.



Restaurant operators' top prediction for wearable technology: 66% said guests paying by wearables would be mainstream or in mass adoption by 2025.

Operators' other top uses for wearable technology:

- Marketing to guests outside the restaurant
- Staff scheduling and training
- Staff check-in to premises and workstations
- Guest recognition
- Staff activity monitoring
- Tailoring menus to guests using their wearables

wearable technology continued

current status

If convenience is a virtue, then wearable technology is practically saintly. The ability of smart watches and similar devices to expedite payment with a simple wave of a wrist is one of wearables' immediate benefits: **Some market estimates project wearable payment volume to eclipse $500 billion by 2020.** As handy as they may be for consumers, these devices already are emerging as indispensable tools for restaurant staff. In Paris, a restaurant operator has waiters wearing smart watches and sends alerts to them, indicating when a meal is ready for pick up or drinks are ready at the bar. Wearables are functioning as nutritional counselors, too. Devices, such as FitBit, track meals consumed and provide feedback, comparing caloric in-take versus burn.

future use

Advances in wearable technology are progressing exponentially and, in many cases, payment options are leading the way. **It's not inconceivable that, one day, microchips, embedded under our skin, will pay for burger and fries.** Said Apple CEO Tim Cook in late 2015: "Your kids will not know what money is." Similarly, developments for improving kitchen operations are mind-boggling, but already within grasp: Recently, KFC employees tested a training program wearing Google Glass that allowed them to watch a tutorial video, hands-free. Others have used Google Glass to create training videos from a unique perspective – the employee's. A manager-in-training, for example, can record his actions and observations during peak traffic, then review the video with supervisors to evaluate performance. Perhaps, most profound, will be the evolution of Internet of Things networking, enabling wearable devices to automatically "talk" to POS and kitchen appliances. Such enhancements would transform how operators communicate internally with staff and creates all sorts of marketing opportunities to reach consumers inside – and outside – the restaurant.

What the guests said:

- 18% said ordering by voice through a smartwatch or wearable device would improve experience, but 41% said they would find it invasive and 20% would visit less.

Wearable technology sources:

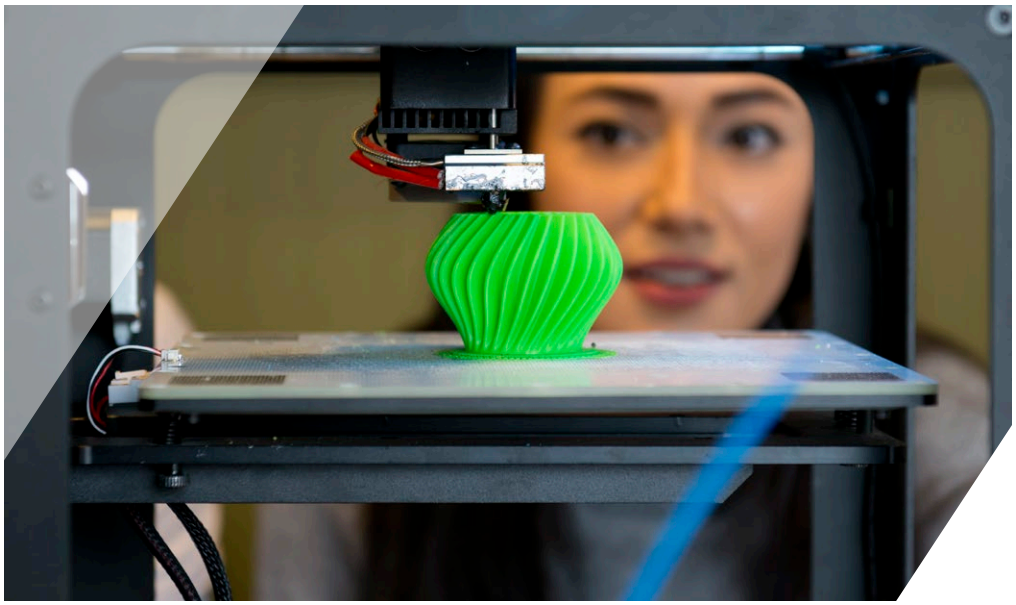
Christine Black, "Sizing up Google Glass," qsrmagazine.com, (May 2014)

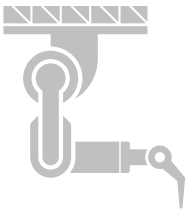
Rian Boden, "Paris restaurant equips waiters with wearables that alert them when orders are ready," nfcworld.com, (Nov. 14, 2014)

Dan Hyde, "Apple boss: Next generation of children 'will not know what money is,'" telegraph.co.uk, (Nov. 11, 2015)

3D printing

Futurologist Jeremy Rifkin declared **the advent of 3D printing as the beginning of the third industrial revolution**, describing it as transformative of a process, if not more so, than the production line assembly that defined the late 19th century. The technology, also known as additive manufacturing, enables the creation of a three-dimensional object from a digital design or file. Essentially, a 3D printer uses a digital model sliced into cross sections called layers to guide production; it "prints" the new object by laying down successive layers (typically a liquid polymer or resin) until completed. Initially used by large manufacturers to produce prototypes cost-efficiently, 3D printers now are available in desktop versions for small businesses and home usage. Today, they can create anything from toys to custom parts and, yes, even food.





Restaurant operators' top prediction for 3D printing: 44% said 3D printing of cutlery/plates would be mainstream or in mass adoption by 2025.

Operators' other top uses for 3D printing:

- 3D printing of furnishings
- Preparing food
- Customizing food

3D printing continued

current status

At the Barcelona restaurant La Enoteca, chef Paco Perez creates a seafood dish with a "coral" centerpiece – a seafood puree shaped into a most intricate design. But Perez didn't make it; he used a 3D printer. About the technology, he told the BBC: "Creativity is shaped by what technology can do." In this case, 3D printing technology also provided the concept for a restaurant business: In London, Food Ink debuted in 2016 pop-up locations serving 3D-printed dishes. The food sculptures were created with ingredients such as hummus, chocolate, dough and cheese – all having the appropriate consistency needed to be piped through a printer's nozzle.

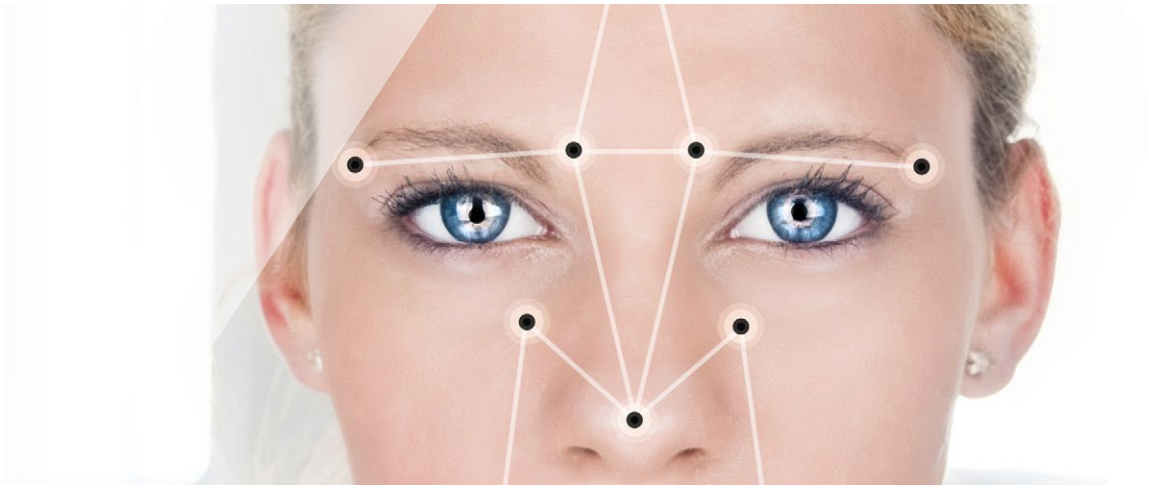
future use

It is difficult to imagine 3D printers becoming as commonplace as microwaves, but industry experts insist they are not a novelty. They say the potential the technology promises in terms of artistry, nutrition and sustainability will drive its development. Its nutritional value could be most promising: the food printers of tomorrow might enable food customization in unprecedented ways, blending new ingredients and precise nutritional value (for example, specific amounts of protein, omega-3 and carbohydrates) into different shapes and sizes. Printers also have the capability to make what is currently considered unappetizing or inedible (think insects) into nutritious and delicious meals. It's a vital concept that could help reduce the environmental impact of cooking and redefine sustenance for a growing global population.

3D printing source: Neil Koenig, "How 3D printing is shaking up high end dining," bbc.com, (March 1, 2016)

biometrics, facial recognition and 3D imaging

Broadly defined, biometrics refers to the use of measurable biological data in technology. It is most commonly used for identification and access control, and its expansive potential prompted a 2016 *Juniper Research* report to rank it the number one technology to transform ecommerce. Biometrics uses distinctive characteristics, both physiological and behavioral, to identify individuals. Rather than use passwords or tokens to validate identity, biometrics performs that task more securely and effectively by using identifiers such as fingerprints, DNA and retinas. **Facial recognition, which is the analysis of facial characteristics, also is a form of biometrics. From fun, social uses such as identifying friends on Facebook to high-level security and surveillance, facial recognition is fast-becoming a part of the societal mainstream.**



Restaurant operators' top prediction for Biometrics, Facial Recognition and 3D Imaging:
46% said security by biometrics/facial recognition would be mainstream or in mass adoption by 2025.

Operators' other top uses for Biometrics, Facial Recognition and 3D Imaging:

- Quality control of food
- Food plating/portion control
- Staff scheduling and training
- Guest sentiment measuring
- Staff recognition
- Suggestions to guests based on health/weight
- Guest recognition

biometrics, facial recognition and 3D imaging continued

current status

In quick-service restaurants from the U.S. to China, facial-recognition ordering is taking root. In one scenario, customers using a self-service kiosk are asked if they would like to save their order by phone number – or by facial recognition. If they choose the latter, the kiosk takes a picture of the customer and stores it. On the next visit, the kiosk will recognize the customer and suggest the last order. To better manage, track and authorize employee actions, restaurants already are using biometric devices such as fingerprint readers and hand-geometry readers. They are being used for a variety of tasks, from improving restaurant operations (managers can override transactions with a simple fingerprint scan) and labor management (employees clock in using biometrics, minimizing fraudulent records).

future use

In addition to showing customers' previous transactions, facial recognition systems soon will be able to make "intelligent" order recommendations based on gathered information and preferences stored in guest profiles. Customers, for example, who routinely order from a gluten-free menu or reduced-calorie menu, could start receiving suggestions suited for their dietary needs. **Futurists insist it is just a matter of time before restaurants and retailers deploy sophisticated facial recognition systems to identify consumers the moment they enter their establishments.** Such knowledge can allow operators to greet guests with a personal welcome and follow up with customized promotions to encourage repeat business. It also is a good bet that biometrics will become the norm for payment authentication – Mastercard already is experimenting with allowing card holders to make online purchases with a selfie portrait.

What the guests said:

- 49% said being recognized without a loyalty card or giving a name would improve the guest experience, and 31% would visit more often.
- 45% said drinks/appetizers being brought more quickly because they were recognized would improve their experience, and 28% would visit more often.

Biometrics, facial recognition and 3D imaging sources:

"Biometrics: The future of payment authentication?" finextra.com, (Sept. 29, 2016)

"Top disruptive technologies in digital commerce for 2016," juniperresearch.com, (Feb. 9, 2016)

Bryan Reesman, "Is facial recognition the future of fast food?" qsrmagazine.com, (February 2017)

virtual reality

A three-dimensional, computer-generated environment that can be explored by an individual, virtual reality still may be best known for its use with video games. But its ability to enable users to manipulate objects or execute a series of actions in a "virtual world" – with special sensory equipment (headsets and data gloves) – has made it an indispensable tool for industry. **For nearly three decades, VR has been used for training, especially for dangerous or difficult tasks.** Among its earliest applications: Flight cockpit simulators to train pilots. Now, VR is used routinely, from helping surgeons prepare for complex operations to aiding scientists solve problems involving molecular structure.

Restaurant operators' top prediction for virtual reality: 53% said restaurant design/flow optimization via virtual reality would be mainstream or in mass adoption by 2025.

Operators' other top uses for virtual reality:

- Staff training
- Kitchen design
- Guest entertainment
- Enhancing the guest experience

virtual reality continued

current status

VR technology already is available for food and beverage applications even if its commercial usage remains limited. But early signs indicate adopting VR technology for taste testing and altering environmental surroundings. A Los Angeles-based vendor currently offers a package of devices – including goggles, chewing "simulators" and scent producers – that physically recreates the sensations of eating a meal without actually consuming one. (Talk about empty calories!) Major technology providers, such as Samsung, also have VR glasses that transport dining guests to different, if not far-fetched, settings. **A real example: Users donning VR glasses can experience eating an Italian dinner in the ocean – complete with fishes and other marine creatures swirling around them.**

future use

There is a reason why expressions such as "we eat with our eyes" remain relevant. Research studies have documented the impact sight and smell can have on dining experiences. In fact, a 2013 study focused on how visual displays could alter the taste of whiskey; participants shown short films illustrating flavors such as "woody" or "sweet" experienced them more acutely while sampling. Some prognosticators expect VR to become as vital as real ingredients in creating new tastes. But VR applications in the future will go far beyond the culinary experience. In food and beverage, it could play a major role in training and management. **Just like VR can help soldiers prepare for battle without engaging in real combat, the technology could train novice restaurant and bar staff to handle the frenetic pace of a packed house when it's actually empty.** Managers also may be able to evaluate performance at a specific location – not by visiting it, but by checking in via VR in real time. An extension of that concept opens the possibilities to using VR to "envision" traffic flow, which could aid restaurant and kitchen design.

Virtual reality source: Stacy Liberatore, "The VR system that lets you eat without a single calorie passing your lips," dailymail.co.uk, (July 7, 2016)

drones

Technically known as unmanned aerial vehicles (UAVs), drones, in layman's terminology, is a flying robot. These vehicles can fly autonomously or by remote control and were first deployed by the military for reconnaissance and weapons systems. But as costs and size shrank, drones exploded in popularity. Now, they are embraced by hobbyists and used for a variety of commercial tasks, including videography and traffic monitoring. **Combining drones with Internet of Things technology, however, is likely to unleash their full potential** – already agribusiness can share information gathered by drones monitoring farms and climate conditions. Such applications factored into a recent *Business Insider* report that forecasted enterprise drone growth to eclipse 29 million shipments worldwide by 2021.

Restaurant operators' top prediction for drones: 48% said deliveries to guests' homes by drone would be mainstream or in mass adoption by 2025.

Operators' other top use for drones:

- Deliveries of supplies

drones continued

current status

"Was that a UFT?" Such an acronym isn't part of our vernacular, but it well could be. That's because unidentified flying trays actually do exist. T**wo years ago, a Singapore-based restaurant became the first in its country to use drones – essentially, hovering trays powered by lightweight propellers — to serve dishes to customers in the dining area.** Programmed to fly without human assistance, the drones could carry up to 2kg and were designed to assist, not replace, waiters. And in November 2016, Domino's Pizza announced it had completed the world's first pizza delivery by drone – landing a pie at a customer's home in Auckland, New Zealand, after a five-minute flight. Domino's is investing in the technology because it anticipates drones will become an "essential component" of deliveries, thanks to their ability to bypass traffic, improve delivery time and increase safety.

future use

As the Domino's example illustrates, drone food deliveries likely will become widespread. In another high-profile case, Google and Chipotle already have partnered to explore burrito delivery via drones at Virginia Tech University. Not only do drones provide an efficient, cost-effective delivery method, they also help restaurant operators lower associated expenses such as driver pay and fuel costs. In the United States, however, regulatory issues could hinder adoption: The U.S. Federal Aviation Authority would need to approve broad commercialization, and establish standards and practices.

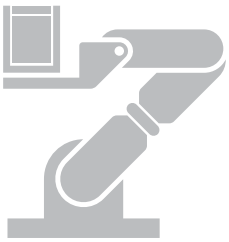
What the guests said:

- 27% said drones delivering food to their home would improve their guest experience, and 19% would visit more often. But 38% said they would find it invasive, and 29% would visit less.

Drones source: Helen Winter, "Singapore launches first drone restaurant," flightcentre.co.uk, (March 3, 2015)

robotics

A branch of computer science and engineering, robotics deals with the design, construction, operation and application of robots. Popularized by the legendary science-fiction author Isaac Asimov in the 1950s, robots of all shapes and sizes perform countless tasks today, often substituting for humans in industrial manufacturing or dangerous situations such as bomb detection. **They can be programmed to perform virtually any task a human can do, including basic functions such as walking, talking and lifting.** The use of robotics is limited only to the imagination, which explains its widespread adoption in commercial fields, domestic environments and military endeavors.



Restaurant operators' top prediction for robotics: 47% said robot cleaning would be mainstream or in mass adoption by 2025.

Operators' other top uses for robotics:

- Kitchen prep
- Quality checking in the kitchen
- Staff training
- Serving guests
- Seating guests

robotics continued

current status

Faster. Better. Cheaper. The three words usually form a mantra driving the advancement of robotic technology. And at the 2016 National Restaurant Association Show, food and beverage operators received a close-up look at the results of such pursuit: Robots capable of transforming the culinary arts into efficient manufacturing. Suzumo International unveiled its sushi robot capable of creating 3,600 pieces of nigiri per hour – or a complete sushi roll every 12 seconds. Typically, a labor-intensive endeavor, sushi creation, if automated, becomes a viable option at sports stadiums and arenas, schools and other mass-audience venues. Middleby Corp., a kitchen equipment maker, and Rethink Robotics also debuted a robotic employee that could make a batch of French fries as fast as any line cook. According to Middleby, the $30,000 robot is good for 35,500 hours of repeatable cooking and more than a five-year life span – making a case that it addresses wage issues, liability costs and staff turnover.

future use

Robotics already has had a profound impact on the automotive and healthcare industries. It seems destined to reshape restaurants, too. According to a National Robotics Education Foundation study, a typical QSR location could reallocate 1.2 workers from counter service with the adoption of remote order taking and the transition of other tasks to robots. In the U.S. alone, that labor shift translates into annual savings in excess of $12 billion in wages. Add evidence proving robots are more accurate and more successful at upselling (and won't complain about dull, repetitive tasks such as cleaning), and it is clear they will play a vital role in restaurants.

What the guests said:

- 18% said being served by a robot would improve the guest experience, but 50% said they would find it invasive and 40% would visit less.

Robotics source: "A robot wants your job: How automation will transform foodservice," aaronallen.com

CONCLUSION

In developing guidelines for technology adoption, here are four takeaways for consideration:

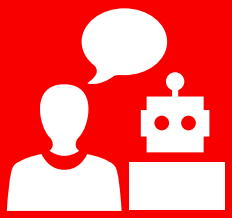
The technologies highlighted in *Restaurant 2025* will inevitably redefine the restaurant industry. But whether they yield success depends upon the ability of operators to separate fact from fiction and apply innovations that produce real benefits for consumers – and for the business.

1 **Recognition and personalization will drive future technologies.** Creating individualized experiences has been a central theme for hospitality, but its importance only will get amplified. Recognizing guests and making them feel welcome – without their need to provide a name or show a loyalty card – lead to business upsides: 49% of restaurant guests said it improves their experience, and 31% said they likely would visit more often. One-third of restaurant operators envision facial recognition technology to be in use within the next five years.

2 **Consumer privacy needs to be respected and safeguarded.** As beneficial as a technology might be, if it can't be trusted – it's useless. Technology proponents need to educate consumers to quell fears and establish protocols and security for safe usage. Evidence suggests both areas need improvement: 68% of consumers say that they would find suggestions based on their digital footprint, e.g., their use of Facebook, to be invasive.

3 **Simplified interactions for guests and staff will be key.** For operators, voice-activation technology could transform interaction with guests, ultimately making it simpler and even fun to conduct a range of tasks, from taking orders to gaining feedback. (In fact, 56% of operators expect to do the latter within the next 5 years.) But technology delivering personalization will have its detractors, too. Wearable devices, for example, likely will be used by staff (51% of operators anticipate staff activity monitoring within five years), but 41% of consumers say they would find it invasive to order with one.

4 **Robots will have their place, but not as a substitute for the "human touch."** In the future, automation is set to perfect efficiency, optimizing productivity and speed of service. 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; 50% of restaurant guests said being served by robots would not improve their experience, and 40% said they would visit less to avoid them.



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