



Redefining Dining: How Digital Transformation and Robotics Are Revolutionizing Restaurants [Part 1]

Exploring the Top 7 Full-service and Quick-service Restaurant Challenges and Their Automation-driven Solutions

Introduction



It's time to toast the trade that gives us everything from champagne-filled anniversaries to greasy late-night bites—the restaurant industry.

From Michelin-starred gastro experiences and swanky uptown bistros to our local diners and guilty-pleasure fast-food joints, restaurants offer more than just delicious food; they play a pivotal role in our local communities. Restaurants and bars considerably contribute to economic stability, job creation, and spurring tourism to empower financial prosperity from the bottom up.

"More than half of Americans have worked in food service at one point or another, accounting for nearly 16 million people employed by the restaurant industry at any given moment."

—National Restaurant Association

After the widespread social isolation during the pandemic, people now crave the camaraderie they get from these essential social networks when they make a reservation at a new restaurant with old friends or return to their old haunts to meet some new faces.

"The role of a restaurateur is to be a custodian of what makes a community feel good about itself."

—Danny Meyer, Founder & Executive Chairman of the Union Square Hospitality Group

Independent full-service restaurants generate substantial employment and event opportunities, often outperforming other industries in building community and acting as a vital cultural vehicle to drive the growth of the arts and music.

In an Economist article, London restaurateurs Chris Corbin and Jeremy King stress that a restaurant's appeal lies in ambiance, social interaction, and immersive experiences, not just the food.

"We're not artists or musicians. But still, a restaurant is an extension of yourself or a vehicle to express yourself. Why shouldn't everything in it give pleasure?"

—Chris Corbin, Co-Manager of The Wolseley, The Ivy, Colbert and The Delauney, London

Full-service (FSRs) restaurants provide complete waitstaff services, and quick-service restaurants (QSRs), which include fast-food restaurants, provide timeless support to cities and towns by pumping economic wealth and life into communities.

However, in 2024, FSRs and QSRs continue to face tough and diverse challenges, from rising labor costs and increased competition to evolving consumer preferences and cyberattacks.

38% say their restaurants were not profitable last year.

—National Restaurant Association

Navigating these threats requires new strategic approaches to advanced technologies, automation, and even robotics to stay competitive and thrive in our new normal. Full-service and quick-service restaurants must digitally transform to remain viable in the post-pandemic era.

"As the pace of change in innovation, consumer preferences, and the economy speeds up, operators that embrace efficiency -and-value-adding technology, whether in the back office, the order counter, or the dining room floor, are the ones best positioned to flourish."

—Restaurant365 CEO and Co-Founder Tony Smith

As we move through the latter half of 2024 and beyond, the FSR and QSR industry can effectively navigate financial and operational challenges and evolving consumer demands by strategically embracing digital transformation, automation, and robotics.

The Top 7 Full-service and Quick-service Restaurant Challenges:



"60% of newly established restaurants close within their first year, and 80% of food service businesses fail within the first five years."

Agata Kubiak, Why Do Restaurants Fail? (Restaurant Success & Failure Rate) UpMenu

Strong headwinds have brought the restaurant industry seven key problems that must be fully understood before discussing the right solution for any establishment.

The FSR and QSR markets in 2024 face seven fundamental challenges, forming a perfect storm of obstacles that restaurants must navigate.

1. Rising Costs
2. Labor Shortages
3. Declining Foot Traffic and Increased Competition
4. Changing Consumer Preferences and Cleanliness
5. Lack of Traceability
6. Operational Inefficiencies
7. Obsolete Tech and Cyber Security

Together, these toxic elements create a potential recipe for disaster that impedes all aspects of the full-service and quick-service restaurant industry.

Below, in part one, we will go through the first three daunting obstacles and provide actionable technological solutions for every type of eatery to stay competitive and succeed.

Challenge 1. Rising Costs



During the pandemic, The Real Deal researched that anywhere between 70,000 and 90,000 eateries turned off their stoves and closed their doors, never to open them again. Headline after headline stated it was due to the lockdowns and customers not dining in; however, rising prices due to inflation, rent, and inventory costs also drove restaurants past the point of debt and into bankruptcy.

And the closures were not uniform across the board.

But what was always clear, regardless of final counts, was that the weight fell harshest on independent restaurants—about 10% of independent restaurants closed compared to 2.5% of chains. About 10 percent closed in 2020 compared to 2.5% of chains.

—Jakab Spencer, Wall Street Journal

For restaurants that survived the pandemic, their profits haven't rebounded as they hoped. Restaurant owners were forced to engage in the intimidating balancing act of managing economic conditions and protecting their profit margins.

A TouchBistro survey discovered, "Despite a slight increase in 2022, profit margins fell 2023 to 9.3 percent, with the mid-sized restaurants being the most brutally hit."

In the same survey, restaurant operators reported that while costs have risen across the board, food and inventory costs are the most recent culprits for causing eateries to burn through their capital—

In 2023, 58% of restaurant operators claimed that inventory costs placed the most significant financial strain upon their establishments, compared to 33% in 2021
—FSR magazine

When food costs rise, passing the costs on to customers is expected.

Challenge 1a. Higher Food Costs and Menu Price Inflation



97% of surveyed restaurant owners cite higher food costs from last year.
—National Restaurant Association Report

Rising menu price inflation makes dining out increasingly expensive for consumers, leading to a shift towards home-cooked meals. To navigate this, FSRs and QSRs must approach price increases cautiously.

"Although inflation for both Food At Home (FAH) and Food Away From Home (FAFH) has moderated, FAFH inflation remains notably higher compared to grocery store inflation. With this unfavorable pricing gap, restaurants need to be careful of increasing menu prices, as this increases the risk of outsized traffic declines with more consumers choosing FAH."

—Sujeet Naik | Coresight Research Analyst

Economic instability and rising food costs have most severely impacted full-service establishments but have also been a substantial concern for the quick-service restaurant markets. Rising costs for raw materials and operational expenses have led consumers to seek budget-friendly dining options, placing pressure on their knife-thin profit margins.

QSRs must carefully manage procurement and consider alternative ingredients to maintain cost-effectiveness without compromising quality.

Challenge 1b. Rising Labor Costs and Wage Inflation



Full-service and quick-service restaurants have also struggled with considerable payroll costs and inflation increases.

98% of restaurant owners say higher labor costs are an issue for their restaurant
—National Restaurant Association Report

Inflation and the staggering rise in the cost of living result in wage inflation for restaurants, prompting them to explore price increases and automation measures to enhance productivity to offset rising labor costs.

"We are all feeling pressure on unit economics. Our labor costs are extremely high. Prime costs are going up. We have to price to close that gap so we have enough profit margin to survive,"

—Lauren Fernandez, CEO and founder of Full Course.

For example, 22 states in the US have passed laws increasing minimum wage, which have prompted restaurant owners and operators to scramble to adjust their schedules while maintaining exceptional service. Some government legislation has even targeted specific markets. California's AB 1228 legislation introduced minimum wage increases and new standards for fast-food chains, spiking troubles across the market.

Restaurant labor costs are skyrocketing — and that's if you can even find new staff members. Restaurant staff have been rightfully asking for better pay, benefits, and predictability in their jobs for years.

—Katherine Boyarsky with Toast, a restaurant technology company

Solutions to Rising Costs



While combating rising costs is multifaceted and often out of restaurant owners' control, they have tools to ease its impact. According to a report by FSR magazine, FSR and QSR eateries can limit discounts, reduce portion sizes, or search for less-expensive suppliers.

- **41% will find new, less expensive suppliers**
 - **36% intend to limit promotions/specials**
 - **28% to reduce hours of operating**
 - **27% will serve smaller portion sizes**
 - **25% must resort to reducing the number of staff**
- Restaurant owners respond to how they will navigate high costs

However, these tactics must be reconsidered in the highly competitive restaurant industry.

Patrons notice smaller portions and poor service, and when happy hours become less 'happy.' Cutting staff to save on overhead results in worse service, which drives customers away and ultimately negates savings.

Finding a less expensive supplier is complex and involves maintaining food quality, ensuring reliable delivery, and navigating contracts. Even if successful, a dip in food quality can still result, which could end in a bad review.

According to Aaron Allen and Associates Global Restaurant Consultants, many savvy restaurant owners are turning to new technology and automation to combat rising labor costs, with notable innovations from companies like Miso Robotics and Pudu Robotics. Miso Robotics' Flippy 2, an advanced robotic kitchen assistant, automates the frying process, significantly reducing labor costs associated with food preparation.

This technology helps maintain consistent quality and speed, allowing human workers to focus on more customer-oriented tasks.

“Such automation can lead anywhere between 30% and 70% cost savings, enhancing overall efficiency and productivity.”

—According to Aaron Allen and Associates Global Restaurant Consultants

Pudu Robotics' award-winning service robot, **KettyBot Pro** is transforming restaurant operations in the service sector. The KettyBot Pro, designed for food delivery within restaurants, elevates service efficiency by reducing the need for waitstaff to carry dishes to tables. Its slim design allows it to navigate crowded environments, and upon arriving at the designated table, it can even identify dishes for the customer.



Its interactive functionality ensures efficient service and provides a platform for friendly customer communication, making it a versatile tool in any restaurant's arsenal.

According to an article by Lin Engineering, “the benefits of robotic technology in the [full-service and quick-service restaurant] industry include improved efficiency, reduced labor costs, and enhanced customer experience.”

These robots help manage resources and finances and delight customers by cooking food correctly, serving it promptly, delivering meals without errors.

“As automation and robotics continue to expand their capabilities to further free up manpower in the dining room and kitchen, it will not remove the need for human labor. Instead, it will free up manpower requirements for lower-skilled roles so that staff can be more responsive to provide better customer service and perform higher-end skilled tasks.”

—Chris Tarr e27 media.

Food businesses that haven't leaned into robotics are concerned with the short-term cost. Yet, in the long-run human-robot collaboration is essential for efficiency as automation will be commonplace assisting with tasks from sowing seeds, harvesting, and processing, to packaging, storage, cooking and service.

According to Jonathan Hoyles at Forbes, “the restaurant industry is expected to break the \$1 trillion barrier in 2024 despite rising costs, primarily due to the restaurants that strategically implement automation and technology.”

Strategic automation helps restaurants stay competitive by addressing rising costs and challenges like labor shortages.

2. Labor Shortages



A labor shortage in the restaurant industry is compounding and building the rise in employment expenses. Labor scarcity and poor retention, particularly in skilled positions like management, are causing a lack of stability in eateries, which sinks customer service levels.

Most restaurants have found this a troublesome issue to tackle because they need help to fill existing vacancies when they want to add more staff to their rosters.

45% of restaurant operators need more employees to meet customer demand.
—National Restaurant Association

The retirement of experienced workers, low satisfaction levels, and unreasonable work hours have made full-service and quick-service restaurants unappealing for younger generations.

"Industry players have voiced labor shortage concerns across all sizes and service offerings (indoor dining, takeout, drive-through and delivery). Even some of the world's largest fast-food conglomerates have had to reduce menu items and cut back on operating hours to juggle a short supply of staff while managing customer expectations."

—Jonathan Hoyles, *Forbes*

The industry often requires long, irregular hours, including nights, weekends, and holidays, leading to burnout and work-life balance challenges. Additionally, many employees are drawn to other industries offering more stable hours, higher pay, and better benefits.

"Such high quit rates within the industry, combined with other job options, has made it difficult for restaurant and hospitality businesses to find workers."
—Ashley Bray with *Bar and Restaurant News*

The combination of these dynamics makes it difficult for restaurants to attract and retain staff, which can severely hamper their service operations. QSRs can result in long lines and backed-up pick-up orders, delayed deliveries, and unclean establishments.

With in-person orders, sticky surfaces, harried greetings, and rushed order-taking between the server and a customer have become the norm. Rushed service often results in miscommunications, which devolve into wrong orders, which spike customer satisfaction levels and tank customer loyalty.

“There’s now nearly 12,000 more restaurants than pre-pandemic looking to pull from a labor force that’s 700,000 workers smaller than pre-pandemic. Yikes.”

—Justin Guinn, with Toast, a restaurant technology company

However, full-service and quick-service restaurants have ways to alleviate some of the pain caused by a lack of staff.

Solutions to Labor Shortages



"Smart robots are helping businesses deal with labor shortages by taking over roles that are hard to fill with human workers,"

—Chia Han Keong, editor with Yahoo News Singapore.

These systems reduce congestion at the point of sale by allowing orders to be placed and paid for ahead of time and offer a convenient, seamless transaction experience.

Robotics and automation technology are pivotal in addressing labor shortages in the restaurant industry by taking over service, point-of-sale (POS) work, and food preparation tasks. Quick-service restaurants revolve around automating POS work and building user-friendly apps.

This move aligns with the broader industry trend towards automation, optimizing service delivery, and reducing operational costs.

—Hollis Johnston, Business Insider.

For full-service restaurants, handheld POS terminals and robots like those developed by Pudu Robotics efficiently handle tasks such as serving food and removing dirty dishware, allowing employees to focus on more complex responsibilities like cooking and customer service management.

"So now they're turning to automation because that's really the only way out. How do I do more with less people on my floor? How do I maintain the same level of service?"
—Peter Dougherty, general manager of Hospitality for Lightspeed, a commerce platform for independent retailers and restaurants

Self-service kiosks are the industry equivalent of mobile payment systems in the QSR space.

Trailblazed by huge chains like McDonald's, self-service kiosks have become a remarkable technological advancement in the quick-service industry.

"I'm used to the kiosks, so I prefer them — they're faster, more accurate, and make things easier to customize. And since workers are there to help if you're confused, I fail to see how it takes away jobs as of now."
—Hollis Johnston, Business Insider.



These kiosks enable customers to place their orders directly, substantially reducing wait times and minimizing the need for cashier staff. They also accelerate the ordering process, diminish the risk of human error, and guarantee more accurate orders.

Hollis Johnston with Business Insider continues, "The beauty of the kiosk really is customization: making your order the way you want it here is much easier than repeating what you want to a cashier several times."

Other major chains like Burger King and Shake Shack have followed suit, seeing the positive reception from customers and reduced time that the automation has received in recent years.

Julie Littman with Restaurant Dive reports that the top reasons customers said they use kiosks include:

- **44% No rush to order**
- **41% Ease of menu exploration**
- **40% Ability to view all the menu options**

Littman's report continues that 59% of users have been surprised by new items and customization options while using kiosks.

Tim Capper's article on the Takeaway & Fast-Food Industry Trends 2024 clarifies that in addition to implementing self-service kiosks, McDonald's UK introduced the "My McDonald's" app. This app allows customers to order ahead, customize their meals, and access exclusive deals, considerably speeding up the ordering process and reducing in-store queues.

Quick-service restaurants have also heavily invested in kitchen robotics. Kernel, a vegan QSR in New York, has already greatly benefitted from integrating kitchen automation technology.

"Team members are enjoying the experience, and automation is creating a better working environment for them and not a worse one,"
—Stephen Goldstein, Kernel's president, told Fortune.

Sasha Rogelberg with Fortune continues that Kernel's three staff members work alongside a robot arm that places food in the oven and then transfers it to an assembly line for further preparation. This collaborative effort between employees doing safer tasks and the robot handling the burning hot stove reduces risk and strain on the staff and enhances operational productivity.

Automation and robotics can also produce benefits and reduce risks in small spaces, such as ELLA, an autonomous robot operating as a barista in a Singapore cafe.

"Born out of 'a very real problem and necessity' to address 'shortage of labor and inconsistencies in quality [that] led to subpar experiences,' the autonomous ELLA is powered by AI and runs in an unmanned, contactless café measuring just 5 square meters. She boasts an ability to consistently produce drink orders and a fearlessness of handling hot coffee."

—Daniel Eng with Crown Digital Business Solutions

The adoption of robotics and AI in the restaurant industry is a game-changer because it eases the burden of labor shortages and high operational costs while cultivating high customer and employee satisfaction.

"It's not that they are necessarily reducing the number of people," Bank of America analyst Sara Senatore told Fortune. "It's more that they're making those people more productive and happier."

One way automation technology helps FSRs do more with less is to reduce mindless repetitive work and enhance efficiency by equipping waitstaff with mobile payment and order systems. Mobile payment systems allow them to manage more tables without returning to a central POS station.



"[They] can manage five instead of four tables—that's a 20% reduction in front-of-house labor costs, which is a meaningful impact to the bottom line for restaurants on thin margins."

—cites Ashley Bray with Bar and Restaurant News

Jonathan Hoyles with Forbes noted, "Technology fills service gaps in the restaurant and hospitality sectors," helping businesses adapt to evolving consumer expectations and labor market challenges.

Autonomous bussing robots, such as Pudu Robotics' **HolaBot**, travel to a patron's table when they finish their meal. When done, patrons can place their dirty dishes, glasses, and utensils into HolaBot's plastic tubs.



By allowing HolaBot to handle the used dishware and bring it back directly to the dishwashers, restaurants face fewer risks of breaking precariously stacked dishware and help bussers save time and energy.

"Generally speaking, [bussing] requires physical strength more than mental strength." —states the reporting team with Frugal Reality. "Jobs that require you to go physical for the better part of the day are difficult."

While some restaurant operators worry that adopting robotics could threaten the employment of their current staff, scientific studies say otherwise.

A recent study in the International Journal of Hospitality Management found that Employees' perceptions of adopting robots were reflected in their trust in their management and motivations.

So, as long as management communicates that these robotics are intended to support, not replace, their staff, valued employees will embrace their assistance.

Jonathan Hoyles with Forbes continues, "Technology has allowed restaurants to work with less staff while increasing efficiency." they aren't returning.

3. Declining Foot Traffic and Increased Competition



Due to FSRs and QSRs raising their prices to cover the increased cost of ingredients, resources, and labor, patrons have reconsidered going out to eat, even to their favorite hangouts.

From a Bar and Restaurant survey of respondents who noticed menu price increases, a majority (57.7%) indicated they had changed or expected to change their dining-out habits by cooking more meals at home.

—Ashley Bray, Bar and Restaurant News

While consumer enthusiasm for dining out remains high, with 90% of adults want to eat out or zoom through the drive-thru, due to to inflation and labor costs, many see this as a luxury rather than a weekly staple as they once did.

A study of 1,000 US consumers in April 2024 found that consumers now spend 30% of their monthly food budgets on restaurants, down from 40% just two years ago.

—PopMenu Survey, reported by Alicia Kelso, National Restaurant News

Declining customer traffic is a dire issue, with data showing year-over-year declines in visit frequency.

Most operators in the top 10 restaurants by revenue experienced significant year-over-year declines in customer traffic in the latter half of 2023, with a further pronounced drop in January 2024,

—Sujeet Naik | Coresight Research Analyst

With declining patronage comes market saturation and competitive pressures beyond a good-looking menu. Customers also visit restaurants less frequently because they feel they're not getting an experience equivalent to what they used to pay for.

38% of consumers report spending the same or more on restaurant meals compared to last year, according to the previously mentioned 2024 PopMenu report

Exacerbating the situation is the phenomenon of tip and fee fatigue. Customers are tipping less due to inflationary and industry pressures. Customers resent feeling they are tipping 20% or more for subpar services. These pressures often cause customers to see if their dollar can stretch longer at a competitor.

"Consumers are becoming more savvy. There is a level of understanding now that the consumer is paying for convenience and service, and that means we as operators need to make sure the food is arriving on time, that it's hot, that the packaging is correct, that all of it is executed well,"

—Michael Alberici, SVP and head of marketing at Smalls Sliders

FSRs and QSRs must now rethink their value proposition beyond just menu options and prices. The restaurant industry is intensely competitive because of new market entrants and existing players who continuously innovate their customer loyalty methods and services and raise their cleanliness and hygiene levels.

45% of operators expect competition to be more intense than last year, including competition for labor resources.

—National Restaurant Association.

High market saturation demands that FSRs and QSRs differentiate themselves to snag new customers and retain loyal ones, despite nearly half of consumers needing to be more cautious about their dining expenditures.

Solutions to Fewer Patrons and Increased Competition



Automation, robots, and advanced technologies can grow customer retention and loyalty while attracting new patrons through innovative loyalty programs, personalized experiences, and value-driven discount strategies.

Innovative and dynamic discount and promotion strategies, sophisticated automated marketing efforts, and even immersive technologies like AR/VR help restaurant operators create targeted discounts and promotions, tailored experiences, and efficient service delivery.

Stacy Hass, a McKinsey & Company Detroit partner, reports, "Restaurants that can leverage technology to create personalized and seamless experiences will thrive in the next normal."

FSRs and QSRs that invest in technology create a memorable and engaging customer experience that fosters loyalty and effortlessly attracts new customers.

For example, curated loyalty programs and Customer Relationship Management Systems (CRMs) powered by sophisticated data analytics automatically personalize rewards and discounts, making them more relevant and engaging.

"Personalized loyalty programs that leverage customer data can increase repeat visits by 20% to 30%."

—Marissa Nolan, Restaurant and Convenience Strategy Lead at Mastercard

This personalized approach fosters a more profound customer connection by rewarding repeat visits, creating a sense of belonging and appreciation. Customers notice and value the restaurant's responsiveness to their needs.

GrubTech's F&B Management with Technology Team states, "By tracking customer preferences and dining habits, you can offer personalized recommendations, rewards, and promotions, fostering loyalty and encouraging repeat business."

Furthermore, such programs turn visitors into loyal patrons because they see the eatery as a place that cares about what food they want, frequently serving it and sometimes discounting it.

Discounts and promotions are another area where technology plays a crucial role, especially for cash-strapped customers seeking value. Automated systems can analyze purchasing patterns to offer targeted discounts, enhancing customer satisfaction and encouraging repeat business.

"Leveraging data-driven insights for targeted promotions can drive revenue and improve customer retention."
—Danny Klein with QSR Magazine

When eateries use actual data from customers who frequent an eatery to provide timely, value-driven deals instead of discounting arbitrary menu items or what happens to be in season, they can out-compete their competition and even lure more patrons out to eat.

Online reservations and interactive menus are also enhancing the dining experience for FSRs.

The convenience of booking a table online increases customer satisfaction. Many people now loathe having to call up even their favorite restaurant and speak to someone on the phone who may not write down their name correctly or get a reservation time wrong. Making a reservation through an app offers customers a much more streamlined and less stressful experience.

Jamie with Librorez Guest Experience Platform Services spotlights "the convenience of booking a table online "increases customer satisfaction and reduces wait times, contributing to a more seamless dining experience."

Referencing other technology, AR/VR is not just for gaming.

Integrating AR/VR in full-service and quick-service restaurants offers an immersive and

interactive way to engage customers. Customers now want to see a space before they reserve it, especially for a special occasion or to impress an essential out-of-town client. They may also love to know how a meal looks before they order it.

"AR menus can provide a dynamic way to visualize dishes, making the ordering process more engaging and fun."

—AppLova is a premier restaurant digital ordering technology enterprise.

This technological innovation attracts tech-savvy customers and adds a unique touch to the dining experience, making it memorable.

Additionally, harnessing customer data and automating online deliveries and pick-ups streamline operations and optimize service efficiency.

CRQLAR, a transformative business intelligence company, indicates, "Leveraging customer data allows restaurants to anticipate needs and individualize interactions, which can significantly boost customer loyalty."

Automation in delivery and pick-up services, especially for quick-service restaurants, ensures timely and accurate order fulfillment, enhancing customer convenience.

"Efficient online delivery and pick-up systems can increase order accuracy by 20% and reduce delivery times by 15%."

—GrubTech's F&B's Management with Technology Team

Efficient delivery and pick-up systems make it easier for restaurants to meet customer expectations and build a loyal customer base.

Additionally, automation and AI enable restaurants to offer customized recommendations, streamline ordering processes, and provide tailored dining experiences.

Krista Dinsmore with Sculpture Hospitality noted, "Automation tools can create a more personalized and efficient customer experience, leading to higher satisfaction and repeat business."

Digital transformation and automation can help with a pivotal function which restaurants often lack time for—marketing.

Digitized marketing is another powerful tool for enhancing customer awareness and engagement. Restaurants can utilize AI-driven marketing platforms to send curated messages, reminders, and discounts, ensuring that customers are informed and engaged.

"Automated marketing systems can increase customer engagement by up to 40%."
—Jonathan Hoyles, Forbes

These platforms can segment audiences, track campaign performance, and adjust real-time strategies, ensuring maximum effectiveness and reach. Finally, integrating robots and automation in service delivery can streamline operations, reduce wait times, and improve efficiency for both full-service and quick-service eateries.

"Instead of doing the same mindless tasks over and over, I can now focus on making customers enjoy themselves more by giving them recommendations and sharing my knowledge. It feels good to be the expert."

—An anonymous US Manager states to Aarni Tuomi, Co-author of the Journal, 'Service Robots and the Changing Roles of Employees in Restaurants: A Cross-Cultural Study'

Pudu Robotics' **BellaBot Pro** exemplifies this by serving customers with an approachable and friendly appearance and acting as a greeter with a customizable display screen. Full-service and quick-service restaurant operators can easily use BellaBot Pro's display screen to alert customers to new promotions, seasonal deals, and how to sign up for loyalty programs.



This integration creates a memorable customer service experience, amplifies engagement, and promotes ongoing loyalty.

The strategic use of automation, robots, and advanced technology in restaurants is boosting customer retention and acquisition. Personalized loyalty programs, targeted discounts, tailored experiences, automated marketing, and efficient service delivery create a memorable customer experience.

In Part One of this exploration, we delved into the transformative impact of digital technology and robotics on the restaurant industry, highlighting how these innovations address the three critical challenges of rising costs, labor shortages, and unprecedented competition. Full-service and quick-service restaurants that adopt these advancements are paving the way for a more efficient, customer-centric dining experience.

Discover how Pudu Robotics can equip your restaurant with cutting-edge solutions today—**here**, before we unveil Part Two.

Stay tuned for Part Two, where we'll examine how to overcome the final four challenges with future-ready automation, robotics, and technology. The journey of revolutionizing the restaurant industry has only just begun.

Works Cited

1. "18 Threats to the Quick Service Restaurant (QSR) Industry in 2024." Solink, 16 May 2024, solink.com/resources/industry-insights/threats-to-the-qsr-industry/. Accessed 17 July 2024.
2. "2024 State of the Restaurant Industry." National Restaurant Association, 5 Feb. 2024, restaurant.org/research-and-media/research/research-reports/state-of-the-industry/#:~:text=45%25%20of%20operators%20need%20more. Accessed 17 July 2024.
3. Admin, Team. "Embracing the Future: Top 8 Restaurant Automation Trends in 2024." Applova, 17 Jan. 2024, [applova.io/blog/top-restaurant-automation-trends/#:~:text=Augmented%20Reality%20\(AR\)%20and%20Virtual](https://applova.io/blog/top-restaurant-automation-trends/#:~:text=Augmented%20Reality%20(AR)%20and%20Virtual). Accessed 6 Aug. 2024.
4. Boyarsky, Katherine. "How to Lower Restaurant Labor Costs in 2024." Toast, 26 Apr. 2024, pos.toasttab.com/blog/on-the-line/lower-restaurant-labor-costs/#:~:text=Restaurant%20labor%20costs%20typically%20range,cost%20percentage%20hovering%20around%2040%25. Accessed 23 July 2024.
5. Bray, Ashley. "How to Solve These Top 2 Restaurant Challenges with Technology." Bar and Restaurant News, 19 Dec. 2022, www.barandrestaurant.com/operations/how-solve-these-top-2-restaurant-challenges-technology. Accessed 24 July 2024.
6. ---. "The Results Are in from Our State of the Industry Survey." Bar & Restaurant, 22 Feb. 2023, www.barandrestaurant.com/operations/results-are-our-state-in-industry-survey. Accessed 24 July 2024.
7. Calabrese, Diane M. "Food for Thought—Cleaning Restaurants - Cleaner Times." Cleaner Times, Nov. 2023, www.cleanertimes.com/magazine/cleaner-times-articles-2/food-for-thought-cleaning-restaurants/#:~:text=%E2%80%9CCleaning%20a%20restaurant%20can%20be. Accessed 8 Aug. 2024.
8. Capper, Tim. "Takeaway & Fast Food Industry Trends 2024." BE Furniture Sales, 23 Apr. 2024, www.befurnituresales.co.uk/takeaway-fast-food-industry-trends-2024/. Accessed 15 July 2024.
9. Chick, Jean. "Restaurant of the Future: Technology, Strategy, CX | Deloitte US." Deloitte United States, 6 Dec. 2021, www2.deloitte.com/us/en/pages/consumer-business/articles/restaurant-future-survey-technology-customer-experience.html. Accessed 9 Aug. 2024.
10. CRQLAR, Team. "Futuristic Feasts: The Tech Revolution in Dining out | Blog." Crqlar, 29 May 2022, www.crqlar.com/blog/a-taste-of-the-future-how-tech-is-spicing-up-hotel-dining-experiences. Accessed 6 Aug. 2024.
11. Davis, Michael. "How Supply Chain Visibility and Traceability Can Drive a Sustainable Food Industry." Supply Chain Brain, 5 May 2023, www.supplychain-brain.com/articles/37184-how-supply-chain-visibility-and-traceability-can-drive-a-sustainable-food-industry. Accessed 7 Aug. 2024.
12. Davis, Sara. "Utilizing Waste and Food Cost Control Data in Restaurants." SynergySuite, 9 Nov. 2023, www.synergysuite.com/blog/utilizing-waste-and-food-cost-control-data-in-restaurants/. Accessed 7 Aug. 2024.
13. Dinsmore, Krista. "Bar and Restaurant Trends in 2024 That Can Help Your Business Grow." Sculpture Hospitality, 18 Jan. 2024, www.sculpturehospitality.com/blog/bar-and-restaurant-trends-2024. Accessed 4 July 2024.
14. Doyle, Jocelyn. "Around the Modern-Day Fire: The Role of Restaurants as Community Hubs | the Sustainable Restaurant Association." The Sustainable Restaurant Association, 9 Aug. 2023, thesra.org/news-insights/insights/around-the-modern-day-fire-the-role-of-restaurants-as-community-hubs/#:~:text=Restaurants%20provide%20a%20modern%20day. Accessed 7 Aug. 2024.
15. Eng, Daniel. "Introducing ELLA, Singapore's First Fully Autonomous Robotic Barista." Crown Digital, 2 Oct. 2020, www.crowndigital.io/post/introducing-ella-singapore-s-first-fullyautonomous-robotic-barista. Accessed 5 Aug. 2024.

16. Eversham, Emma. "Restaurant Cleanliness More Important than Customer Service, Finds Report." Restaurant Online, 26 Apr. 2021, www.restaurantonline.co.uk/Article/2016/09/12/Restaurant-cleanliness-more-important-than-customer-service-finds-report?utm_source=copyright&utm_medium=OnSite&utm_campaign=copyright. Accessed 31 July 2024.
17. Ewing-Chow, Daphne. "Here Are Five Global Restaurants Staffed by Robot Chefs." Forbes, 31 Mar. 2024, www.forbes.com/sites/daphneewingchow/2024/03/31/here-are-five-global-restaurants-staffed-by-robot-chefs/. Accessed 8 Aug. 2024.
18. "Five Ways to Boost Restaurant Revenue with Data-Driven Insights during NYC Restaurant Week | Modern Restaurant Management | the Business of Eating & Restaurant Management News." Modern Restaurant Management, 5 Aug. 2024, modernrestaurantmanagement.com/five-ways-to-boost-restaurant-revenue-with-data-driven-insights-during-nyc-restaurant-week/. Accessed 9 Aug. 2024.
19. "Four Reasons Why Poor Equipment Is Bad for a Restaurant | RestaurantNews.com." Restaurant News, 10 Feb. 2017, www.restaurantnews.com/four-reasons-why-poor-equipment-is-bad-for-a-restaurant/. Accessed 7 Aug. 2024.
20. "Four Reasons Why Poor Equipment Is Bad for a Restaurant – Commercial Appliance Repair Columbus Ohio." Commercial Appliance Repair, 16 Dec. 2019, commercialappliancerepair.biz/2019/12/16/four-reasons-why-poor-equipment-is-bad-for-a-restaurant/. Accessed 8 Aug. 2024.
21. Frugal Reality Team. "Bussing Tables at a Restaurant – Pay, Tips, Skills - Frugal Living - Lifestyle Blog." Frugal Living - Lifestyle Blog, 4 Mar. 2022, frugalreality.com/bussing-tables-restaurant/. Accessed 6 Aug. 2024.
22. Grubtech, Team. "The Future of Dining: How Technology Is Shaping the Restaurant Industry." Blog.grubtech.com, 24 July 2024, blog.grubtech.com/post/the-future-of-dining-how-technology-is-shaping-the-restaurant-industry. Accessed 6 Aug. 2024.
23. Guinn, Justin. "How to See Shortages as a Restaurant Staff Retention and Churn Crisis." Toast, May 2022, pos.toasttab.com/blog/on-the-line/restaurant-staff-retention. Accessed 25 July 2024.
24. Haas, Stacey. "How the Restaurant Industry Can Thrive in the next Normal | McKinsey." McKinsey & Company, 19 May 2020, www.mckinsey.com/industries-retail/our-insights/how-restaurants-can-thrive-in-the-next-normal. Accessed 8 Aug. 2024.
26. Hitchings, Henry. "Why Do People Go to Restaurants? It's Not about the Food." The Economist, 14 July 2020, www.economist.com/1843/2020/07/14/why-do-people-go-to-restaurants-its-not-about-the-food. Accessed 4 July 2024.
27. Hoyles, Jonathan. "Council Post: Technology Fills Service Gaps in the Restaurant and Hospitality Sectors." Forbes, 10 Mar. 2022, www.forbes.com/sites/forbes-techcouncil/2022/03/09/technology-fills-service-gaps-in-the-restaurant-and-hospitality-sectors/. Accessed 17 July 2024.
28. "Industry Kitchens." Industry Kitchens, 29 Nov. 2023, www.industrykitchens.com.au/Blog/how-commercial-kitchen-equipment-affects-food-quality/. Accessed 8 Aug. 2024.
29. Jackson, Chris. "Nine in Ten Americans Say That the Cleanliness of a Business Is an Important Factor for Them When Deciding Whether They Will Be Repeat Customers or Not." IPSOS, 2 Nov. 2017, www.ipsos.com/en-us/news-polls/Nine-in-ten-Americans-Say-Cleanliness-of-Business-is-an-Important-Factor-When-Deciding-Whether-They-Will-Be-Repeat-Customers-or-Not?trk=article-ssr-frontend-pulse_little-text-block. Accessed 31 July 2024.
30. Jakab, Spencer. "Why Your Favorite Restaurant Might Close." Wall Street Journal, 13 Jan. 2023, www.wsj.com/articles/chain-restaurant-local-restaurant-closing-11673616374. Accessed 8 Aug. 2024.
31. Jamie. "The Future of Dining: Integrating Tech for Unforgettable Guest Experiences - Libro." Libro, 1 Mar. 2024, librorez.com/en/resources/the-future-of-dining-integrating-tech-for-unforgettable-guest-experiences/. Accessed 6 Aug. 2024.
32. Johnson, Hollis. "We Tried the Kiosks That Analysts Say Could Help McDonald's Win Back \$2.7 Billion in Sales. Here's the Verdict." Business Insider, 26 July 2018, www.businessinsider.com/mcdonalds-kiosk-vs-cashiers-photos-2018-3#so-which-is-better-im-used-to-the-kiosks-so-i-prefer-theyre-faster-more-accurate-and-make-things-easier-to-customize-and-since-workers-are-there-to-help-if-youre-confused-i-fail-to-see-how-it-takes-away-jobs-as-of-now-20. Accessed 5 Aug. 2024.
33. Kazarian, Kristen. "Robots Reach for Food Processing | Food Engineering." Food Engineering Magazine, 18 Apr. 2022, www.foodengineeringmag.com/articles/100208-robots-reach-for-food-processing. Accessed 9 Aug. 2024.
34. Keller, Maura. "The Top 4 Challenges Facing Restaurants in 2024." Bar and Restaurant News, 2 May 2024, www.barandrestaurant.com/operations/restaurant-industry-challenges-2024-and-beyond. Accessed 17 July 2024.
35. Kelso, Alicia. "Study: Consumers' Restaurant Budgets Fell 10% in Two Years." Nation's Restaurant News, 13 May 2024, www.nrn.com/consumer-trends/study-consumers-restaurant-budgets-fell-10-two-years. Accessed 8 Aug. 2024.
36. Keong, Chia Han. "Smart Robots Help F&B Businesses Deal with Manpower Shortages." Yahoo News Singapore, 14 Nov. 2022, sg.news.yahoo.com/smart-robots-help-fb-businesses-deal-with-manpower-shortages-120704562.html. Accessed 9 Aug. 2024.
37. KEXY, Team. "Major Pain Points for the Food and Beverage Industry on the Supplier Side." GetKexy, 12 May 2024, www.getkexy.com/distributor-blog/major-pain-points-for-the-food-and-beverage-industry-on-the-supplier-side#:~:text=generate%20more%20money.-. Accessed 19 July 2024.
38. Kim, H, and H Qu. "The Impact of Technology on Operational Efficiency in the Foodservice Industry. ." Journal of Foodservice Business Research, vol. 24, no. 1, 2021, pp. 23–38.
39. Klein, Danny. "Fast-Food Trends for 2024: The Age of Automation and Customer Experience." QSR Magazine, 12 Dec. 2023, www.qsrmagazine.com/slideshow/fast-food-trends-for-2024-the-age-of-automation-and-customer-experience/#:~:text=In%202024%2C%20restaurants%20must%20be. Accessed 15 July 2024.
40. ---. "The State of Restaurants in 2024: Higher Costs, Higher Stakes." FSR Magazine, 23 Jan. 2024, www.fsrmagazine.com/feature/the-state-of-restaurants-in-2024-higher-costs-higher-stakes/. Accessed 8 Aug. 2024.
41. Krook, Dana. "Restaurant Cleaning: How to Properly Sanitize Your Restaurant." Touch Bistro, 26 Mar. 2024, www.touchbistro.com/blog/restaurant-cleaning/#:~:text=According%20to%20QSR%20Magazine%2C%20guests. Accessed 31 July 2024.
42. Kubiak, Agata. "Why Do Restaurants Fail? (Restaurant Success & Failure Rate)." UpMenu, 3 Apr. 2024, www.upmenu.com/blog/why-do-restaurants-fail/#:~:text=According%20to%20CNBC%2C%20approximately%2060. Accessed 8 Aug. 2024.
43. Lawrence, Ainsley. "Implementing Traceability Systems in Restaurants - FoodSafetyTech." Food Safety Technology, 6 May 2024, foodsafetytech.com/feature_article/implementing-traceability-systems-in-restaurants/. Accessed 8 Aug. 2024.
44. Lin Engineering, Team. "Exploring New Robots in Food Preparation, Serving, and Delivery | News." Lin Engineering, 27 Apr. 2023, www.linengineering.com/news/revolutionizing-the-food-and-beverage-industry-exploring-new-robots-in-food-preparation-serving-and-delivery. Accessed 8 Aug. 2024.
45. Littman, Julie. "Why QSRs Are Doubling down on Kiosks." Restaurant Dive, 27 Nov. 2023, www.restaurantdive.com/news/qsrs-burger-king-taco-bell-el-pollo-loco-shake-shack-doubling-down-kiosks/700564/. Accessed 5 Aug. 2024.
46. McDermott, Kristen. "Understanding the Importance of Restaurant Cleanliness." LinkedIn, Summit Facility Solutions, 23 Feb. 2023, www.linkedin.com/pulse/understanding-importance-restaurant-cleanliness-kristen-mcdermott#:~:text=In%20fact%2C%20a%20study%20by. Accessed 31 July 2024.
47. Meyer, Danny. Setting the Table. Harper Collins, 13 Oct. 2009.

48. MRM Staff. "Best Practices for Handling a Data Breach | Modern Restaurant Management | the Business of Eating & Restaurant Management News." Modern Restaurant Management, 5 Aug. 2024, modernrestaurantmanagement.com/best-practices-for-handling-a-data-breach/. Accessed 7 Aug. 2024.
49. Multiteria, Team. "Why Restaurants Are Important to Local Economies." Multiteria, 26 Jan. 2021, www.multiteriausa.com/blog/why-restaurants-are-important-to-local-economies/. Accessed 7 Aug. 2024.
50. National Restaurant Association. 86 Food Waste, Managing Food Waste in Restaurants. National Restaurant Association, WWF, TORO, 2021.
51. Nolan, Marissa. "5 Trends in the Restaurant Industry to Watch in 2024." Mastercard Data & Services, 27 Feb. 2024, www.mastercardservices.com/en/advisors/consumer-engagement-loyalty-consulting/insights/5-trends-restaurant-industry-watch-2024. Accessed 4 July 2024.
52. Parvez, M. Omar, et al. "Employees' Perception of Robots and Robot-Induced Unemployment in Hospitality Industry under COVID-19 Pandemic." International Journal of Hospitality Management, vol. 107, no. 103336, Oct. 2022, p. 103336, <https://doi.org/10.1016/j.ijhm.2022.103336>.
53. Pay, Kade. "NY Restaurant and Foodservice Show 2023." Clarionevents.com, 17 Feb. 2023, events.clarionevents.com/IRFSNY2023/Public/eBooth.aspx?IndexInList=70&FromPage=Exhibitors.aspx&ParentBoothID=&ListByBooth=true&BoothID=834262. Accessed 8 Aug. 2024.
54. Restaruant 365, Team. "Annual State of the Restaurant Industry Survey for 2024." Running Great Restaurants, Restaurant365, 1 Jan. 2024, www.runninggreatrestaurants.com/articles/annual-state-the-restaurant-industry-survey-2024. Accessed 7 Aug. 2024.
55. "Restaurant Robotics: How Robots Are Changing Foodservice." Aaron Allen & Associates, Global Restaurant Consultants, 29 July 2022, <http://aaronallen.com/blog/restaurant-robotics>.
56. Rogelberg, Sasha. "Restaurant Robots Are the "Vanguard of Automation," Top Analyst Says. It's Not Coming for Fast-Food Workers' Jobs—It's Actually Helping Them." Fortune, 23 Mar. 2024, fortune.com/2024/03/23/restaurant-robots-automation-workers-kernel-ai-bank-of-america/. Accessed 7 Aug. 2024.
57. Saleem Khatri. "POS Systems: The Backbone of Restaurant Tech | Modern Restaurant Management | the Business of Eating & Restaurant Management News." Modern Restaurant Management, 24 Mar. 2020, modernrestaurantmanagement.com/pos-systems-the-backbone-of-restaurant-tech/. Accessed 7 Aug. 2024.
58. Staff, T. R. D. "14% of Restaurants Closed Permanently because of Pandemic." The Real Deal, 19 May 2021, therealdeal.com/national/2021/05/19/only-14-of-restaurants-closed-permanently-because-of-pandemic/. Accessed 9 Aug. 2024.
59. Tarr, Chris. "Serving up the Future: How Robots Are Revolutionising the F&B Industry." E27, 5 Dec. 2022, e27.co/serving-up-the-future-how-robots-are-revolutionising-the-fb-industry-20221127/. Accessed 8 Aug. 2024.
60. Tuomi, Aarni, et al. "Service Robots and the Changing Roles of Employees in Restaurants: A Cross Cultural Study." School of Hospitality and Tourism Management, vol. 17, no. 5, 31 Jan. 2020. e-Review of Tourism Research.
61. Tussyadiah, Iis P., et al. "Applications and Implications of Service Robots in Hospitality." Cornell Hospitality Quarterly, vol. 62, no. 2, 25 May 2020, p. 193896552092396, <https://doi.org/10.1177/1938965520923961>.
62. Ujwal Subedi. "The Hidden Costs of Outdated POS Systems and How to Avoid Them - DibTech." DibTech, 29 July 2024, dibtech.com.au/hidden-costs-of-outdated-pos-systems/. Accessed 9 Aug. 2024.
63. Watkins, Erin. "5-out | How AI and Machine Learning Improve Restaurant Inventory Management." 5Out, 24 July 2024, www.5out.io/post/how-ai-and-machine-learning-improve-restaurant-inventory-management. Accessed 7 Aug. 2024.
64. Winer, Lee. "Food and Beverage Industry Challenges in 2024." FactBird, 14 Mar. 2024, [http://www.factbird.com/manufacturing-matters-podcast/challenges-facing-food-and-beverage-industry-2024](https://www.factbird.com/manufacturing-matters-podcast/challenges-facing-food-and-beverage-industry-2024).
65. Zabin, J. "Despite Advances in Technology Aimed at Restaurant Sustainability, Food Waste Remains a Major Problem |." Restaurant Technology News, 22 Apr. 2024, restauranttechnologynews.com/2024/04/despite-advances-in-technology-aimed-at-restaurant-sustainability-food-waste-remains-a-major-problem/. Accessed 7 Aug. 2024.



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