WHITE PAPER

AUTONOMOUS-FIRST TECH: HOW RETAIL CAN PIVOT TO AUTONOMOUS STORES

Infosys®
Navigate your next

Executive Summary

This is the age of autonomy, with autonomous devices from driverless vehicles to sentient fridges becoming ubiquitous. As technologies simplify or eliminate remedial processes, routine tasks are being undertaken without human intervention. Autonomous shopping technology empowers consumers and retailers to delegate significant parts of the shopping process.

Retailers are capitalizing on autonomous technologies to enable a frictionless shopping experience for consumers right from check-in to delivery. Moreover, data and actionable insights generated from these systems simplify store operations, optimize inventory and reduce store labor cost.

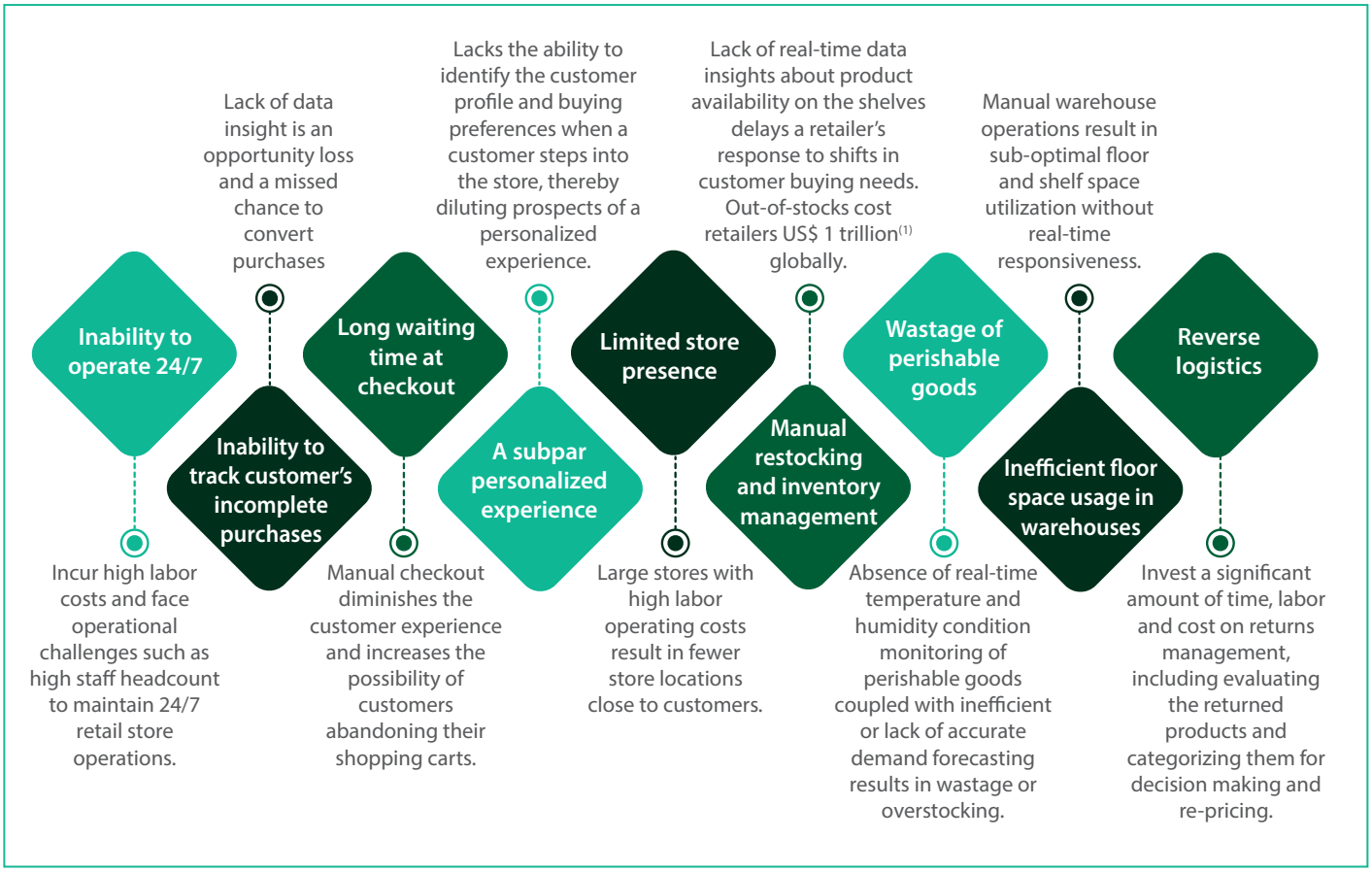
The Covid-19 pandemic has altered lifestyles, including how consumers shop. Autonomous stores are welcomed by consumers as it enables speed, ensures social distancing and facilitates contactless shopping, thereby making shopping a safe and convenient experience.

Current scenario

Shifts in technology have reshaped the retail landscape, as evidenced by changes in the customer's shopping journey and preferences. Competition has intensified with the advent of digital native retail enterprises. It has compelled retailers to reimagine the dynamics of physical retail. While online and eCommerce is growing, retail stores still form a significant portion of the business, and continue to be relevant for the retail industry. If retailers lack the agility to innovate in stores, it will risk their ability to compete effectively.

Challenges faced by traditional retail stores and warehouses

Traditional retail continues to face several challenges:



Automation – The way forward

Brick and mortar retailers need to provide value addition to customers. Tech savvy customers are always seeking value beyond online shopping. They expect traditional retailers to adapt to their needs. Retailers need to adapt to modern shopping trends for sustaining their business. For a sustainable retail business model, an automation model is the way forward.

The shift due to the pandemic has made innovation a business imperative with retailers accelerating the adoption of autonomous stores, which is expected to reach US$ 26 billion by 2026.[2]

Autonomous stores

Autonomous stores provide customers with convenience and safety across the shopping experience. Essentially, these brick and mortar stores integrate technology in daily store interactions to ensure an efficient customer experience. Store automation covers large parts of the value chain, from a seamless check-in to a technology suite that enhances store operations to a seamless checkout.

75% of shoppers want an autonomous shopping experience, according to Loss Prevention Magazine.

Customer journey in autonomous stores

In a traditional retail store, the store assistant performs a crucial role from arranging stocks to assisting customers till checkout. Customers also need assistance when they are shopping in-store. Autonomous retail store operations reduce the intervention of a store assistant and empower customers to shop independently.

Store of the future

Personalized recommendation

1) Digital kiosk
For a small basket size, digital kiosk is a practical solution for swift checkouts

2) Digital signage
Allows innovative interaction with customers and deeper engagement

3) Interactive devices
Provide reviews, product information and offers as customers browse online

Seamless checkouts

4) Fraud detection at checkout points
Use facial recognition / RFID or technologies to detect fraud

5) Scan and go
Scan products and check out the product directly via an app

Extended checkout options

6) Click and collect
In-store pick up of goods ordered online via walk up window

7) Curbside pick up
Collect products via drive through

Technologies for enhancing Store tasks

8) Automated pickers and packers
Use robotic / semi robotic technologies to enhance the work of human pickers

9) Electronic shelf labels
Enable retailers to display dynamic product pricing on shelves

10) Cleaning robots
Handles routine cleaning activity

Omnichannel fulfillment

11) Automated fulfillment centers
Use of non-customer facing areas for automated picking and online order fulfilment

12) Dark store
Turn your unused space of brick-and-mortar store into a center for fulfillment of operations

Business scenarios

Picture a customer walking into an autonomous store. At check-in, the retailer can initiate the customer's entry using methods such as scanning the QR code from an app, facial recognition, finger vein capture or smart card.

Strategically placed cameras within the store detect and capture the entry. In the videos, deep learning models detect the entry of customers.

Cameras placed within the store capture footfalls, which is used for tracking data insights such as time spent at the aisle for each product, products in demand, crowd analysis, etc. Each customer is tracked across the store and monitored for compliance of Covid-19 safety protocols in the store.

Computer vision applications such as retail heat map technology uses real-time imaging to sense movements and assign colors related to the volume of traffic for each floor in the store. Purchase pattern identification, areas of peak movement in the store, and customer affinity towards certain products are recognized, allowing retailers to make informed decisions about store layout and product placement.

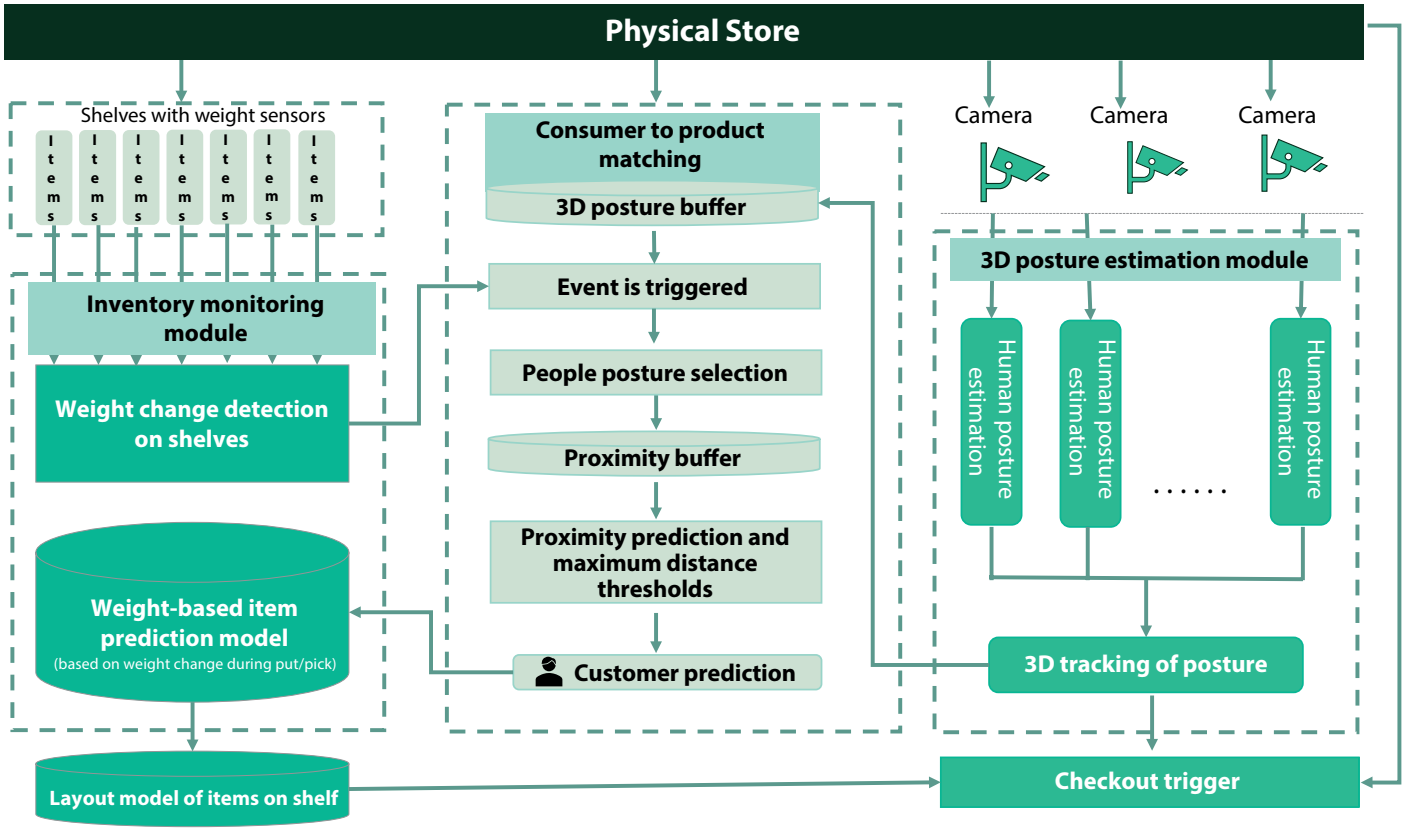
For privacy reasons, should a customer opt out of the facial recognition program, the store can adopt anonymous shopper tracking. The cameras can be trained using machine learning algorithms to identify positions and generate 3D images. When the customer begins this journey, a random ID is assigned to the customer to keep track of movement within the store.

Self-identification Technologies

Retailers such as Sephora, ATU Duty Free use heat maps to track customer activities, test new strategies related to merchandising, and experiment with store layouts.

When the shopper is moving across aisles, browsing through shelves, and picking or putting products back on the shelf in the autonomous store, the retailer's product mapping software, combined with computer vision and deep learning models trace the movement and actions.

Conceptual architecture for customer-product recognition



When the customer picks fresh or packaged products from the shelf, the model supported by weight sensors, cameras, and digital technologies adds the tally on a mobile app. The virtual cart on the app calculates the bill based on the final items in the physical cart.

Let us find out how the autonomous store manages multi-human and multi-product matching. Essentially, when the customer walks in the field of view of more than one camera, (s)he gets an anonymous ID assigned. When the customer picks up a product from a shelf, it triggers inventory monitoring and multi-human to multi-product matching pipelines. With deep knowledge of the physical model of the store, the system understands the 3D location of the product being picked up.

Some retail stores incorporate RFID tracking devices in carts using radio waves to read and transfer data from small chips to a reader equipped with an antenna. The reader transmits the data to an asset tracking system where it is stored, evaluated, and provides actionable insights. It enhances the customer experience as well as prevents the possibility of theft and shoplifting.

In addition to carts, even shelves have in-built intelligence. Smart shelves track inventory of products in real time. When smart shelves are integrated with inventory management and POS systems, it provides actionable insights to retailers. Smart shelves also work as 'electronic labels' displaying real-time product prices.

Robots scan shelves and optimize product placement and availability. In addition, smart interactive devices engage with customers to reduce the dependency on store associates.

How Kroger benefited from smart shelves?

Kroger launched 'electronic shelves' by integrating with Edge, an electronic shelf label solution, in partnership with Microsoft. It allowed Kroger to provide information related to nutritional value of the product, promotional offers and real-time prices which helped drive sales as well as customer engagement.

Retailers bleed due to theft and shoplifting. Computer vision and ML-based algorithms reduce theft at counters and detect suspicious behavior. By identifying each product picked or placed back during shopping, tracking virtual cart and connecting these actions with a transaction, loss of products can be prevented.

Moreover, computer vision improves geofencing allowing customer recognition, thereby enabling personalized recommendations and discounts based on purchase history. The availability of a digital signage or digital kiosk offers brand insight about customers, promotional offers, and relevant product details that a customer may not be aware of.

In this manner, retailers can learn and track the promotions gaining traction and others that customers are not responding to. It can be used to push personalized messaging and marketing campaigns. Customer insights are captured at each point where they interact with any display, shelf, or kiosk at the store.

All in all, computer vision coupled with AI enables:

- **Intelligent markdown optimization**

  Predicts the ideal pricing for each product based on current and historical transaction, inventory data, business rules, internal and external company data, budget targets, and planned promotions. Built-in integrated workflow engines augment the decision-making process and implementation of price-labeling.

- **Shrinkage reduction**

  A small portion of shrinkage can be attributed to unexpected markdowns. It can be resolved by automating inventory tracking to lower costs

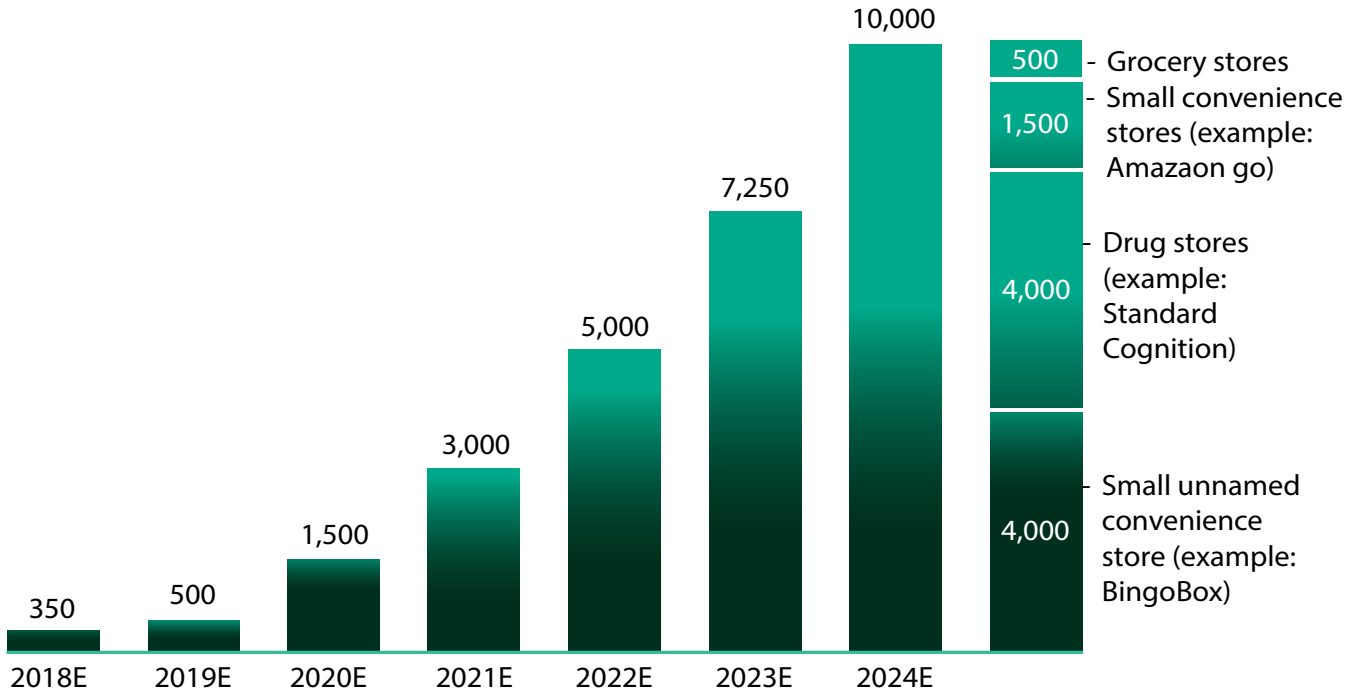
Finally, after picking the chosen products, the customer walks to the checkout counter. In a traditional brick and mortar store, checkout is a major pain point for both retailers as well customers. When there are high footfalls, long queues for checkout result in loss of a potential conversion. Automating checkout or providing extended checkout options helps address this pain point.

When the customer completes shopping, either a designated frictionless checkout area or digital wallet charges the customer. In other store configurations, a POS kiosk can virtually auto-populate the cart for checkout, allowing the customer to use payment methods such as cash and credit.

Stores with autonomous checkouts are set to increase to 10,000 by 2024. [3]

Infosys provides retailers with technological support to kickstart their 'just walk out' journey.

Global Store with Autonomous Checkouts



Source: Business Insider Intelligence estimates

In autonomous stores, the checkout journey of a customer takes a linear route:

1. **Biometric authentication:** Enable biometric kiosks for faster checkout.
2. **RFID checkout:** Pre-tag all items in the store with RFID tags. The RFID reader scans every item, thereby saving the customer's time during checkout.
3. **Smile to Pay:** Use facial recognition technology to activate payments.
4. **Scan-and-go:** Customers use a mobile device or portable scanner to scan items as they place items in a shopping cart. For checkout, they can either pay at a POS terminal or use online payment options
5. Click-and-collect

   Also known as 'buy online, pick up in store', it uses eCommerce and retail software solutions combined with in-store pickup. Compared with traditional delivery, click-and-collect reduces transportation costs. Click-and-collect is set to increase by 45% by 2023.[4]
6. Mobile checkout

   Mobile checkout stations allow customers to check out anywhere in the store. It is equipped with an item scanning portable device and payment processing technology.

How Amazon Go stores operate?

Challenges with fully automated stores

A new technology is bound to take time for mainstream adoption by consumers. In addition, other factors influence solution implemention:

1. **Variable store layouts** – Every store has a unique layout. However, when it comes to larger stores such as Walmart or Whole Foods Market, it becomes challenging to track shoppers and products.

2. **Retrofitting existing stores** – Installations of cameras or sensors is a time-consuming process as it requires retailers to remove all stock from shelves and then re-stock. In addition, it is almost impossible to prevent shoppers from displacing products, which in turn confuses sensors on the shelves.

3. **Expensive solution** – Adopting an autonomous-first solution requires significant capital expenditure.

How can retailers evolve and accommodate rising customer expectations?

Retailers can adopt a lightweight or hybrid autonomous shopping solution. These solutions blend human intervention with digital technologies such as computer vision to deliver a superior customer experience.

Hybrid convenience store AI GO

The store powered by computer vision technology allows tracking shoppers and products picked and placed back by shoppers using gestures. The unmanned checkout is available 24/7 and traditional checkout via cashier is available during daytime. The anonymous shoppers receive bills when they leave the store.

The hybrid solutions allow customers to gradually shift to autonomous shopping rather than pivot to autonomous from day one. It gives them sufficient time to get used to the new technology. Using a hybrid model, the retailer can maximize in-store manhours and grow the revenue. It also enables the retailer to introduce innovative ways to interact with shoppers and support them till they are comfortable to manage these journeys independently.

Other autonomous store concepts

Micro stores / Nano stores

Micro stores or fulfillment centers involve micro-retailing. It is a retail model of small-scale, pop-up shops that helps leverage several innovative downsized activities. The pandemic effected a shift to online shopping, which enabled retail stores to allocate significant store space to a micro fulfillment center (MFC). This trend not only allows retailers to transform a portion of their retail stores into mini centers for distribution but also provides an in-house solution to address complexities in distribution. MFCs reduce manual work otherwise undertaken by workers supported by robots. It allows store workers to prioritize tasks and drive process efficiencies.

MFCs rationalize space (barely 20,000 square feet). Moreover, since they do not have stringent construction requirements, they are a viable option for grocers. Their products are either exclusively available online or are direct-to-consumer (DTC), helping retailers reduce the number of brands stocked.

Moreover, since micro stores do not have much real estate for inventory, these stores ensure that the customer's journey in an MFC is memorable by leveraging technological innovations such as digital mirrors.

Micro-retailing not only helps create locally curated, in-person customer experiences but also allows retailers to tailor assortments to local buyers. It drives convenience, enables omnichannel shopping, and leverages robotics to personalize the shopping experience.

Dark stores

During the pandemic, industry research revealed that 49% of shoppers were focused on product availability compared to quality or even price.[5] It signified a change in the interest of customers, and created demand for dark stores. Essentially, a dark store is a retail space for the purpose of completing online orders of consumers while not being open for in-store shopping.

Apart from dark stores dovetailing a contactless shopping experience, they benefit retailers in several ways:

Inventory can be easily managed by spreading it across multiple dark stores. If a product is sold out in one dark store, retailers can dispatch last mile deliveries to fulfill orders from another store location. The modern business imperative is fast fulfillment. A retailer benefits by paying low operating costs in a hybrid dark fulfillment center where retailers offset their capital expenditure by offering online shopping along with faster and more economical delivery options compared to a traditional physical store.

Several shopping malls, grocery stores and big box retailers such as Walmart are exploring mini dark fulfillment centers, while grocery chains are evaluating a semi dark or hybrid approach where customers place their orders online for pickup, while still roaming the aisles. The concept of dark stores is gathering momentum with technology making them a compelling proposition for retailers to use them as fulfillment centers. Warehouse technology startups such as Fabric and Alert Innovation are working with retailers to integrate new technologies such as robotics and adding products into smaller, robot-specific places.

As autonomous technology covers a lot of ground, retailers need to implement a solution that works best for them by partnering with a domain expert to realize the potential of autonomous solutions.

Infosys can help

Infosys partners with retailers to adopt an accelerated, go-to-market strategy. Our team implements advanced technology solutions after validating business cases through market feedback. We scale the solution with incremental modular rollouts, thereby mitigating risks and managing costs.

Infosys engagement model

Build on existing platform	Buy and integrate	Hybrid (Buy and build in parallel)
Infosys and partners bring core platforms including code, models, build / deployment pipelines	Buy solution from established vendor	Buy solution from established vendor
Build client-specific use cases and integrations on top of these platforms	Infosys works with vendor to integrate solution with client backend systems / platforms	Infosys works with vendor to integrate solution with client's backend systems / platforms
Client has complete control over the solution lifecycle	Lifecycle is vendor dependent	Launch few stores to validate the business case
Client can reuse existing hardware and assets	Requires hardware based on vendor specification due to lack of interoperability	Meanwhile, Infosys and partners bring core platforms including code, models, build / deployment pipelines
Longer time-to-market	Faster and predictable time-to-market	Build client-specific use cases and integrations on top of these platforms
High initial investments with significant reduction after increase in volume	Initial investments will be predictable	Client switches to the above build solution option based on value realization and future roadmap

Infosys invests in research and development to develop innovative autonomous store solutions for retailers by contextualizing modern and emerging market technologies. Leveraging design thinking and technology, Infosys empowers retailers to keep pace with changing market dynamics and competition.

Infosys partner ecosystem

Infosys has partnered with multiple start-ups and market leaders to develop autonomous solution capabilities. A partner is recommended from the Infosys Innovation Network for various autonomous store initiatives based on relevant solution capabilities.

Partners and solution fit

Solutions	Solution Fitment
Wanzl	Fully autonomous store / dark store / micro autonomous store
Berkshire Grey	Fully autonomous store / dark store
Geek+	Fully autonomous store / dark store
Vantiq	All store formats
AWM	Grab and go store
Niflr	Grab and go store
Rozum	Micro autonomous store
DMVI	Micro autonomous store
Just Walk Out technology by Amazon	Autonomous stores

The bottom line

Autonomous store technology is being considered as an alternative to manned stores. The Covid-19 pandemic has intensified interest in autonomous and dark stores.

Autonomous technology has come a long way. However, more research is required to address theft and manual overrides.

Retailers are applying innovative concepts to deliver a seamless customer experience. While retrofitting a store involves a high up-front cost, in the long run, autonomous technology can maximize retail efficiency and boost profit margin.

About the Authors

Santhosh Subramaniam

Senior Industry Principal, Domain Consultancy Group, Retail, CPG and Logistics Practice

Santhosh_Subramaniam@Infosys.com

Satyajit Bhowmick

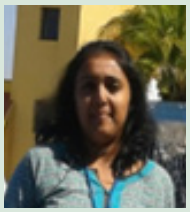
Industry Principal, Domain Consultancy Group Retail, CPG and Logistics Practice

satyajit.bhowmick@infosys.com

Gaurav Saxena

Principal Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Gaurav_Saxena12@Infosys.com



Pooja Bhavanam Reddy

Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Pooja_Reddy01@infosys.com

Pulkit Grover

Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Pulkit.Grover@infosys.com

Meenakshi Rampati

Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Meenakshi.Rampati@Infosys.com

Ashwija Satishchandra Shetty

Sr. Associate Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Ashwija.Shetty@Infosys.com

Neha Jain

Associate Consultant, Domain Consultancy Group, Retail, CPG and Logistics Practice

Neha.Jain59@infosys.com

References

1. https://hbr.org/2020/10/what-robots-can-do-for-retail
2. https://mitefcee.org/autonomous-retail-tech-trends-2021/
3. https://intellias.com/autonomous-checkouts-the-future-of-retail/
4. https://www.marketingweek.com/how-covid-19-has-changed-shopper-behaviour/
5. https://www.businessinsider.com/in-store-checkout-report?IR=T
6. https://www.mckinsey.com/industries/retail/our-insights/automation-in-retail-an-executive-overview-for-getting-ready
7. https://www.zdnet.com/article/robot-store-concepts-proliferate-during-pandemic/
8. https://www.hitachivantara.com/blog/building-future-of-brick-mortar-one-autonomous-shop-at-time/
9. https://mobidev.biz/blog/7-technology-trends-to-change-retail-industry
10. https://www.mytotalretail.com/article/the-store-of-the-future-how-to-evaluate-the-value-of-autonomous-technologies/
11. https://acuvate.com/blog/retail-technology-trends-2021/

12. https://www.perchinteractive.com/retail-marketing-blog/smart-shelves

13. https://supplychaindigital.com/supply-chain-risk-management/top-10-automated-warehouses

14. https://www.fortna.com/insights-resources/seven-types-of-warehouse-robots-considerations-for-leveraging-robots-in-the-dc/

15. https://searchenterpriseai.techtarget.com/feature/Autonomous-retail-cuts-operational-costs-personalizes-shopping

16. https://vantiq.com/why-vantiq/

17. https://viso.ai/applications/computer-vision-in-retail/

18. https://awm.tech/frictionless-shopping.html?utm_source=google&utm_medium=cpc&utm_content=ac-a1&utm_campaign=ac&gclid=EAIaIQobChMIj-Dajcbn9AIVY5pmAh0GHQ9WEAAYASAAEgINUPD_BwE

19. https://www.businessinsider.in/retail/news/the-worlds-biggest-camera-operated-autonomous-store-has-opened-in-shanghai-this-is-how-it-works-/articleshow/81258411.cms

20. https://www.geekplus.com

21. https://www.greyparrot.ai/

22. https://losspreventionmedia.com/autonomous-shopping-experience/

23. http://www.berkshiregrey.com/

24. https://www.wanzl.com/en_IN

25. https://www.digitalmediavending.com/

26. http://www.niflr.com/

27. https://rozum.com/

For more information, contact askus@infosys.com

Infosys®
Navigate your next