

Systematic Review of Cashierless Stores (Just Walk Out Stores) Revolutionizing The Retail

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Abstract. *The paper aims to examine the evolving retail sector in recent years, specifically how digitalisation and technological innovations have transformed it. All actors have had to adapt to remain competitive. Notably, a new innovation in the retail sector, namely the checkout-free or cashierless store, emerged in 2018. Systematic literature is relied upon to achieve the study's objectives. The significance of this study lies in the use of multiple IT tools such as AI, cameras, sensors, and self-organising shelves to replace human intervention in the retail sector. Globally, several startup companies have developed this new unmanned solution, and Amazon Go stands out as one of the most well-known among them. The primary objective of this pioneering concept is to enhance efficiency by saving time and reducing queues. The aim is to enable customers to enter and exit the store with minimal human contact as quickly as possible. This paper presents the recent trend of the cashierless concept, its evolution, and proliferation. A systematic literature review and data analysis from the Crunchbase Database were conducted. The findings demonstrate that this recent concept is altering both consumers' purchasing behaviours and companies' business models. This paper provides novel perspectives and insights into the wider literature on cashierless concepts and smart retail in the context of digital business.*

Keywords: cashierless stores, just walk out shopping, smart retail, AI, entrepreneurship research, startup, Hungary.

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Introduction

With the emergence of free-market capitalism in the 19th century, shop selling became dominant, followed by the emergence of large-scale enterprises in the 20th century, as a result of the concentration of capital in the retail sector. As a consequence of the Great Depression, the self-service sales form emerged in the 1930s. With the exception of a few products (e.g. meat), service in these new types of shops is not at the counter, allowing faster service, a larger selection, and a reduction in the number of employees (Cochoy, 2015; Morrison, 2023; Gelencsér et al., 2023). Retailers are constantly trying to develop new ways to provide better service to their customers and to make it easier and safer to use (Preda et al., 2009). Thanks to digitization, the technologies that support shopping have recently become more and more advanced, just think of the tools that support shopping: payment options or even smartphone apps, online shopping that offer a shopping experience. Developers have come up with novel technologies and concepts for modern societies in the 21st century in the hope of providing a better and safer shopping experience (Schögel & Lienhard, 2020; Purwantono et al., 2021). Thus, these innovative ventures are gaining ground (Dankó & Hajdú, 2019; Ton et al., 2022).

This has led to the development of technologies such as self-service techniques in retail stores, which include self-service checkout machines and self-scanning devices (Sharma et al., 2021) are now commonly available in retail (Schuman, 2014). The impact of self-service checkouts on consumer behavior has been widely researched (Dabholkar et al., 2003, Alexander et al., 2009; Schlieve & Pezoldt, 2010; Creighton et al., 2015). Research on the use and experiences of self-service checkouts remains limited and arguably requires further investigation (Bulmer et al., 2018). In Sharma et al. (2021), they examined the impact of self-service technologies on customer satisfaction in Great Britain and Australia and found that the level of development of self-service checkout use in retail stores has only a marginal impact on overall ratings of retail store and customer experience, with frontline staff in supermarkets still appearing to be more relevant.

Based on market dynamics and market estimations, the number of unmanned stores would probably grow globally in the future (Paraschiv et al., 2022; Globe Newswire, 2023). In scientific publications no comprehensive literature analysis about the global presence of unmanned smart shops has yet been carried out. Based on literature reviews of our previous research and further research needs in this topic (Bulmer et al., 2018), the question arises whether the location of scientific research is consistent with the location of technology expansion. In this sense, whether there is a research gap that points to the countries in which the adoption of the technology under study is worth investigating. Identifying geographical areas where the presence of the technology has not been investigated is important, as cultural, income, and generational differences could influence technology acceptance.

Thus, this paper clarifies the following research questions (RQ):

RQ1: How intensively is the cashierless store concept already being investigated in scientific research, especially in the retail?

RQ2: In which countries has there been scientific research on unmanned smart shops?

RQ3: Where are the startups located that provide technology for the cashierless concept?

The rest of the paper is organized under the following sections. Literature Review, the research methodology is explained. The results and conclusions of the study are finally presented.

Literature review

With the development of artificial intelligence (AI), machines today can use technologies such as computer vision and deep learning to take photos or videos, process and analyze them, and thus understand their environment (Türegün, 2019). Based on these technologies the first unmanned physical store of Amazon GO opened in 2017 as a grocery store in Seattle, WA (Polacco & Backes, 2018). The customers in the shop are using a mobile app on their smartphone, and while they shop inside the store a sophisticated mix of AI technologies records their moves and recognizes them as buyers of the products and when they leave the shop, they just walk out and are automatically charged for the products they have bought (Yfantis et al., 2020). Several startups have developed similar technologies (Szabó-Szentgróti et al., 2023).

The onset of the COVID-19 outbreak generated an extraordinary acceleration that emerged over the past five years (Savastano & Anagnoste, 2020) and in the upcoming years it is expected to have a strong upward trend (Paraschiv et al., 2022). The smart retail market is forecasted to reach \$111.19 billion by 2029, projected to grow at a compound annual growth rate (CAGR) of 21 percent (2022-2029) (Globe Newswire, 2023). As noted by Dumanska et al. (2021), it is important for both academics and practitioners to explore new ways to address the identified challenges in the development of e-commerce and m-commerce by protecting vulnerable consumers, while also exploring innovative business models for e-commerce (Paraschiv et al., 2022).

As usual after the birth of a new phenomenon, many new definitions have emerged among researchers and professionals. Researchers have been studying the topic since 2018, when the Amazon Go prototype store opened. Several terminologies are known in the literature for this new technology: 'cashierless store', 'cashierless concept', 'Amazon Go' as the first operational store, and the terms Amazon uses for 'Just walk out technology'. Other terms are also used in international terminology, such as "unmanned convenience store", "walk-in walk-out store", "frictionless shopping", "smart store", "automated shop", "self-service store" and "no-checkout store". Table 1 summarizes the different terminologies used for the new technology.

Table 1. The terminologies of the new technology

Terminology	Source
Amazon Go	Tsumori et al. (2018), Türegün (2019)
automated shop	Bartl et al. (2022)
cashierless concept	Ponte and Bonazzi (2021, 2023)
cashierless store	Falcão (2020), Gazzola et al. (2022)
cashierless convenience store	Ives et al. (2019), Ruiz et al. (2019), Dominguez (2019), Zhang et al. (2023)
frictionless shopping	Quinones et al. (2023)
grab and go	Cui and van Esch (2022)
just walk out technology	Tsumori et al. (2018), Ives et al. (2021)
no-checkout store	Vandeveld and Whipp (2016), Singh et al. (2020), Wang (2021), Shankar et al. (2021)
self-service store	Chen et al. (2022)
smart store	Huertos et al. (2021)
unmanned (convenience) store	Storekey (https://www.storekey.com/en/unmanned-concept)
walk-in walk-out store	Kudtarkar et al. (2023)

Source: Authors' own research.

Research methodology

In line with the goal of this paper, multimethod research was applied. Research using multiple qualitative or quantitative methods is called multimethod research (Király et al., 2014). A systematic literature review was used to answer the first two research questions (RQ1, RQ2) and a database analysis was conducted to answer the third research question (RQ3).

Systematic literature review

In the first part systematic literature review method was applied which is based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) concept (Moher et al., 2009). Keywords were identified via using Google Scholar where the following terms were acknowledged: Amazon Go; automated shop; cashierless concept; cashierless store; cashierless convenience stores; frictionless shopping; grab and go; just walk out technology; no-checkout store; self-service store; smart store; unmanned store; walk-in walk-out store. Literature uses these terms literally; therefore, verbatim keyword search was used to ensure results that are more precise.

After that, literature sources were extracted from the Web of Science and Scopus literature databases. Boolean operators were used and the exact applied Scopus advanced query key was the following:

(TITLE-ABS-KEY ("Amazon Go") OR TITLE-ABS-KEY ("automated shop") OR TITLE-ABS-KEY ("automated store") OR TITLE-ABS-KEY ("cashierless concept") OR TITLE-ABS-KEY ("cashierless store") OR TITLE-ABS-KEY ("cashierless shop") OR TITLE-ABS-KEY ("cashierless convenience store") OR TITLE-ABS-KEY ("frictionless shopping") OR TITLE-ABS-KEY ("grab and go") OR TITLE-ABS-KEY ("just walk out technology") OR TITLE-ABS-KEY ("no-checkout store") OR TITLE-ABS-KEY ("no-checkout shop") OR TITLE-ABS-KEY ("self-service store") OR TITLE-ABS-KEY ("self-service shop") OR TITLE-ABS-KEY ("smart store") OR TITLE-ABS-KEY ("smart shop") OR TITLE-ABS-KEY ("unmanned store") OR TITLE-ABS-KEY ("unmanned shop") OR TITLE-ABS-KEY ("walk-in walk-out store") OR TITLE-ABS-KEY ("walk-in walk-out shop")).

Web of Science (WoS) advanced query key was based on Scopus database query. While keeping the search focus, the database search key was adapted to the WoS search specifics. In literature 'store' and 'shop' expressions are used as synonyms, therefore both were applied in the query keys. Whereas Amazon Go launched its first unmanned store in 2018, selected publications were limited to publication years from 2018 to 2023. Language filter criteria must be applied to the database research to ensure quality and traceability, therefore only English-language scientific papers were considered (Table 2).

Table 2. Review Protocol

Item	Information
Research questions	RQ1: How intensively is cashierless store concept already being investigated in scientific research, especially in the retail? RQ2: In which countries has there been scientific research on unmanned smart shops?
Information sources	Google Scholar (keyword identification), Web of Science and Scopus (database evaluation).
Filter criteria	Publication date: 2018-2023
	Language: English
Research strategy	Selection process: only articles that deal with the analysed store type in the retail sector and involved geographical coverage (continent or country or city was mentioned) was selected.
Data synthesis	Qualitative synthesis: Articles were classified by topic, country, literature, and journal.

Source: Authors' own research.

Table 3. Filter results

Database	Total results	Year 2018-2023	English language	Limited to journals
Scopus	422	227	217	109
Web of Science	344	236	233	136
Total	766	463	450	245

Source: Authors' own research.

Altogether 766 papers were found based on title, abstract and keyword (specified by the author) research (Table 3). Hits were further limited by years of publication and language, and only peer-reviewed articles considered relevant. 245 results matched the search criteria, and these have been screened to detect duplications. Altogether 81 articles were excluded due to redundancy and the remaining 164 hits were analyzed on the basis of titles and abstracts. Irrelevant articles were excluded, when articles did not deal with unmanned stores. Finally, 47 articles were examined in detail. After revising the full text of 47 hits, 27 articles have been considered insignificant because they dealt with other aspects of smart retail or they analyzed the back-end technological development of unmanned technologies. As a final point, 20 articles were relevant for the systematic review where only articles that mention geographical coverage (either the continent or country or city was mentioned) of the analyzed store type in the retail sector were taken into account (Figure 1).

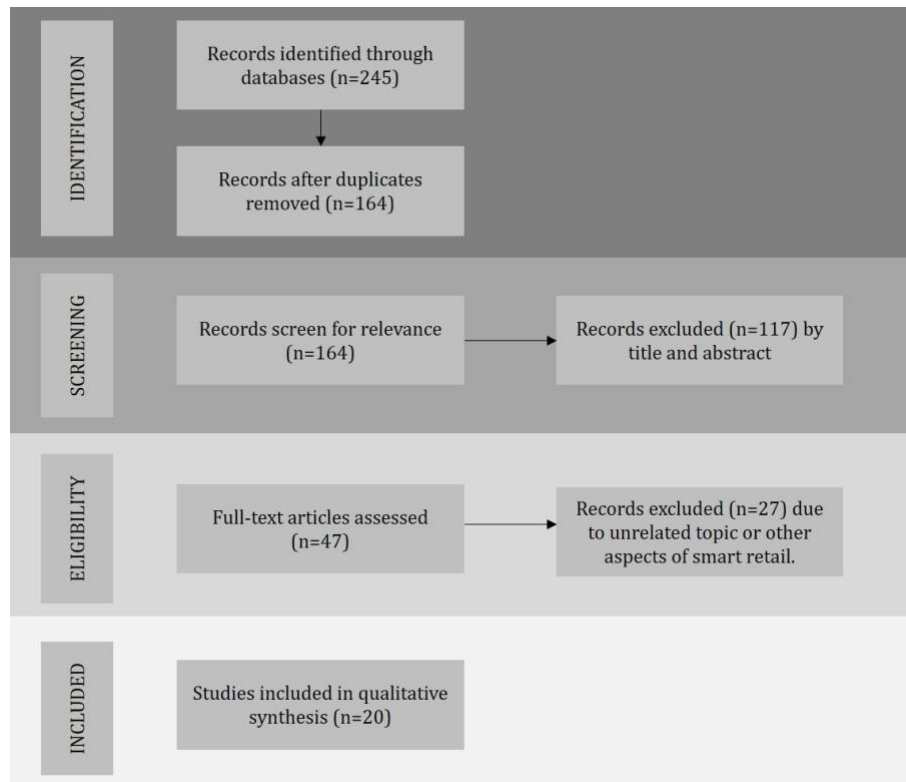


Figure 1. Paper screening process based on the PRISMA theory

Source: Own compilation based on Moher et al. (2009).

Crunchbase database and analysis

In the second part of the paper, to answer the RQ3, we conducted database analysis in the American Crunchbase database, which is the world's largest and most comprehensive dataset of high-tech companies and investors in the US (crunchbase.com). This database contains information on innovative startups with a focus on its potential for economic and managerial research (Dalle et al., 2017). Furthermore, Crunchbase ensures proper data quality, and several other studies have already used it (Marra et al., 2015; Dalle et al., 2017; Pisoni & Onetti, 2018; Weking et al., 2020). The database operates as a virtual marketplace, that means: the registered companies are responsible to keep the database up-to-date because the database works as an online platform, where investors and interested parties can search for startups. The database was filtered for startups founded after 2013, based on the startup definition of Kollmann et al. (2016) and for the startups with cashierless concept (Table 6). In addition to the use of the database, grey literature was also used to obtain up-to-date market information. As smart retail technology is still emerging, and there is a gap between promised and actual business value, this research allows for future research of several aspects.

Results and discussion

Systematic literature review

After the paper screening process (Figure 1) in total 20 articles were categorized by countries where research has been conducted, topic, literature, and by journal (Table 4). In terms of unstaffed smart shops, 8 countries were mentioned in some form in the databases examined.

Table 4. Summary of the most relevant literature

Country	Topic	Literature	Journal
USA	Amazon Go introduction	Ives et al. (2019)	Journal of Information Technology Teaching Cases
	Financial reporting in shops like Amazon Go	Türegün (2019)	Journal of Corporate Accounting and Finance
	Amazon Go analysis	Furnelli (2021)	CASE Journal
	Surveillance capitalism and convenience economy	Huberman (2021)	Economic Anthropology
China	Utilitarian and hedonic motivations and technology readiness (Bingo Box)	Chang and Chen (2021)	Journal of Retailing and Consumer Services
	Technology readiness (BingoBox and Tao Cafe)	Park and Zhang (2022)	Journal of Retailing and Consumer Services
	Self-service store location	Zhang et al. (2022)	Journal of Environmental and Public Health
	Service innovation, experiential relationship quality and shopping outcomes	Wu et al. (2022)	Journal of Marketing Communications
	Utilitarian and hedonic motivations in smart shops	Chang et al. (2023)	Industrial Management and Data Systems
Malaysia	Unmanned store app prototype design	Hamidi et al. (2020)	Indonesian Journal of Electrical Engineering and Computer Science
	Smart retail technology	Ng et al. (2019)	Young Consumers
Italy	Consumer behaviour analysis	Gazzola et al. (2022)	Sustainability
	Technology acceptance analysis (UTAUT)	Ponte and Bonazzi (2023)	Technology Analysis and Strategic Management
Taiwan	User experience	Lo and Wang (2019)	Sustainability
	Effects of informational-based readiness and customer readiness as well as social influence	Chen et al. (2022)	Asia Pacific Business Review
Thailand	Attitude and behavioural intention (TAM) analysis in JWOT (Just Walkout Technologies)	Chuawatcharin and Gerd Sri (2019)	International Journal of Public Sector Performance Management
India	Technology readiness and acceptance of AI-powered automated retail store (AIPARS)	Pillai et al. (2020)	Journal of Retailing and Consumer Services

South Korea	Environmental characteristics of unmanned stores	Soyeon (2023)	Journal of Distribution Science
Non-country-specific	Food accessibility in rural areas (collected good solutions: Sweden, China, USA)	Cometti et al. (2019)	Journal of Public Affairs
	Overview article (US, Sweden)	Lyster (2019)	Architectural Design

Source: Authors' own research.

United States of America

Amazon Go was launched in 2018 in the USA and has been the subject of numerous publications. With regards to our systematic literature review 4 hits were considered relevant, thus the store and USA as a location were mentioned in 4 articles. The concept of Amazon Go stores, including the convenience store industry, was introduced by Ives et al. (2019). Likewise, Furnelli (2021) focused on the Amazon Go concept. In her paper, Türegün (2019) analyses financial reporting questions in terms of technological development and introduces Amazon Go as a case study. The convenience economy has escalating unsettled questions about surveillance issues. Huberman (2021) expresses some concern about deals such as Amazon Go, saying that surveillance capitalism will develop in a way that serves its interests, however, she also highlights some positive side of shops monitored by artificial intelligence.

China

Chang and Chen (2021) conducted a survey in China to analyse the utilitarian and hedonic motivations affecting consumer shopping intention using hedonic information systems acceptance model (HISAM). Their research was carried out among the consumers of BingoBox, the largest chain of unmanned shops in China. BingoBox as a research site was also included in Park and Zhang's (2022) research alongside Tao Cafe. They investigated the role of technology readiness and the paradoxical mechanisms that influence user attitude and continuous usage intention of cashierless convenience stores. Unmanned store location selection problem was studied by Zhang et al. (2022), where Beijing was selected as their research site. Without mentioning specific brands, the authors note that in Beijing, unmanned shops are undergoing significant development. A survey in Wuhan was conducted by Wu et al. (2022) and it was about the relationships among the dimensions of service innovation, the dimensions of experiential relationship quality, and the dimensions of shopping outcomes. Respondents were asked from one of Wuhan located smart unmanned shops. Chang et al. (2022) underline the extent to which cashierless stores are a developing retail phenomenon and China plays a significant role in it. Concerning China, among the articles we have revised, Chang et al. (2022) make a clear distinction between the companies providing the technology (Cloudpick) and the companies using the technology. They also mention actors (Jian24) where both are present.

Malaysia

Mondo Smart Store was launched in 2021 as the first unmanned store in Malaysia. Hamidi et al. (2020) proposed a hypothetical cashierless store concept in their article in 2020, one year

before Mondo was opened. They also selected some examples from around the world, like Narrafar (Sweden), Bingo Box (China), and Amazon Go (USA). Smart retail technology (SRT) expectations were analysed by Ng et al. (2019) where they focused on the expectations of Generation Z consumers in Malaysia. Unmanned stores were not the focus of this paper; however, they made a small reference to Malaysia's first automated restaurant (grEAT) which opened in 2018.

Italy

The first unmanned store in Italy (Slipop) opened in September 2022 (Pekic, 2022). Prior to the launch of Slipop, Gazzola et al. (2022) conducted a preliminary study to uncover knowledge about the technology and identify the relevance of factors, but the authors highlighted the lack of unmanned stores in Italy. The concept was illustrated by the example of Amazon Go. Ponte and Bonazzi published their paper in 2023 on the technological acceptance of cashierless stores in Italy. Their secondary research included a review of cashierless technologies, where Amazon Go was also mentioned as an example of an unmanned Just Walk Out store. Their primary data collection was based on the UTAUT model.

Taiwan

Lo and Wang (2019) introduced X-Store unmanned store in Taiwan, and they analysed the user experience and experience gaps of these shops. Amazon Go was referred to in this paper as well, however, the authors emphasized that X-Store was launched earlier than Amazon Go. Chen et al. (2022) examined potential users of unmanned stores in Taiwan how the effects of informational-based readiness and customer readiness as well as social influence on the intention to use self-service stores and the moderating effects of social influence. US-owned Amazon Go has been mentioned again along with China and Japan as emerging participants in smart retail.

Thailand

The paper of Chuawatcharin and Gerd Sri (2019) focused on technology acceptance of cashierless stores in Bangkok. Although no existing unmanned stores were available at the time of their publication, in 2023 summer Lotus's Pick & Go cashierless store was opened in Bangkok.

India

In the study of Pillai et al. (2020) customer adoption behaviour was analysed in case of AI-powered automated retail store (AIPARS) in India. According to their paper, India has many retailers using AIPARS technology like Watasale, Aditya Birla Retail, Reliance Retail, and Shoppers Stop, however, not all of these use cashierless business model. They were referred also to international unmanned store competitors such as Amazon Go (USA), Walmart (USA) Suning (China), and Auchan (France).

South-Korea

Several unmanned automated shops are now available in South Korea. Park (2023) conducted research on how in-store characteristics affect customers when they use

cashierless stores. No specific Korean-based store was mentioned in the article as a survey location, although Emart24, 7Eleven, GS25, and CU are the main four role-players of the automated store market (Yim, 2021).

Non-country-specific literature

Lack of food availability and affordable nourishing food shortage in rural areas causes major problems at global level and according to Cometti et al. (2019) unmanned stores can alleviate these problems. Swedish (Narrafar), Chinese (Wheelys 247, Moby Mart), and US (Amazon Go) examples were mentioned as good practices for 'food deserts'. The industrial architecture aspect was introduced by Lyster (2019), and Amazon Go (USA), Moby Mart (China) were also mentioned as illustrative examples.

Journal productivity

Although articles were published in 17 journals, just two of them contributed to over 25% of the total. The most influential journals and their corresponding percentages of articles published, along with their country of origin and Scopus quartile, are listed in Table 5. 40% of the articles were published in Q1 and 20% in Q2, Q3, and Q4 of the Scopus database.

Table 5. Journals with publications on cashierless stores (100%=2018-2023 all relevant papers)

Journal	Nationality	Scopus classification	% of publications
Journal of Retailing and Consumer Services	UK	Q1	15%
Sustainability (Switzerland)	Switzerland	Q1	10%
Industrial Management and Data Systems	UK	Q1	5%
Journal of Marketing Communications	UK	Q1	5%
Young Consumers	UK	Q1	5%
Asia Pacific Business Review	UK	Q2	5%
Journal of Corporate Accounting and Finance	USA	Q2	5%
Journal of Environmental and Public Health	Egypt	Q2	5%
Technology Analysis and Strategic Management	UK	Q2	5%
Architectural Design	USA	Q3	5%
Indonesian Journal of Electrical Engineering and Computer Science	Indonesia	Q3	5%
Journal of Information Technology Teaching Cases	Switzerland	Q3	5%
Journal of Public Affairs	USA	Q3	5%
CASE Journal	UK	Q4	5%
Economic Anthropology	USA	Q4	5%
International Journal of Public Sector Performance Management	UK	Q4	5%
Journal of Distribution Science	South-Korea	Q4	5%

Source: Authors' own research.

Results of the Crunchbase database analysis

Despite the fact that the technology developed by Amazon is not unique in the world. According to the American Crunchbase database a number of startups have developed similar technologies around the globe (Table 6).

Table 6. Startups reinvented the cashierless technology

Startup	Foundation date	Location	In operation/no	Used technology
Aisle 24	2015	Canada	operating	mobile application
Bingobox	2016	China	operating	
Avastus Analytics	2017	Canada	not	
Cloudpick	2017	China	operating	
AiFi	2018	USA	operating	
Amazon Go	2018	USA	operating	
Inokyo	2018	USA	not	
Storekey	2018	Sweden	operating	
Trigo	2018	Israel	operating	smart cart
Veeve	2018	USA	operating	
Cashier basket	2022	Hungary	operating	

Source: Authors' own research based on Crunchbase database.

Aisle24

The first Canadian cashier-less grocery franchise was founded in 2015 and builds fully automated convenience stores that are open 24/7, 365 days a year (aisle24.ca).

Bingobox

Bingobox was founded in 2016 by Zilin Chen. China's Bingobox started developing its 24-hour cashierless store model four months earlier than Amazon. The BingoBox technology features an unmanned smart cashier, RFID and computer vision to track merchandise, QR code scanning to allow users to enter the store, and Alipay and WeChat Pay payment support (technasia.com/talk/zilin-chen-bingobox).

The first automated stores were launched in China in 2016, but the initial concept was not very successful due to a lack of customer service and satisfaction, and by mid-2017 BingoBox laid off more than 80% of its employees. Following this, the coronavirus pandemic broke out and overnight automated shopping became the safest option for shoppers. The technology has now spread across Asia and Australia (retail-insight-network.com/comment/bingobox-cashierless-stores/).

Cloudpick

Cloudpick is a Shanghai-based company that provides AI-based smart store solutions for the retail industry (Ting, 2021). Founded in 2017, by 2019 Cloudpick had already established nearly 130 stores in countries such as the United States, Canada, Japan, Korea and Singapore. With a technology background based on computer vision, machine learning and multi-sensor integration technology, its proprietary algorithm engine can accurately identify product information and customer shopping behaviour. In this case, payment is also automatically made upon exit from the store (en.cloudpick.com/en/Default.aspx).

AiFi

Just days after Amazon Go opened its store in Seattle, a US startup (AiFi) announced a new system similar to its "Just Walk Out" technology (Ives et al., 2019), capable of controlling the purchases of up to 500 people, up to tens of thousands of items, across tens of thousands of square metres of retail space (Perez, 2018), available for small stores and large chains alike. Their technology enables reliable, cost-effective and fully contactless autonomous shopping using artificial intelligence-based computer vision technology, providing an unparalleled experience for retailers and consumers alike (aifi.com). It can also track shopper behaviour in the retail space: are shoppers shopping in groups? Are they shopping in groups? What products are they picking up and putting back on the shelf? Furthermore, does it monitor the way shoppers walk, their posture, what direction they are moving in the store? But it is also able to identify abnormal behaviour, such as shoplifting (Perez, 2018). In addition to providing information on consumer behaviour, it also provides up-to-date statistics, thus contributing to more efficient operations (Financial Express, 2018). Thanks to all these many positive features, AiFi is gaining ground in retailers worldwide (Table 7).

Table 7. The partners of AiFi in 2023

Continent	Country	Retail partner	Location
America	USA	Choice Market	Denver
		Detroit Lions	Brush
		Dollar General	Goodlettsville, Banner,
		Indy 500	Speedway
		LOOP Neighborhood Market	Campbell
		Miami Dolphins	Miami
		Microsoft HQ	Redmond
		Verizon HQ	Basking Ridge, Boston
Europe	UK	Leicester City Football Club: King Power Stadium	Leicester
		ALDI Shop & Go	London
	France	Carefour Flash	Paris
	Ireland	Market x Flutter	Dublin
	Poland	Zabka	Gdynia and other 55 places
	Germany	Rewe	Frechen
Asia	Spain	Flax & Cale	Barcelona
	United Arab Emirates	Carrefour City+, Majid Al Futtaim	Dubai
	China	AIGO	Shang Hai
		Cainz	Honjo City

Source: Own compilation based on Aifi.com.

Amazon Go

Amazon, the world-famous online retailer founded by American Jeff Bezos, has been at the forefront of the creation of cashierless technology. The Amazon Go technology was developed with the aim of eliminating queuing in stores (Gross, 2019). On 22 January 2018, after five years of development, the first self-service Amazon Go store opened in Seattle, USA (Gershgorn, 2018; Ives et al., 2019; Türegün, 2019), combining a range of creative technologies (Table 8).

Table 8. Amazon Go included technologies

One-click web shopping for retail
An app that uses location-based services
QR code identifiers
Integrated payment
Image recognition
Multi-sensor technology
Artificial intelligence
Machine learning

Source: Ives et al. (2019, p.3).

Amazon referred to the combination of these technologies as "Just Walk Out" concept (Roemmele, 2017). Overall, Amazon Go stores combine online and offline shopping, essentially using a dense network of cameras, pressure sensors and complex computing devices to analyse the shopping process, to measure when a customer buys a product or puts it back on the shelf. It lists the products to be purchased and sends them to the shopper's Amazon account (Desai, 2021). Hundreds of cameras monitor the shopper during the shopping process, and the algorithm created then totals the purchase price of the products to be purchased before the shopper leaves, and deducts it from the shopper's account. Finally, it sends an invoice for a successful purchase (Dankó & Hajdú, 2019), so the entire shopping process requires only remote monitoring and replenishment of goods compared to traditional retail in terms of human resources (Sikos et al., 2019). Table 9 summarises the steps of the "just walk out" shopping process.

Table 9. „Just walk out“ process

	Process steps	Characteristics
1.	Installing the application	To enter the shopping area, the customer must download the "just walk out" application.
2.	Open the app	Open the app. By opening the app and scanning the scanner at the entrance gate, a connection is established between the smartphone and the just walk out store system.
3.	Interaction	Interaction between the smartphone and the system.
4.	Product search and product information	Product search and product information Products are available in product categories similar to traditional retail outlets.
5.	Product selection	Product selection. Customers can select the product they want and the system will automatically place the product on the shopping list. If you do not wish to purchase it, you can simply return it to the shelf.
6.	Payment	After passing through the exit gate, the app deducts the total price of the products on the virtual shopping list from the customer's account.
7.	Close application	Completing the purchase

Source: Own compilation based on Purwantono et al. (2021).

The majority of innovations (i.e. the most common innovations) fall into the category of ordinary or common innovations. However, according to Duening et al. (2020) these innovations have only a small impact on the current processes, products or services offered. Although Amazon did not invent the online sale of products, it has nevertheless made it easier and cheaper by offering its many sellers' products for sale on one platform. So, both Apple

and Microsoft have become successful by bridging the existing gap and creating more sustainable technology (Wang, 2013). To sum up there is no doubt that Amazon Go falls into this category of innovation.

Inokyo

Inokyo opened its cashierless store in Mountain View, California, in August 2018. To shop at Zippin's store, you must first download an app that gives you a QR code, then scan the code when you enter the store (Dale, 2018). The cameras track what the customer takes off the shelves, and a single QR scan of the app calculates the price of the product you have purchased when you arrive and leave the store (www.cbinsights.com/company/inokyo).

Storekey

The Swedish enterprise Storekey is a crucial contributor to the smart technology revolution. The pioneering tech firm responsible for the Lifvs store network possessed a total of 20 outlets throughout Sweden by 2023. Through its efforts, Storekey transformed 129 physical stores into unmanned operations while exporting this innovative notion to nations including Denmark, Ireland, and Japan (Nyman, 2023). This comprehensive unmanned retail solution enables retailers to extend their opening hours and increase their profitability. The Storekey system comprises a retailer back office to manage product inventory, opening hours, event viewing, payment acceptance, and personalized campaign sending via the app, as well as an end-user app that permits store unlocking, item scanning and payment, product and campaign browsing, and nearby unmanned store locating (storekey.com).

Trigo

Trigo, an Israeli startup founded in 2018 by former Google, Amazon and Apple employees Daniel Gabay and Michael Gabay, entered the international market in 2019. Called "EasyOut® technology", Trigo offers autonomous shopping technology to businesses. Cyb-Org determines which products a shopper has taken off the shelf based on weight instead of image processing, making Trigo cheaper to operate than Amazon Go, which loses about 8% of sales due to various system glitches that prevent it from detecting shoplifting (trigoretail.com). The number of retail partners using the Trigo system has grown exponentially (Table 10).

Table 10. Partners of Trigo in 2023

Continent	Country	Retail partners	Locations
America	UK	Wakefern	New Jersey
Asia	Israel	Shufersal	Tel Aviv
Europe	UK	Tesco	Chriswell, Fulham, London,
	Holland	Aldi Nord	Utrecht
	Germany	Rewe	Berlin, Cologne Sülz, Munich
	Germany	Netto	Munich

Source: Own compilation based on trigoretail.com.

Veeve

Veeve provides smart carts to Kroger and Albertsons groceries in the USA. Veeve carts would be a first-year investment of under 100 000 USD, which is cheaper than self-check-out stations (Aydin et al., 2023).

Cashier Basket

Cashier Basket is a Hungarian application that provides smart cart self-checkout solutions for instore businesses. The company was founded in 2022 by the students of Szeged University in the framework of the Hungarian Startup University Program (HSUP) (u-szeged.hu/sztehirek/2023-julius/hogyan-legyel-sikeres).

Conclusion

The paper clarifies the unmanned store concept and then shows the emergence, functioning and diffusion of the new technology. Technological innovations in retail are changing both people's shopping habits and companies' business models. Amazon's "Just Walks Out" solution offers a completely different and innovative shopping experience and with the rise of smart retailing and the rise of cashierless technologies, more and more companies are entering this market. Since 2018, the technology has already been rolled out in many countries, with expansion efforts in the USA, China, Japan and Western Europe being the most notable.

This systematic literature review was initially based on 245 articles, but using PRISMA theory we were able to filter down to relevant literatures on the topic. So, in relation to the first research question (RQ1) we can conclude that the number of scientific papers about unmanned shops are still limited (47 articles) compared to the market expansion of these technologies. Most of these publications dealt with technological background and technological development possibilities of cashierless technologies (27 articles) where the number of papers related to country specific analysis (20 articles) was even more limited. It can therefore be concluded that the cashierless store concept has been studied in academic research mainly from a technological point of view, but has not yet been widely explored in terms of global distribution. Concerning the second research question (RQ2), country specific researches are limited as well and they are conducted mostly in developed countries. Currently, cashierless business models in retail are mostly composed of a startup company which develops the technology and a retail company that applies these technologies. In the light of the Crunchbase database analysis, locations of startups were defined (RQ3), and USA and China are considered as the main market players in technology development.

However, it is still a new and largely unknown solution for customers, including in our country, but the market dynamics suggest that it is set for significant growth. Cashierless shops pose some challenges, but these can be effectively overcome with the proper introduction of new technology. To identify or filter out potential flaws in cashless technology from the consumer side, it is necessary to test the acceptance of the technology by customers. In the next step of our research, we will explore people's acceptance of technology in cashierless shops, which we will mainly investigate in our country. The varying degrees of global adoption of technology and cultural and income differences between countries are likely to have an impact on the level of technology adoption, and we plan to extend our research to more countries in the future.

Based on the results of this paper some research gaps can be defined: (1) conducting more research in countries where unmanned stores are already operating, (2) technology readiness analysis in developing countries (Pillai et al., 2020), (3) Due to unmanned technology expansion, existing physical stores may enter the market, or completely new players can enter the market. Therefore, an updated unmanned store database where location is indicated could fill a gap for researchers and the profession in this market.

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