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Adoption of unmanned, cashierless retail technology in Croatia: A study on student perceptions

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ABSTRACT

Objective: The objective of the article is to examine the technology acceptance of unmanned, cashierless technology. Since 2015, several startups have developed a new technology innovation called unmanned, cashierless technology, which has been steadily spreading globally over the past nine years. This study presents an analysis of user acceptance of this innovation among students in higher education institutions in Croatia.

Research Design & Methods: We examined factors influencing attitudes towards cashless transactions within the framework of the unified theory of technology acceptance and use (UTAUT2). We developed seven hypotheses based on previous literature and research models. We conducted the research through an online survey of Croatian students (n=406). We applied variance-based structural equitation modelling (PLS-SEM) to analyse the primary database.

Findings: The new trend in smart retail could help retailers to find a new way to improve their competitiveness. Based on our results, most UTAUT2 predictors such as performance expectancy, effort expectancy, social influence, hedonic motivation, and price sensitivity significantly influence behavioural intention.

Implications & Recommendations: This study offers implications for existing research on the new technology acceptance and contributes to relevant literature on customer behaviour. Given the importance of customer perception to improve business performance, the current study has some implications for marketers and retailers.

Contribution & Value Added: Investigating the adoption of unmanned, cashless technology, particularly among Generation Z, is an important and actual topic. This research can guide stakeholders and policymakers who are planning to introduce this cashierless technology. Based on the factors analysed, we can identify important and less important factors influencing consumers' intentions. In this way, we can identify certain preferences of the target group analysed and use it as a basis for targeting them (e.g., in a campaign) when opening new stores.

Article type: research article

Keywords: smart retail; cashierless stores; unmanned stores; technology acceptance and use; UTAUT2; PLS-SEM

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INTRODUCTION

The twenty-first century has witnessed remarkable technological progress, with artificial intelligence (AI) being one of the most significant advances. Artificial intelligence comprises subsets such as machine learning and deep learning, enabling computers to imitate or even replace human behaviour. Digital transformation has revolutionized manual processes and companies with sufficient resources have rapidly invested in AI to boost their profits (Piotrowski & Orzeszko, 2023; Kliestik *et al*., 2023; Androniceanu, 2024; Androniceanu *et al*., 2023). Hence, digital technologies are becoming increasingly crucial in the context of the fourth industrial revolution, especially for MSMEs (Wong & Yap, 2024; Civelek *et al*., 2023;

Lewandowska *et al*., 2023). According to Davenport *et al.* (2020), Kolková and Ključnikov (2022), AI appears to have an impact on various aspects of business. The key areas of focus within this field include marketing strategies, business models, sales processes, and customer service options (Sieja & Wach, 2023). Moreover, it seems to affect customer behaviour across all industries (Davenport *et al*., 2020; Dias *et al*., 2023). Meanwhile, customer demands are constantly changing (Moraru, 2021) and firms must keep up with these changes to remain relevant (Knežević *et al.*, 2021). To do so, they must become more agile and cost-efficient by reducing operational costs (Minh *et al.*, 2022; Turek *et al.*, 2023). This trend is particularly evident in the retail sector (Ingalagi *et al.,* 2021), because as Knežević *et al.* (2016) found, new market conditions can create opportunities for small retailers.

The retail sector is highly competitive, due to numerous avenues for satisfying the consumer, minimal entry barriers, and the relative ease with which successful business models may be replicated (Śmigielska & Stefańska, 2017). The modern retail structure has evolved through the introduction of new formats since the mid-twentieth century, marked by significant innovations such as online retailing or augmented reality (Jajic *et al.*, 2022). Furthermore, the grocery sector has experienced significant internationalization since the 1980s, further shaping the retail industry. This sector is a prominent example of an innovation-intensive industry and its growing contribution to the overall economy is a consequence of the implementation of a multitude of diverse innovations (Ćuzović *et al.,* 2017).

Since 2015, various startups worldwide, such as AiFi, Aisle24, BingoBox, Cloudpick, Inokyo, and Trigo, have developed cashierless technologies (Schögel & Lienhard, 2020; Andrzejewski & Dunal, 2921; Szabó-Szentgróti *et al.*, 2023a; 2023b). Cashierless store (hereafter cashierless and unmanned terms are used synonymously) is a store with no personnel that can provide 24-hour service without closing, allowing consumers to quickly pick up and pay without time limits and even checkout. It can also quickly generate consumer details and greatly reduce the time consumers spend in the store (Hsu, 2022). According to Ponte and Bonazzi (2023), it is anticipated that these technologies will have a pivotal impact on the checkout process, reducing time requirements and minimising congestion. The first significant breakthrough in this field occurred in 2018 when Amazon launched the Amazon Go store in Seattle, USA. Since 2019, the coronavirus pandemic has led most governments to impose mobility restrictions. Consequently, there has been a notable surge in the interest of businesses in digitisation and the utilisation of digital media for business purposes (Alkhatib *et al.*, 2023). This has led to a continued rise in cashierless technology, such as contactless shopping (Kwon & Ahn, 2023).

The Central and Eastern European region, especially – European emerging markets – including Croatia, has also become part of this trend. The research by Hunady *et al.* (2022) indicates that Croatia exhibits a medium level of technology readiness and in September 2023, the first cashierless smart store was opened by the leading Croatian retail chain Konzum in the centre of Zagreb (URL 1). Thus, the research topic remains pertinent and timely.

However, Payne *et al.* (2023) suggest that the future of cashierless shops remains uncertain. Ray *et al.* (2023) investigated the impact of gratifications and emotions on the acceptance of Amazon Go. The authors propose that scholars should examine the factors that influence the adoption of interactive technologies in countries where cashierless stores are prevalent, except the United Kingdom and the USA, where numerous studies have already been conducted (Türegün, 2019; Ives *et al.,* 2019; Ray *et al.,* 2023). As Vitezić and Perić (2024) propose, an analysis of the attitudes of people living in countries with varying degrees of technological development may prove a fruitful avenue of enquiry for researchers. This research aims to address this gap in the literature by examining the level of acceptance associated with unmanned, cashierless technology in Croatia, where it has been available since the autumn of 2023. The focus is on the impact of cashierless technology on Generation Z consumers. Jung *et al.* (2024) noted that this group is the primary target for stores using this technology.

This article will explain technology acceptance among students enrolled in higher education in Croatia (n=406) based on an online survey data collection. For this purpose, we employed the extended unified theory of acceptance and use of technology (UTAUT2). We conducted the analysis and hypothesis testing using the variance-based structural equations method (PLS-SEM). The article will conclude with suggestions and recommendations for stakeholders and policymakers, as well as research suggestions.

The rest of the paper is structured as follows. The literature review section gives an overview of the main research findings related to UTAUT2 model. Based on the theoretical framework, hypothesises were developed. The next section – methodology – describes the sampling process, the variables definition, and the description of models implemented in hypothesis verification. The findings section includes the key results and the article will end with conclusions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Literature Review

We derived the theoretical framework for our proposed model from the extended unified theory of acceptance and use of technology model (UTAUT2). In recent years, research based on the UTAUT and UTAUT2 models has become increasingly prevalent.

Gumasing *et al*. (2022) investigated the behavioural intentions of the Philippine population to utilise online grocery applications. The researchers employed the UTAUT2 model to ascertain the factors that influence the acceptance and utilisation of online grocery applications amongst Filipinos. They specifically considered the impact of health risks associated with COVID-19. The study found that behavioural intentions and cues to action significantly influenced usage behaviour. The factors that positively influenced behavioural intentions to use online grocery apps were performance expectancy, perceived benefits, cues to action, and perceived severity (Gumasing *et al.*, 2022).

Sun *et al.* (2023) conducted a study examining the utilisation of flash delivery services for imported spirits among Chinese consumers. The study extended the UTAUT2 with the incorporation of knowledge, risk, and innovativeness, thereby facilitating the identification of factors influencing Chinese consumers' decision-making processes. The findings from this study provide insight into the aspirations of imported spirits flash delivery service providers to enhance sales across China. Moreover, they demonstrate the potential of the extended UTAUT2 as a research tool applicable to diverse subject matter.

Kilani *et al.* (2023) conducted a study in Jordan to examine the degree to which UTAUT2 variables can affect the adoption of e-wallets. The results demonstrated that trust is the most influential factor in determining the intention to continue using the technology. This implies that the perceptions and expectations of customers regarding a service provider or system directly impact their future perceptions of the same system.

Zarco *et al.* (2024) conducted an in-depth analysis of biometric payment systems, drawing upon two distinct yet complementary research studies. In the initial study, the researchers identified the variables that predict the intention to use this technology in a sample of 1905 potential users through the application of diverse feature selection methodologies derived from artificial intelligence within a comprehensive model that integrates the tenets of the UTAUT2 model, the general risk theory, and the trust theory. In the second study, the researchers enlisted two panels of experts from the financial technology industry to evaluate these findings. The researchers concluded that the primary factors influencing consumer acceptance of biometric payment cards are perceived risk and social influence.

However, there have been a limited number of studies, primarily in Asia, that have focused on the factors influencing customers' adoption of cashierless technologies and stores. These studies include Qi (2019), Hsu (2022), Lin (2022), and Szabó-Szentgróti *et al.* (2023b). Qi (2019) conducted one of the first studies on consumers' intentions towards checkout-free stores, using the extended integrated technology acceptance model (UTAUT2) in Hong Kong. Qi's (2019) study aimed to investigate the reception of checkout-free stores among Hong Kong residents. Hsu (2022) also carried out a similar study in Taiwan. It revealed that a number of factors influence consumers' intentions. The factors include performance expectancy, effort expectancy, social influences, facilitating conditions, behavioural intention, and use behaviour. Lin (2022) investigated the factors influencing consumers' attitudes and intentions to patronise an unmanned convenience store called X-store in Taiwan (Lin, 2022). In Europe, limited study is available regarding this topic. However, Szabó-Szentgróti *et al.* (2023) proposed a similar model for Hungary, while Hopalı (2023) examined customer attitudes in Turkey.

The following section presents a theoretical and conceptual background for each construct, and in line with that, a series of hypotheses are proposed for consideration.

Hypotheses Development

The extended unified theory of acceptance and use of technology model (UTAUT2) constituted the basis of our hypothetical model. However, we had to adjust the core model (Venkatesh *et al.,* 2012) to the purposes and specificities of this study. We kept and utilized the main constructs from the core model (performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivation). We replaced price value construct with price sensitivity. We also excluded the habit latent variable and use behaviour from our model because with regard to this technology, habit and common use are not yet established in Croatia. However, in the scope of habit and frequent use, further research should be conducted. The following section presents the theoretical and conceptual background of each construct, upon which the hypotheses are based.

Performance expectancy (PE): The construct serves to analyse how an individual believes that using the analysed technology will help them to achieve advantages in their performance (Venkatesh *et al.,* 2012). In other words, applying the technology provides benefits to users to finish their tasks, therefore they would be more motivated to use the new technology if it eases everyday life (Venkatesh *et al.,* 2003; Morosan & DeFranco, 2016). In their study, Kapser and Abdelrahman (2020) emphasized that PE is a major construct in various studies that has a predictive effect on Behavioural intention (BI). In the case of unmanned stores, we assume, that shopping in these stores would help individual performance. Thus, we formulated the following hypothesis:

H1: Performance expectancy (PE) has a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Effort expectancy (EE): This construct serves to reveal how making efforts affect behavioural intention. Making efforts means how it is easy to learn the new technology and what efforts need to be made to complete a task using the technology (Venkatesh *et al.,* 2012). The concept of unmanned store shopping procedure is to be simple and efficient (Selter *et al.*, 2023; Park, 2023). Therefore, we hypothesised:

H2: Effort expectancy (EE) has a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Social influence (SI): According to the core UTAUT2 model, the social influence variable identifies how important it is to an individual that others believe they should use the analysed technology (Venkatesh *et al.*, 2012). Recent studies proved that social influence has an important role in technology acceptance nowadays as well (Nordhoff, 2020; Arpaci *et al.,* 2021; Mitchell *et al.,* 2022). This indicates that those who perceive that influential individuals in their social network endorse the use of automated shops are more likely to utilise them than those who are less convinced that their social network supports the use of such stores. Accordingly, we formulated the following hypothesis:

H3: Social influence (SI) has a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Facilitating conditions (FC): The concept of FC construct is how easily the necessary tools or equipment are available to use the technology (Venkatesh *et al.,* 2012; Palau-Saumell *et al.*, 2019). Since shopping in cashierless stores requires mostly a smartphone, a smartphone application, and a bankcard (Ives *et al.,* 2019; Türegün, 2019; Ton *et al.,* 2022a), we hypothesised:

H4: Facilitating conditions (FC) have a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Hedonic motivation (HM): Brown and Venkatesh *et al.* (2005) defined HM as "the fun or pleasure derived from using a technology" and according to them this construct plays a major role in technology acceptance. Cashierless stores are considered as a way new shopping experience in most countries. Cutting-edge technologies are increasingly used by retail stores to increase customer experience (Poncin *et al.*, 2017; Adapa *et al.,* 2022; Roshchyk *et al.,* 2022). Consequently, we formed the following hypothesis:

H5: Hedonic motivation (HM) has a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Atmosphere (AT): By creating a new construct (Atmosphere), the purpose was to explore whether behavioural intentions are influenced by the specific internal atmosphere of shops. A limited variety of products are offered in cashierless automated shops and a more airy layout is necessary to ensure the required technology (Xu *et al.*, 2020; Schögel, 2020). A lower range of products is more advantageous concerning store experience and focused shopping (Triantafillidou *et al.*, 2017). Accordingly, we hypothesised:

H6: Atmosphere (AT) has a direct and positive impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Price sensitivity (PS): Due to the low penetration of technology, respondents are not yet able to assess value for money. Therefore, we substitute the price value construction with price sensitivity (Kapser & Abdelrahman, 2020). Croatian consumers are mainly price-conscious (Milaković & Mihić, 2016) and these shops with limited product variety usually represent higher price levels than discount chains or supermarkets. We assumed that higher prices have a negative effect on the intention of use. Therefore, we formulated the following hypothesis:

H7: Price sensitivity (PS) has a direct and negative impact on behavioural intention (BI) in cashierless intelligent stores in Croatia.

Behavioural intention (BI): This latent variable measures the intention to use the analysed technology (Venkatesh *et al.*, 2012). Since unmanned store availability is limited in Croatia, in this article, we analysed only the intention of use. Concerning the statements of this construct, we needed some editorial changes to make the questionnaire meaningful for the revised technology.

RESEARCH METHODOLOGY

Data Collection

The questionnaire development was in line with the objective of exploring technology acceptance of smart stores, employing validated scales. We asked respondents to rate 29 statements on a Likert scale of 1 to 7, where 1 represented a strong disagreement and 7 represented a strong agreement. These 29 statements (Appendix 1.) accounted for eight latent variables in line with the research model. Given the limited availability of smart stores in Croatia, the objective was to ascertain expectations rather than perceived or experienced opinions. We conducted the survey from November 2023 to January 2024. We applied the snowball sampling method to collect answers. During the sample design, we aimed to interview mostly currently active students, studying at Croatian higher education institutions that are most likely open to this new technology. To prevent any potential confusion, the questionnaire commenced with a definition of unmanned stores. We provided the participants with the information that their responses would be anonymous and that they could cease participation in the survey at any time without providing a reason. We received a total of 484 responses and prior to database analysis a data screening process was necessary to filter out records where the response duration was not appropriate. Moreover, we needed to exclude inconsistent straight-line responses. We based the data analysis on a sample of 406 respondents. We used Microsoft Excel and SmartPLS 3.2.9 (Ringle *et al.*, 2022) software to analyse responses and develop the final proposed model.

Data Analysis Methodology

For the analysis of the research model, we used the structural equation modelling (SEM) method, which has a wide range of applications in scientific articles (Alavi, 2013; Memon & Rahman, 2013; Zhu *et al.*, 2019; Wei, 2021; Gelencsér *et al.*, 2023; Ton *et al.*, 2022b; D'souza *et al.,* 2021; Lieonov *et al.,* 2022). Our PLS-SEM (partial least squares-structural equation modelling) method is suited for the study of technology acceptance and is a widely used statistical tool by researchers (Lowry & Gaskin, 2014; Alalwan *et al.*, 2017; Indrawati & Putri, 2018; Ameri *et al.*, 2020; Tseng *et al.*, 2022; Kilani *et al.*, 2023;

Stočes *et al*., 2023; Szabó-Szentgróti *et al.*, 2023b). Hair *et al.* (2014) and Leguina (2015) emphasize that the PLS-SEM (also known as PLS-PM) methodology is gaining popularity in scientific publications partly because it allows the estimation of theoretical constructs that cannot be measured directly and the investigation of the relationship between them. Furthermore, PLS-SEM comprises two distinct models: a measurement model and a structural model. The measurement model outlines the indirect relationships between observed variables (indicators) and latent variables. The structural (inner) model describes the relationships (path) between latent constructs. One of the advantages of the method is that it can handle both reflective and formative models (Hair *et al.*, 2011).

Our model of technology acceptance of unmanned stores includes a reflective measurement model, i.e. the manifest variables are considered as the cause of the latent variable. We call these latent variables first-order variables. When we measure the higher-order (*e.g.,* second-order) latent variable with other latent variables it is called a hierarchical (*e.g.,* second-order) latent variable. The structure of the present research model is also a commonly used second-order hierarchical variable, where the relationship between the reflexively measured first-order variable and the formatively measured second-order variable (Figure 1) is investigated (Becker *et al.*, 2012).

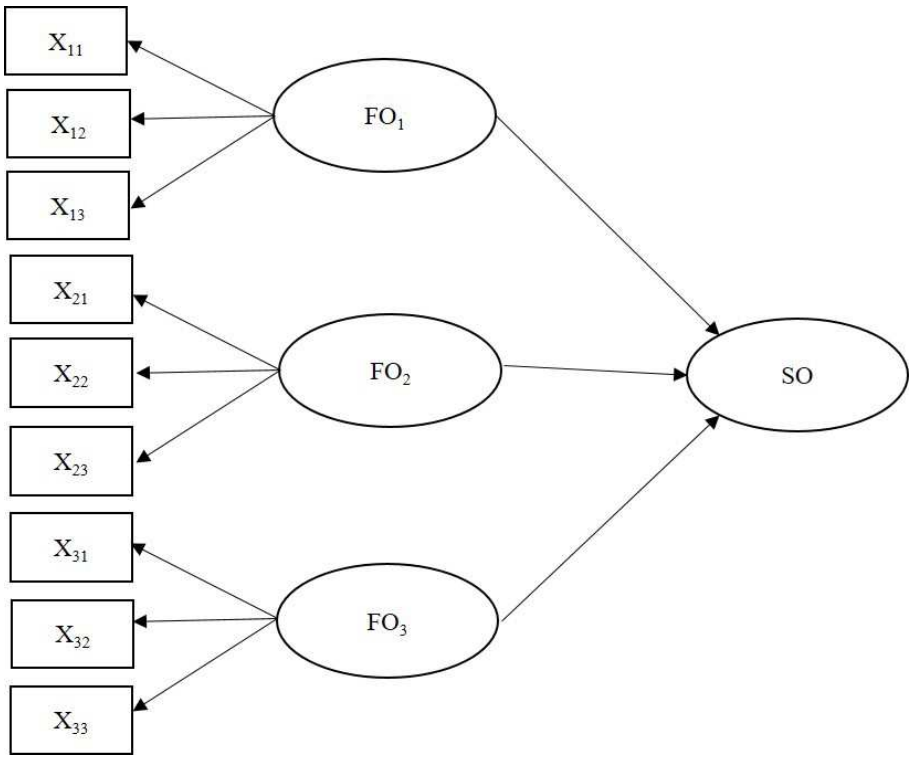

Figure 1. Type II. hierarchical latent variable model

Source: Becker *et al*., 2012.

In the data analysis, we first performed the measurement model testing and then we introduced the structural model estimation and hypothesis testing. In the results and discussion chapter, we will describe the best-fitting model.

RESULTS AND DISCUSSION

Measurement Model

Firstly, we analysed the validity of the reflective measurement model using outer loading values, Cronbach's alpha (α Value), composite reliability (rho_a, CR), and average variance extracted (AVE) measures. As demonstrated in Table 1, the outer loadings were all greater than 0.7, and Cronbach's alpha values exceeded the established threshold of 0.7 (Hair *et al.*, 2011). However, Griethuijsen *et al.* (2014) allow a 0.6 threshold for α Value, which is a less strict requirement. According to Hair *et al.* (2011), composite reliability should be higher than 0,7, but in exploratory research values from

0.60 to 0.70 are considered to be satisfactory. Table 1 presents our CR values, which were above the allowed thresholds. All the average variance extracted (AVE) values for the latent constructs exceeded the suggested minimum limit value of 0.5 (Hair *et al.*, 2010; Hair *et al.*, 2011). After comparing the data to the threshold values, the variables that met the criteria were retained in the final model (Appendix A).

Table 1. Construct reliability, convergent validity and VIF values

Constructs	Items	Outer loadings	p values	α Value	rho_a	CR	AVE	VIF
Performance expectancy (PE)	PE1	0.804	0.000	0.867	0.869	0.910	0.717	1.780
	PE2	0.819	0.000					1.887
	PE3	0.891	0.000					2.772
	PE4	0.869	0.000					2.491
Effort expectancy (EE)	EE1	0.837	0.000	0.886	0.894	0.921	0.744	2.222
	EE2	0.859	0.000					2.167
	EE3	0.886	0.000					2.593
	EE4	0.868	0.000					2.339
Social influence (SI)	SI1	0.886	0.000	0.873	0.878	0.922	0.798	2.273
	SI2	0.891	0.000					2.402
	SI3	0.903	0.000					2.350
Facilitating conditions (FC)	FC1	0.863	0.000	0.776	0.852	0.896	0.812	1.670
	FC2	0.938	0.000					1.670
Hedonic motivation (HM)	HM1	0.903	0.000	0.885	0.886	0.929	0.813	2.630
	HM2	0.913	0.000					2.725
	HM3	0.889	0.000					2.298
atmosphere (AT)	AT1	0.875	0.000	0.705	0.705	0.871	0.772	1.421
	AT3	0.882	0.000					1.421
Price sensitivity (PS)	PS2	0.874	0.000	0.845	0.850	0.906	0.764	2.017
	PS3	0.904	0.000					2.417
	PS4	0.842	0.000					1.881
Behavioural intention (BI)	BI1	0.868	0.000	0.860	0.863	0.914	0.781	2.051
	BI2	0.873	0.000					2.123
	BI3	0.909	0.000					2.495

Source: own study based on calculations in PLS-SEM.

The discriminant validity of the model indicates that the constructs used are sufficiently distinct from one another (Hair *et al.*, 2017). Fornell-Larker criteria and heterotrait-monotrait ratio (HTMT) are expected to confirm that. However, HTMT is considered to be more accurate compared to Fornell-Larker criteria (Henseler *et al.*, 2015). In the present study, we applied both methods to verify discriminant validity (Table 2 and Table 3). According to the Fornell-Larcker criterion, the research model has no discriminant validity issues because the "AVE value of each latent construct is higher than the construct's highest squared correlation with any other latent construct" (Hair *et al.*, 2011). Regarding HTMT values that should be below than 0.9, one value showed a discriminant validity issue between PE and BI constructs. The data has been subjected to a more in-depth analysis to explore the reasons for this HTMT value. We did not obtain better results by excluding manifest variables (statements). Therefore, we had to revise responses. Reducing the number of records showed improvement in HTMT value. However, we decided to keep 406 responses and we considered this HTMT value when formulating our conclusions.

According to Hair *et al.* (2011), variance inflation factor (VIF) values exceeding 5.0 indicate the presence of multicollinearity. Prior to the estimation of the structural model, we conducted a multicollinearity test to evaluate VIF values. The VIF values of our model (Table 1) show no multicollinearity issues between latent constructs. However, the model meets the less permissive 3.0 value.

Table 2. Discriminant validity (Fornell-Larcker criterion)

Constructs	AT	BI	EE_	FC	HM	PE	PS	SI
AT	**0.879**	–	–	–	–	–	–	–
BI	0.535	**0.884**	–	–	–	–	–	–
EE_	0.693	0.684	**0.863**	–	–	–	–	–
FC	0.651	0.428	0.718	**0.901**	–	–	–	–
HM	0.677	0.782	0.754	0.583	**0.902**	–	–	–
PE	0.608	0.834	0.743	0.486	0.785	**0.847**	–	–
PS	0.135	0.498	0.210	0.018	0.362	0.418	**0.874**	–
SI	0.478	0.722	0.586	0.371	0.697	0.737	0.483	**0.893**

Source: own study based on calculations in PLS-SEM.

Table 3. Discriminant validity (HTMT criteria)

Constructs	AT	BI	EE_	FC	HM	PE	PS	SI
AT	–	–	–	–	–	–	–	–
BI	**0.687**	–	–	–	–	–	–	–
EE_	0.874	**0.773**	–	–	–	–	–	–
FC	0.894	0.510	**0.868**	–	–	–	–	–
HM	0.858	0.897	0.846	**0.696**	–	–	–	–
PE	0.779	0.965	0.840	0.592	**0.897**	–	–	–
PS	0.175	0.582	0.233	0.070	0.417	**0.487**	–	–
SI	0.610	0.830	0.660	0.446	0.792	0.846	**0.557**	–

Source: own study based on calculations in PLS-SEM.

According to Hair *et al.* (2011), variance inflation factor (VIF) values exceeding 5.0 indicate the presence of multicollinearity. Prior to the estimation of the structural model, we conducted a multi-collinearity test to evaluate VIF values. The VIF values of our model (Table 1) show no multicollinearity issues between latent constructs. However, the model meets the less permissive 3.0 value.

Structural Model and Hypothesis Testing

Once we tested the variables included in the model, we conducted the structural model assessment via 5000 bootstrap calculations, during which, we evaluated the statistical significance of the path coefficient was evaluated (hypotheses testing). To assess the fitness of the model, we employed the standardized root mean square (SRMR) with a value of less than 0.08 deemed appropriate according to Henseler *et al.* (2016). The model demonstrates an adequate level of model fitness, as indicated by an SRMR value of 0.061, which indicates a good fit. Figure 2 shows a representation of the final model.

According to Knock (2015), common method bias (CMB) can be excluded if a "full collinearity test is equal to or lower than 3.3." Outer VIF values did not show any multicollinearity issues (Table 1) and inner VIF values have been as follows: PE→BI: 3.282; EE→BI: 3.402; SI→BI: 2.585; FC→BI: 2.428; HM→BI: 3.763; AT→BI: 2.396; PS→BI: 1.437. Moreover, EE and HM were not considerably above the limit value. Thus, we detected no CMB in our model.

The final model has an adjusted R^2 value of 0.766 (p=0.000), which suggests that a 76.6% variance of the behavioural intention of cashierless stores can be accounted for by the analysed seven latent variables. Noteworthy, 0.766 value means a strong explanatory power according to Henseler *et al.* (2009) and Hair *et al.* (2011), therefore the structural model was substantial (>0.75). We analysed the relationships of the research model to test seven hypotheses. Results in Table 4 show that performance expectancy (ß=0.439, p=0.000), effort expectancy (ß=0.119, p=0.024), social influence (ß=0.099, p=0.027), hedonic motivation (ß=0.282, p=0.000), and price sensitivity (ß=0.146, p=0.000) significantly influenced behavioural intention (BI) while facilitating conditions (ß=-0.047, p=0.255), and atmosphere (ß=-0.041, p=0.261) have no proven meaningful effect on BI variable.

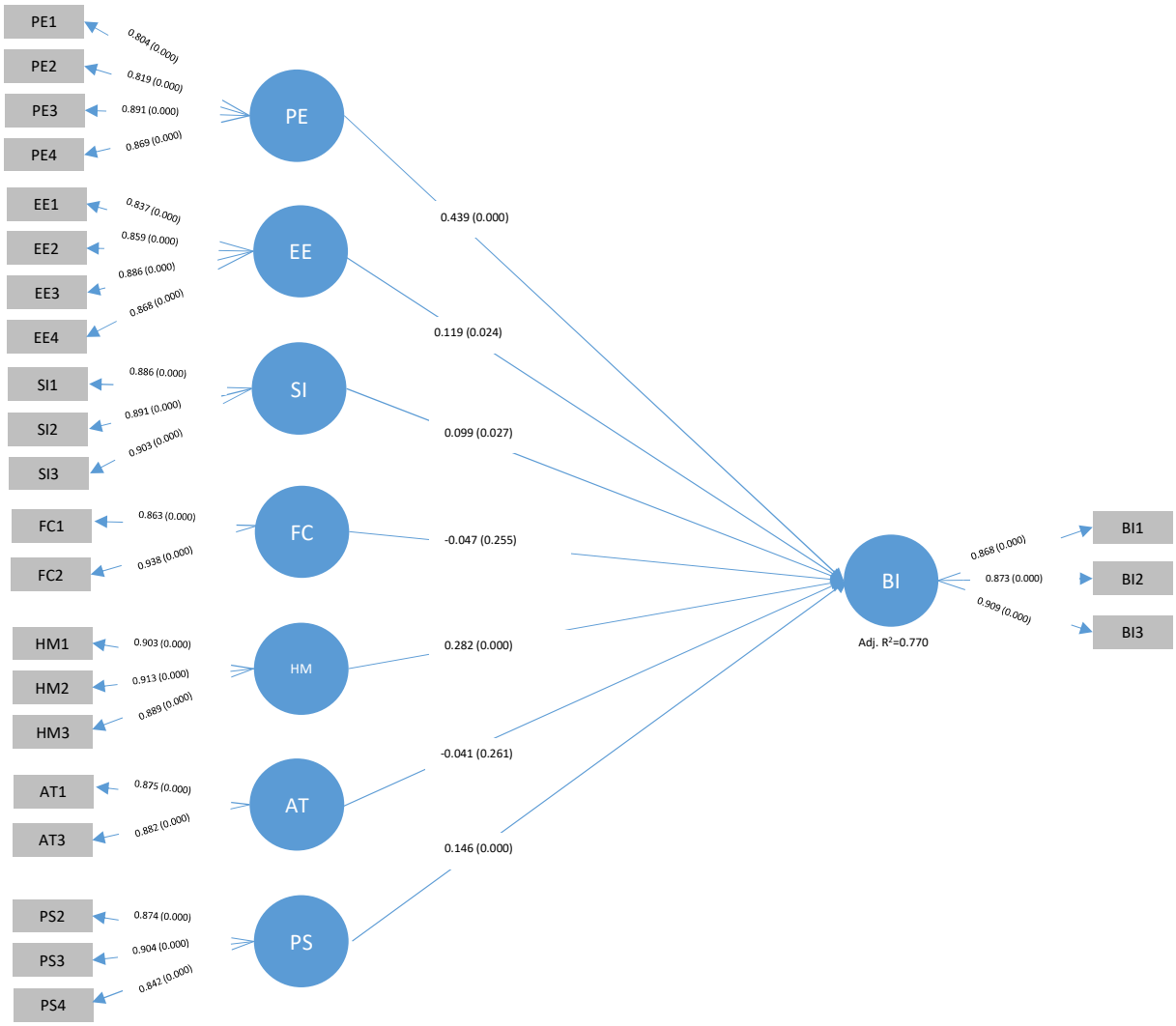

Figure 2. Validated research model of unmanned store technology acceptance in Croatia
Source: own elaboration based on calculations in PLS-SEM.

Table 4. Bootstrap results and hypothesis results

Paths and Hypotheses	Coefficient (ß)	Sample mean	STDEV	t statistics	p values	Hypothesis validation
PE -> BI (H1)	0.439	0.440	0.061	7.134	0.000*	*supported*
EE -> BI (H2)	0.119	0.120	0.053	2.258	0.024*	*supported*
SI -> BI (H4)	0.099	0.100	0.045	2.218	0.027*	*supported*
FC -> BI (H3)	-0.047	-0.047	0.041	1.139	0.255	rejected
HM -> BI (H5)	0.282	0.280	0.053	5.291	0.000*	*supported*
AT -> BI (H6)	-0.041	-0.041	0.037	1.125	0.261	rejected
PS -> BI (H7)	0.146	0.146	0.034	4.331	0.000*	*supported*

Source: own elaboration based on calculations in PLS-SEM.

CONCLUSIONS

As Vitezić and Perić (2024) have posited, technology is evolving at a rapid pace. It is therefore of interest to ascertain whether consumers' attitudes towards AI devices evolve over time and at what rate. The undertaking of new cross-sectional and longitudinal studies in diverse service areas may yield novel insights into the acceptance of AI devices. This study aimed to investigate the factors influencing user acceptance of AI-driven unmanned technologies among Croatian university students, who represent the primary target group for this technology (Jung *et al.*, 2024). We based the model used in the

study on the UTAUT2 model. We collected data through an anonymous online survey. We used the bootstrap method (Table 4) to test the hypotheses using a recommended sub-sample of 5000. The coefficients (ß) were from -1 to +1, the closest coefficient to -1 indicated a strong negative relationship, and the closest coefficient to +1 indicated a strong positive relationship (Hair *et al.,* 2021).

Based on our results, there was a proven statistical relationship (p=0.000) between performance expectancy (PE) and behavioural intention (BI), thus performance expectancy (PE) directly and positively influences behavioural intention (BI) in cashierless smart stores. Therefore, we confirmed the first hypothesis (H1). From a practical point of view, it can be concluded that university students believe that cashierless technology would be useful in their daily lives, which would increase their flexibility and help them to be more efficient and complete their shopping faster. Moreover, the PE variable is one of the main constructs in various studies, and in many cases, it has the strongest predictive effect on BI (Kapser-Abdelrahman, 2020). Prior studies showed a relationship between PE and BI. Arpaci *et al.* (2022) examined Metaverse acceptance and found that people would not avoid using Metaverse if they believed that they would benefit from it easily and quickly. Furthermore, the PE construct is proven to be significant in various fields of science from medical sciences (Schmitz *et al.*, 2022), financial technology (Senyo & Osabutey, 2020) to education technology (Meet *et al.*, 2022).

Noteworthy, the younger generation is receptive to new technology and therefore represents a potential target audience for the development of marketing strategies.

We investigated a statistically significant relationship (p=0.027) between social influence (SI) and behavioural intention (BI). Thus, we confirmed hypothesis three (H3). Social influence has a direct and positive impact on the behavioural intention of these stores, *i.e.* respondents care about other people's opinions on whether they use the technology. It is well established that in some cases, we change our opinions or actions as a result of the opinions of others, and it is particularly true for the younger generations that the opinions of others significantly influence their actions (Deutsch-Gerard, 1955). In their study about mobile banking, Dhingra and Gupta (2020) have come to the same result, namely that SI has a predatory effect on BI. Korkmaz *et al.* (2022) examined autonomous public transport systems in which the authors found that the attitude of people in the user's social circle towards a new technology has a direct impact on the user's attitude towards the technology and thus on their willingness to adopt and use the technology.

We found no proven statistical relationship (p=0.255) between facilitating conditions (FC) and behavioural intention (BI). Thus, there was no confirmed relationship between behavioural intention and the resources needed to shop in unstaffed smart shops, such as smartphones, internet connection, smartphone compatibility, or other technologies used by respondents. This result was surprising because we expected a proven link precisely for this generation. Using smart devices is now taken for granted by this generation, so this may have also played a part in the results. Hence, we rejected hypothesis four (H4), according to which facilitating conditions directly and positively influence behavioural intention in cashierless smart shops. In their studies, Shoheib and Abu-Shanab (2022) found that in the case of social commerce, FC has a proven effect on BI. Meanwhile, Beh *et al*. (2021) found that FC impacts BI in smartwatch use. However, similarly to the results of this study, Nordhoff *et al.* (2020) found no significant effect between FC and BI in the case of automated cars. However, paths have also been examined from other angles and found proven relationships between SI→FC, FC→EE and FC→HM.

We found a statistically proven relationship between hedonic motivation (HM) and behavioural intention (BI) (p=0.000). We confirmed hypothesis five (H5) that hedonic motivation directly and positively influences the intention to use cashierless smart stores. These results suggest that students perceive shopping in cashierless stores as fun and enjoyable, which may encourage them to shop in such stores in the future. Prior research supported the significant relationship between HM and BI (Nordhoff *et al.*, 2020; Nikolopoulou *et al.,* 2021; Arpaci *et al.,* 2022). The customer experience plays an important role for Generation Z and innovative technologies are increasingly being used by retail stores to enhance the customer experience (Poncin *et al.*, 2017; Adapa *et al.*, 2020).

We did not confirm the statistical relationship between atmosphere (AT) and behavioural intention (BI) (p=0.261). Therefore, we rejected our hypothesis (H6) that atmosphere (AT) directly

and positively influences behavioural intention in cashierless smart stores. Accordingly, respondents did not feel they would have advantages from the less crowded location in unmanned shops and the cleaner and simpler interior.

We identified several key considerations for practitioners, given the statistically proven relationship (p=0.000) between price sensitivity (PS) and behavioural intention (BI). This validates our hypothesis seven (H7), indicating that price sensitivity (PS) has a direct and positive effect on behavioural intention for Croatian university students in cashierless smart shops. Previously, Kapser and Abdelrahman (2020) examined PS and their studies have concluded that PS negatively influences BI in Germany, meaning PS was the most relevant construct for user acceptance of autonomous delivery vehicles before the actual market launch of technology. Mathew *et al.* (2023) examined price sensitivity on attitudes about last-mile drone delivery of food products in India. They found that PS impacts attitudes in an emerging country like India where concerns about higher prices of a new technology were validated. Regarding our results, we can conclude that the surveyed respondents were reluctant to pay more for a product, because it is sold in a new technological environment. This result is in line with the fact that Croatian consumers are price-sensitive (Milaković & Mihić, 2016). The other reason may also be that members of this generation do not necessarily have sufficient income. This suggests the need for a well-considered pricing strategy for automated stores where the pricing strategy should be adapted to the size of the shop and the purpose of use (*e.g.,* convenience quick purchase or weekly shopping).

In 2023, Konzum launched the first unmanned automated shop in Zagreb, Croatia. It is still considered a limited availability technology in Croatia and worldwide. However, scholars predict further expansion of this market (Kwon & Ahn, 2023). Knežević *et al.* (2016) found that new market conditions could create opportunities for small retailers. One such opportunity is the distribution of cashierless, unmanned technology. Hence, it is important and timely to investigate the factors influencing behavioural intention and, with the uptake, the actual use, which can serve as a guide for experts.

This research makes a significant theoretical contribution by being the first research in Croatia and the Central-Eastern-European on the topic. We formulated a modified model using the core variables of UTAUT2 and we adapted the model to the technological specificities. We applied further development with a new construct called atmosphere (AT). The construct aimed to explore whether behavioural intentions are influenced by the specific internal atmosphere of shops. We made a comparative analysis with the existing research about technology acceptance and the modified model could serve as a basis for future research on technology adoption and for investigating unmanned technologies.

The managerial implications of this article constitute a valuable contribution to our understanding of the factors influencing the willingness to adopt AI-powered unmanned stores. This is crucial given the growing labour shortage in the retail industry and the need for faster adoption of new technologies. This study could serve as a guide for stakeholders, outlining the strategies, measures, and pricing policies that should be introduced in AI-driven cashierless stores to ensure their success. It is crucial to recognise that the younger generation is receptive to new technologies and enjoys experiencing this new trend. Therefore, they represent a potential target group for the development of business, communication, and marketing strategies. The efficiency of the shopping process is an important factor, thus, the provision of convenience features is essential. The communication strategy of unmanned stores is recommended to be based on our result that the opinions of others are important to Generation Z. Nevertheless, given the price-sensitive nature of the target audience, it is of paramount importance for stakeholders to consider this factor throughout the pricing policy.

We examined the technology acceptance of AI-based cashierless technology among university students in Croatia. However, the findings may be limited by the fact that some respondents did not have experience purchasing in unmanned stores, and thus may not have had a realistic consumer experience. For this reason, we analysed only behavioural intention. Besides that, we collected the data used in this study via an online survey in Croatia and therefore the generalisability and conclusions of the proposed model can be expanded by further research at different locations. The format of cashierless stores is already available in more and more countries such as the United States, Canada, China, Croatia, Israel, Hungary, Poland, and Sweden (Szabó-Szentgróti *et al.*, 2023a).

A future study could investigate the differences in consumer behaviour depending on the country's level of economic development. Furthermore, cross-sectoral data can improve our understanding of how the perceptions of customers with different characteristics influence the strategies that emerge in the retail sector.

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Appendix A: Survey statements

Code	Constructs and statements	Measure source
	Performance expectancy	
PE1	I would find automated smart stores useful in my daily life.	Venkatesh *et al*. (2012), Kapser & Abdelrahman (2020)
PE2	Using automated smart stores would increase my flexibility in my daily life.	
PE3	Using automated smart stores would help me accomplish things more quickly.	
PE4	Using automated smart stores would increase my productivity.	
	Effort expectancy	
EE1	Learning how to shop in automated smart stores would be easy for me.	Venkatesh *et al*. (2012)
EE2	My interaction with automated smart stores would be clear and understandable.	
EE3	I would find automated smart stores easy to use.	
EE4	It would be easy for me to become skilful at shopping in automated smart stores.	
	Social influence	
SI1	People who are important to me would think that I should shop at automated smart stores.	Venkatesh *et al.* (2012)
SI2	People who influence my behaviour would think that I should shop at automated smart stores.	
SI3	People whose opinions I value would prefer that I shop at automated smart stores.	
	Facilitating conditions	
FC1	I have the resources necessary to shop at automated smart stores (*e.g.,* smartphone, internet).	Venkatesh *et al.* (2012)
FC2	I know necessary to shop at automated smart stores (*e.g.,* using the application).	
FC3	Automated smart stores are compatible with other technologies I use (*e.g.,* smartphone). (deleted)	
FC4	I can get help from others when I have difficulties shopping at automated smart stores. (deleted)	
	Hedonic motivation	
HM1	Shopping at automated smart stores would be fun.	Venkatesh *et al*. (2012)
HM2	Shopping at automated smart stores would be enjoyable.	
HM3	Shopping at automated smart stores would be very entertaining.	
	Atmosphere	
AT1	I would prefer automated smart stores to be less crowded with customers.	Own statements
AT2	I would prefer automated smart stores to have a smaller selection of products. (deleted)	
AT3	I would prefer automated smart stores to have clean and simple interiors.	
AT4	I would find products easier in automated smart stores. (deleted)	
	Price sensitivity	
PS1	Automated smart stores would offer me better value for money. (deleted)	Indrawati & Putri (2018), Kapser & Abdelrahman (2020)
PS2	I would not mind paying more to try automated smart stores as a shopping option.	
PS3	I would not mind spending more money to get my shopping done in automated smart stores.	
PS4	If I knew that automated smart stores were likely to be more expensive than conventional shopping options that would not matter to me.	
	Behavioural intention	
BI1	I intend to shop at automated smart stores in the future.	Venkatesh *et al*. (2012), Kapser & Abdelrahman (2020)
BI2	I would always try to shop at automated smart stores in my daily life.	
BI3	I plan to shop at automated smart stores frequently when available in the future.	

Source: own study.

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Conflict of Interest

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