



POZNAŃ UNIVERSITY
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AND BUSINESS



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DIGITISATION AND AUTOMATION OF PUBLIC SERVICES

Vulnerability Analysis of Self-Check-Out-Stores

MSc in Transition Innovation and Sustainability Environments (TISE)

Transdisciplinary Field Research Training

Supervisors: Dr. Marguerite Barry & Dr. Günther Schreder

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Asmita Singh

Aymen Abbas

Giovanni Baccani

Kamila Akhmetova

Stefano Zaniboni

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Part I: Understanding the Technology

Introduction

“Europeans spend between 17 and 35 minutes per day on shopping and personal services”. According to Eurostat, the time Europeans spend on shopping and personal services (like visiting a doctor or a hairdresser) ranges from 17 minutes per day in Romania to 35 minutes in Germany, according to a survey carried out in 15 EU countries between 2008 and 2015. As urban lives become hectic and population concentration in cities has been at the highest levels in history, there is an obvious inclination towards solving associated problems for consumers and improving the shopping experience. One of the ways companies claim to achieve this is by automating the shopping process, for example, Amazon Go is an unmanned, self-checkout store which promises a really fast and convenient shopping experience for the urban shopper who has an established digital presence on their mobile phone application with a payment method already set up. The foundation of such shopping experience is the complete digitization and automation of every stage a consumer goes through when shopping starting from entering the store to exiting without human intervention. Contemporarily, the fabric of this automated shopping experience is primarily reliant on an automated store access through the mobile application with a QR code to scan at the entry checkpoint at the store, and tracking the mobile application owner with cameras and proximity sensors, utilizing weight of the products/produce off the shelves to add it to cart on the mobile application remotely and allow the consumer to exit the store without having to interact with a human cashier by automatically debiting the payment method in-app at the exit checkpoint for the items in the cart. The after-sales support are still under development, as is the concept, which is fairly recent with the first such store opened in the US in 2018.

Literature Review

Self-service technologies (SSTs) have become a ubiquitous feature of the contemporary retail environment. The adoption of these technologies has been on the rise, and they have increasingly been integrated into the retail industry in recent times (Arnfield, 2014; Yang et al., 2012). Over the recent years, a considerable number of reputable European retailers have

demonstrated a strong inclination towards investing heavily in self-scanning technology, which they consider an integral component of their growth strategy (Retail Technology, 2010). Such a shift in focus has led to the development and implementation of SSTs as a means of providing personalized services to consumers. It enables retailers to enhance customer experience by providing them with options to make purchases, seek assistance, and access information without requiring the intervention of human personnel. The adoption has brought about significant changes in the way customers interact with businesses and has revolutionized the retail landscape (Lee et al., 2023). These technologies have brought profound changes to business models. Among their many benefits, they enable customers to engage in activities that were previously restricted to employees which resulted in a more interactive and engaging shopping experience for customers and has the potential to enhance customer loyalty and increase sales (Roy et al., 2018). Brick-and-mortar retailers can use it as a means of improving the shopping experience, customer service, and gaining a competitive edge. This technology also serves as a way for businesses to stay competitive in today's market (Betzing, Hoang, & Becker, 2018). The global self-service technology market is predicted to reach a valuation of USD 32 billion by 2023, driving the demand for better consumer services. (Market Study Report LLC, 2019). The goal of SSTs ranges from saving the customer time (Meuter et al., 2000) to reduce waiting time, thus speeding up the billing process (Dabholkar & Bagozzi, 2002).

Marzocchi and Zammit (2006) emphasized the advantages of self-service technologies (SSTs) for customers. Using SSTs enables customers to better manage their budgets and access more information about products and offers. In terms of service delivery, the effectiveness of SSTs for customers has been measured by their level of engagement, which in turn reduces costs and enhances service quality and productivity.

Weijters et al., (2007) and Yang et al., (2011) contended that self-service technologies (SSTs) have brought about substantial transformations in the way services are both provided and used. Customers also partake in the delivery of these services by means of SSTs. By boosting customer satisfaction, SSTs can foster customer loyalty. Hilton et al., (2013) argue that by using these SSTs, shoppers can share their feedback regarding products purchased from a store. In doing so, other potential customers get a chance to decide whether to buy the product based on the information provided by other customers.

According to the research conducted by Fernandes and Pedroso (2017), Self-Service Technologies (SSTs) with user-friendly interfaces have the potential to enhance the perceived ease of use (PEOU) and perceived usefulness (PU) of users, thereby reducing service failures, improving accuracy, and increasing usage. Additionally, H. Lee et al. (2009) opine that the quality of service provided by SSTs can be influenced by various factors like convenience, assurance, design, enjoyment, and interface functionality. The use of self-service technologies (SSTs) is often associated with increased speed and convenience for customers. There are five main perceived benefits of SSTs, which include: a) maximum convenience, b) cost savings, c) increased options for service and product delivery, d) a sense of intrinsic gain for the customer, such as feeling necessary, recognized, and independent, and e) improved service quality, as customers gain greater control over their transactions (Rinta-Kahila, 2013). According to Renko and Druzijanic (2014), self-checkouts offer several significant advantages for consumers. These include a faster-perceived checkout process, shorter lines, and increased privacy. Additionally, self-checkouts provide a high level of convenience and allow store employees to help shoppers with purchase decisions, while also giving consumers greater control over their checkout experience. Finally, self-checkouts enable shoppers to scan items at their own pace, which allows for more time to verify prices.

Customer Challenges: As the use of self-service technologies (SSTs) increases, there is a growing concern that customers may be burdened with additional responsibilities and end up doing more work than they would in a traditional service setting. This can discourage customers from utilizing SSTs while shopping. Studies by H. Lee et al. (2009) and Yang et al. (2012) suggest that SSTs may have some disadvantages as during peak hours, customers who are required to use a self-checkout terminal might experience queues, or they may encounter slow service. An important problem that was identified during early research on SSTs was related to this issue. According to H. Lee et al. (2009), certain retailers do not keep self-checkout available for customers throughout their entire business hours. As a result, customers may have to use traditional checkout lanes at night. Renko & Druzijanic (2014) explain that self-checkout systems have a few drawbacks for customers, including the fear of making mistakes, the potential for technology-related errors that require assistance from a cashier, and slower checkout times when purchasing items like cigarettes or alcohol.

Due to the ongoing progress of e-commerce, the way we shop for groceries is rapidly changing. Grocers are transforming the in-store and online experience to offer more convenience, such as home delivery, store pickup, and Amazon Go's checkout-free shopping. To enhance the grocery shopping experience, retailers are incorporating artificial intelligence into smart shelf-label technologies (Relex, 2019). Shoppers who go to grocery stores are seeking ways to save time and be efficient. They are expecting technological advancements to provide them with a smooth and seamless experience, whether they are shopping in-store or online. Additionally, the use of mobile devices as a new digital platform has revolutionized the way shoppers interact with retailers, both online and in person. Customers are seeking a personal touch as well, desiring individualized recommendations and interactive shopping experiences that are enjoyable. (Source: Whisk, 2019) According to a recent report by PwC (2019), Irish customers are quickly adopting new technologies, such as AI-powered digital voice assistants, smart devices for mobile payments, and digital wallets for click-and-collect, and are willing to pay for a consistent experience. Although online and mobile shopping has significantly increased, shoppers still value the in-store shopping experience (PwC, 2019). As a result, the retail market has been greatly influenced by the impact of e-commerce businesses and the rapid growth of mobile connectivity. Nevertheless, there remains a vast segment of customers who prefer to shop in physical retail stores. The decision-making process of consumers is often influenced by the tactile experience of physically touching and feeling a product which cannot be replicated through online shopping. This underscores the significance of brick-and-mortar retail stores, which are increasingly adopting innovative in-store technologies to elevate the shopping experience (Richardson, 2018).

Ireland Grocery Retailing: In 2018, the estimated value of grocery retail sales in Ireland was €14.6 billion, which was predicted to rise to €14.9 billion in 2019. The grocery retail market in Northern Ireland (NI) is dominated by supermarkets, accounting for 60% of the market, whereas in Ireland, supermarkets account for 53%. The remaining market share is made up of convenience stores, forecourt retailers, and discounters (Mintel, 2018). According to Mintel's research, the primary grocery shopping in households across Ireland is done by women. In 2018, 57% of grocery shoppers in the Republic of Ireland and 64% in Northern Ireland were predominantly female. Although 34% of grocery shoppers in the Republic of Ireland and 25% in Northern Ireland are men, they share the responsibility with others. As a result, females remain the leading shoppers, while Irish males believe they share grocery responsibilities equally. Self-service kiosks were implemented in Irish retail stores in 2003, allowing customers to check out their purchases without assistance. (Lawlor, 2016). The introduction of self-checkout systems in supermarkets and grocery retail establishments was largely driven by consumer preference. A spokesperson for Tesco in Ireland provided this explanation, citing the pivotal role of customer choice in the implementation of these technologies. (Irish Examiner, 2013 As per recent research, a significant

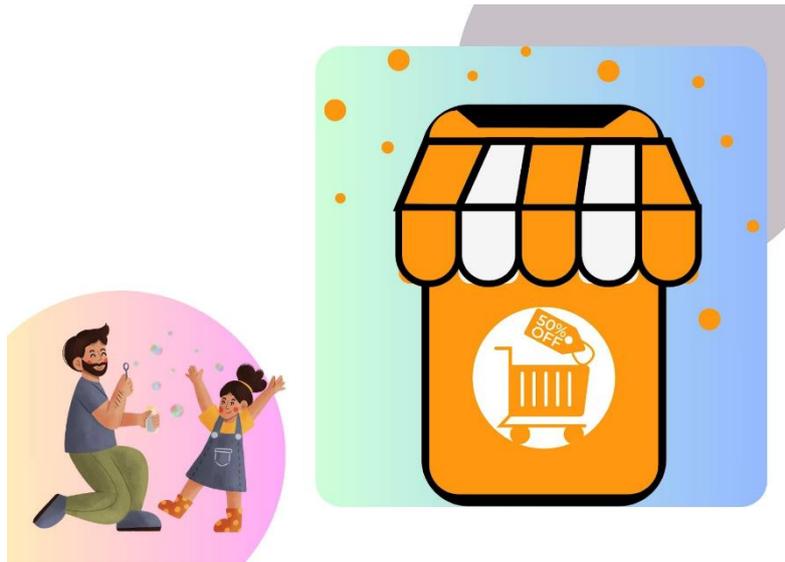
majority of shoppers in Ireland, amounting to 83%, have shown a preference for self-checkout systems over their traditional counterparts manned by cashiers. The increased speed and convenience offered by these systems have made them popular among shoppers. However, it has come to light that elderly customers do not seem to share the same level of enthusiasm for these systems. (Empathy Research, 2018).

The installation process of the self-checkout system by NCR and CBE has been completed at JC's Supermarket in Dublin, which is a noteworthy Irish supermarket. Being the largest retail store in Ireland, JC's Supermarket is now encouraging the overall Irish retail sector to adopt SCS. JC Supermarket faced the difficulty of satisfying customer demands and improving its competitive standing in the nearby market. (Andriulo et al., 2015). Many major supermarket chains such as Tesco, Sainsbury's, Asda, and Morrison's have been actively embracing self-checkout technologies in Ireland. Self-checkout facilities are now widely available in most of these stores. For instance, Tesco has taken the lead in implementing self-service tills, with almost half of its 2115 stores across the UK now offering this technology. Asda has upgraded the checkout systems in nearly all of its stores. The supermarkets have cited faster customer flow as the main reason behind this move towards automation. (Financial Times, 2019).

Customer Journey Map

In order to arrive at the research question, we decided to map a "Customer Journey" from the Customer Excellence (CX) domain of software engineering as a way to analyse the journey of a customer in the backdrop of a service in a very specific circumstance and then derive the different aspects of the process in a big picture scenario from the peculiarities observed in the map. We used a CX tool known as "Uxpressia" to draw the map. In order to outline a typical customer journey, we designed a "Day in the life" of an urban parent scenario, who belongs to a middle to high income household who decides to go into an unmanned, self-checkout store like Amazon Go, with their child, to grab a quick breakfast while on the way to work. And two scenarios that we noticed could be particularly problematic (according to us), were designed, which raise questions on safety, transparency, data protection, incidents, and other phenomena that can happen at an unmanned, self-checkout convenience market visit from the perspective of both the consumer, and the designer of the concept.

Customer Journey Map: Vlad, Vanessa and the convenience store of the future!



Background

Vlad is an artist who lives in a big city, in a family of 3 people. On this day Vlad is running late for work and their 11-year-old child Vanessa has to be dropped off at school. Vlad needs a quick meal before they head to work and it has to be bought from a place on the way to their office. Vlad searches for a place to grab a quick breakfast near their workplace on the internet and stumbles upon a social media ad for an unmanned self-checkout store which promises a very quick and easy shopping experience. Vlad loads the directions to the store on his cell phone app, and heads in the direction with Vanessa, who will later head to school. Vanessa is excited about going to an unmanned store.

Scenario 1

Vlad downloads the store application which mandates sharing of preliminary data, Vlad's location, name, bank and payment details to access the store. Soon they arrive at the store. At the store Vlad scanned their QR code from the store application onto the entry checkpoint at the store. They then proceed with the shopping. As they enter the store Vlad is immediately worried about the surveillance with cameras and sensors and especially about the safety of their minor child. They wonder if there is a way to ensure that the surveillance would end when they leave the store, there seems to be no information about this on the store application or in store. The store utilizes item weight, cameras and sensors to add an item to the cart when Vlad picks it up and automatically deletes the item from the card if they put it back. Vlad picks up four things and Vanessa asks if she can have some candy. Vlad refuses and signals them to move to the next aisle.

Scenario 2

Vanessa gets upset when they do not get the candy, and decides to take the candy and put it in her pocket without telling Vlad. However, Vanessa gets nervous while doing this and accidentally bumps into an aisle of drinks, spilling a bottle of Gatorade on the ground. Frustrated

and in a hurry to leave, Vlad looks for store assistance; or help to clean the floor up. However, this is an unmanned store so Vlad ends up finding no one. Since they are already late for work, Vlad and Vanessa reach the exit checkpoint in a hurry where Vlad taps the store application to pay and proceeds to work. Later during the day Vlad checks their wallet on the self-checkout Store app, to find out if he was charged for the spilled drink and finds out about an extra charge for candy he did not buy.

Customer Journey

1. Vlad is an artist living in a big city, with a family of 3 people.
2. Today they are running late for work, need quick lunch, and to drop their 11-year-old child, Vanessa, to school.
3. Vlad sees an advertisement for a "No-Queue, No Cashier" self-checkout store on the way to work and decides to try it.
4. Vlad downloads the mandated phone app to access the store and is ready to go shopping.
5. Vanessa is excited to go to an unmanned store.
6. As Vlad & Vanessa enter the store, Vlad is immediately worried about the surveillance and wonders if there's a way to ensure the tracking stops when they leave the store.
7. Vlad picks up 4 items and the cameras and sensors automatically add the products onto the cart on the store app.
8. Vanessa asks Vlad if they can get some candy and Vlad refuses.
9. When Vlad isn't looking Vanessa grabs some candy and puts it in their pocket.
10. While grabbing candy, Vanessa gets nervous and spills a drink on the floor.
11. Frustrated, Vlad seeks help for cleaning but since this is an unmanned store, he couldn't find any.
12. Vlad and Vanessa have no choice but to leave the mess and hurry outside the store.
13. At the store checkpoint just before exit, Vlad's payment method on the app is automatically charged for his purchase.
14. Later during the day, Vlad notices he paid for some candy but not the spilled drink. They do not know who to approach since this was an unmanned store.

Problem Definition

Immersion in the project began with a brainstorming session, during which various ideas related to the digitisation and automation of public services were discussed. During the discussions, team members carefully reviewed and compared many promising ideas, ranging from the development of an application to support the mental health of students, to a chatbot focused on the needs of agriculture, namely supporting farmers. Through careful discussions and analysis of various literature and research materials on relevant topics, the team members came to the decision and eventually, the “Vulnerabilities analysis of self-checkout stores” was chosen as a topic.

From the perspective of both the consumer and the designer of the unmanned, self-checkout stores, there are some features that differentiate them from brick-and-mortar stores having human employees. From the customer journey map, The customer journey divided the shopping experience into the following areas:

1. **Awareness:** The stage where the consumer first learns about the service and store either through media or family/peers. They often look for videos to prepare them for their first unmanned self-checkout experience since the concept is fairly new.
2. **Consideration:** After their awareness of the concept and depending on their lifestyle, preferences, the consumer may choose to utilize the services of an unmanned, self-checkout store.
3. **Store Access:** The access is through logging into the store’s mobile application, then scanning a QR code either at the store entry barrier or in some cases, the shopping cart which is specifically designed to sign customers in.
4. **In-store experience:** In case of unmanned self checkout stores, the customer experience starts the moment the customer decides to go into the store and logs into the mobile app for this purpose, unlike physical stores where the experience begins when the customer enters the store. The mobile application has directions for the nearest store that the customer can go to or it can redirect the customer to another app interface like Google Maps for the same. In this case it is important to note that surveillance starts even before the customer has stepped into the store. For example the app will know the location of the customer when they decide to navigate towards the store. The in-store experience is based upon two key pillars which are as follows:
 - a. A network of cameras, Sensor fusion and RFID and NFD technologies: These are focussed on not only the customers but the product aisles where they help the software to understand which products have been picked off the shelves. Radio Frequency identification or RFID is a technology that uses radio waves to passively identify a tagged object.
 - b. Computer learning and Deep Learning algorithms: These utilize AI technologies for gathering information about shopping experience and remodeling it for improvement.

Once the user puts something in their card using the proximity sensors, camera input and the weight input from the aisle this product is automatically added to their shopping cart on the mobile application. If the user puts a product back in the aisle, similar kinds of inputs like above inform

the algorithm on the mobile application to remove the product from the user's online shopping cart.

5. **Payment:** After finishing shopping, which in this case means that the user is back to the entry barrier after visiting the product aisles they wanted to, and putting the desired products in their cart, the entry barrier now acts as an exit barrier, the payment method registered on the mobile application is automatically debited for the products in the shopping cart. NFD or Near field detection technologies assist in contactless payment through chip-based cards or mobile phone enabled virtual payment systems.

6. **Technical glitches/assistance:** Since the stores that we are discussing about, are unmanned stores, there is no human assistance available in case of in-store incidents, spillage of products, or a method to raise queries or questions. The only assistance that is available is through television monitors displaying information, sign boards, chatbots and dedicated kiosks.

7. **After-sales experience:** The process of returns, warranties and renewal, replacement and other after-sales services are largely unclear with either the option of chatbots or in-app support. Several companies with remote technical and customer assistance have been criticized for these mechanisms being overly complicated and frustrating experiences for the end user.

Guiding Question and Vulnerabilities

Our guiding question from the above discussion came out to be:
“Unmanned self-checkout stores: shopping experiences of the future or a recipe for automation disaster?”. Every stage has its own set of vulnerabilities, as observed from the Customer Journey map, we can sum these up as:

1. Technology-related

a. **Blanket permission:** the mobile application has the user's information and location, there's no information on when tracking starts or ends, the user's data is shared with third parties using a single permission on the app and the implications of which are unclear.

b. **Surveillance and privacy:** in the event of data breach, false agency and criminal intent, personal safety of consumers is compromised.

c. **Glitches:** in an unmanned store, a technical glitch can cause confusion, losses and even potential threats to life and property.

d. **Emergency assistance:** such stores will rely on non-human assistance to emergencies, which is problematic since it will result in severe losses.

2. Behaviour-related

- a. **Promote gray areas:** without human discretion in the process, consumers will lose their trust in the system and can lead to misuse of the gray areas.
- b. **Promote indiscriminate shopping:** the incident of the stampede over Stanley cups in the USA is an example of how promoting obsessive characteristics can be dangerous.
- c. **No access for people with disabilities:** such stores are advertised as stores for the “achievers”; this is a bad strategy to hide exclusive practices. Merely being able to walk fast and fetch products off aisles is not a sign of individual performance and creates a mental block towards those with disabilities.

3. Consumer protection related

- a. **Absence of a regulatory authority:** while the key areas of the automated shopping experience all have individual regulators, the amalgamation of these areas results in a wider scope of regulation. Also, of concern here is the fact that since AI technologies are developing rapidly, regulators have not caught up to them at the same pace.
- b. **Unmanned dispute resolution:** without a human to inspect/determine the nuances of product or process details, the process can greatly suppress consumer’s rights
- c. **Remote assistance can mar customer experience:** explicit and detailed information on returns, exchanges and defective products etc, is yet to be fleshed out.

4. Payment related

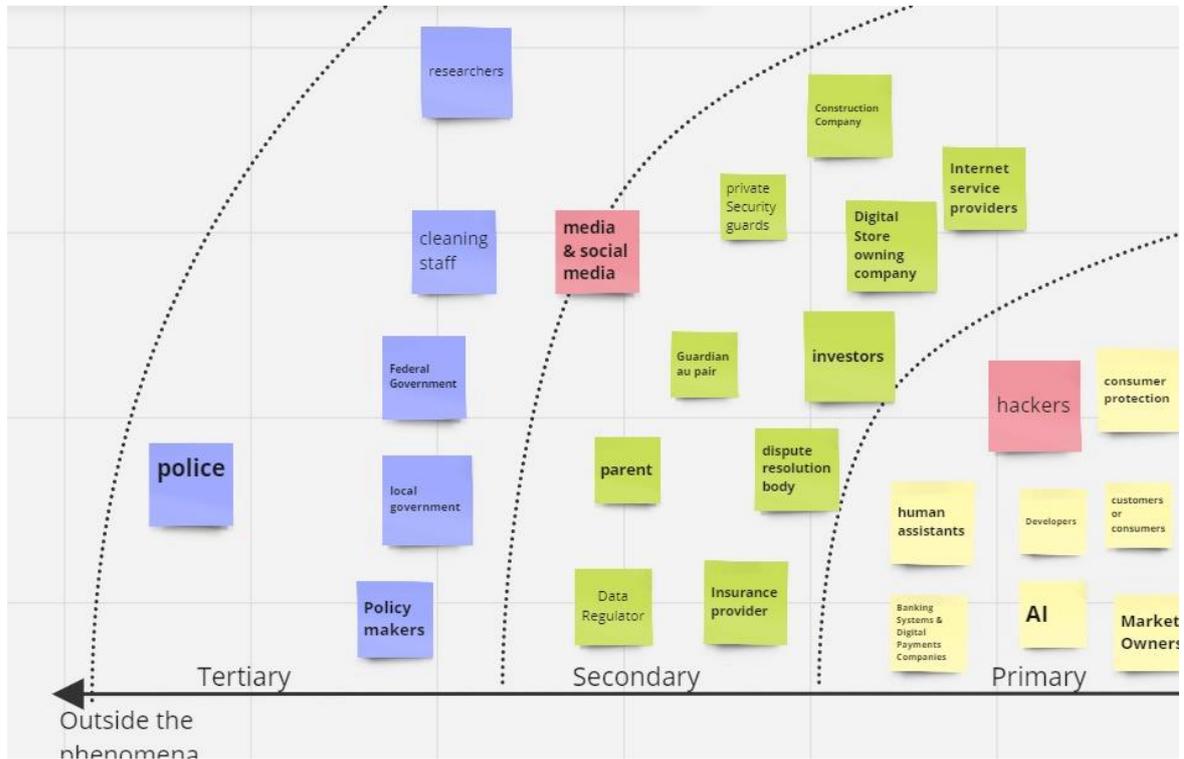
- a. **Credit score:** for consumer eligibility for payment services, information from banks/credit institutions is sought under the "soft credit pull" umbrella without users understanding the implications or consequences.
- b. **Absence of relevant legislation:** payment transaction information is shared with third parties without consent even, since laws have not been specifically designed for such hybrid formats
- c. **Ambiguity:** in case of insufficient balance, the store may block users from further purchases and raise action. However, the stand on this remains unclear. Also, if two consumers are shopping next to one another, erroneous products may be added to cards or swaps many occur.

5. Social impact

- a. **Social exclusion:** the concept of the mobile application is a vital aspect of the completely automated experience, which means that people who do not have access to a mobile phone cannot shop at such stores. The waiting time to set up the app, and the lag at the access checkpoint can be frustrating for some people. The target demographic is also very limited compared to the overall population, and this creates a divide.
- b. **Making technology indispensable:** one of the major concerns about heavy reliance on technology is not just energy and infrastructure intensiveness but also the fact that this will render simple activities which don’t need any additional resources like visiting a market and getting to know local farmers and produce obsolete. Simple activities like these are known to be beneficial for the elderly and growing children and have been known to have a positive impact on mental health of individuals.

c. **Employment loss:** unmanned stores can greatly aggravate unemployment and can add to problems like homelessness, thereby increasing vulnerability.

Stakeholder Analysis



Part II: Discussing the Vulnerabilities from a Transdisciplinary Perspective

Experts Panel Discussion

To understand different perspectives on vulnerabilities issues of self-check-out stores, we have invited scholars to join us in a panel discussion. Our idea was to involve practitioners from multiple research backgrounds to contribute in framing the identified vulnerabilities within their disciplines. Our participants were Prof. Sanda Soucie, Prof. Fabrizio Esposito and Dr. Gunther Schreder. Prof. Soucie has expertise in marketing, and so we were curious to explore with her the business ideas and the strategies implemented by companies to establish these retail facilities. With Prof. Esposito, an expert in private law, we wanted to embrace in our discussion the legal perspective on the issue that might arise within these technologies. Dr. Schreder, a psychologist, impersonated the role of a customer, describing his point of view in relation with his experience as a user.

Experts Profiles

Prof. dr. sc. Sanda Soucie



Tenured Professor at Department of Trade and International Business of the Faculty of Economics & Business at the University of Zagreb, Croatia

Co-ordinator and teacher in Wholesale and retail business, Business Logistics, Trade Services, Fashion Retailing, Trade Business, Store Location and Design Management, Corporate social retail Supply Chain Management, Category Management and Private Brands, Benchmarking, Retail Management, Retail Logistics, Contemporary Strategies of Distribution, Risk and Security Management in Global Logistics courses at the Faculty of Economics & Business in Zagreb

Prof. Fabrizio Esposito



Assistant Professor in Private Law at the NOVA School of Law, Lisbon, Portugal

His research focuses on the relationship between private law, economic law, EU law, economics and legal theory. He is particularly interested in the intersection between consumer law, data protection, competition law, and sector specific legislation in addressing the challenges raised by technological developments in the attention economy. He is currently working on price

personalization, and the use of theories of harm in consumer law with a special attention to consumer data collection. Fabrizio is about to publish a monograph showing how to change the mainstream research paradigm at the intersection between law and economics by taking the consumer interest as core value in market regulation (Nova School of Law, n.d.).

Dr. Günther Schreder



Academic staff research - Department for Knowledge and Communication Management at the University for Continuing Education of Krems, Austria

Research / topics

- Usability and user-centered design
- Information visualization
- Collective intelligence
- Cognitive science of organizational culture and organizational communication

Current lectures

- Usability Design Methods
- Cognitive Psychology

Stakeholder Interaction: Summary

March 19, 2024. @1730 CET

Guest List: Prof. dr. sc Sanda Soucie, Prof. Fabrizio Esposito, Dr. Günther Schreder

The interaction started with our initial Curiosities about the need for automation of the shopping experience, our initial question to Prof. Soucie was what in her opinion would be the motivation behind automation and digitization of the shopping experience and in what manner have the motivations changed the traditional methodology of shopping for consumers. In response, Prof. Soucie introduced us to the disruption caused to the shopping experience by covid-19 pandemic, and how this was the primary reason behind the large-scale automation of the shopping experience. While the first automated shopping experiences came into existence way before the covid-19 pandemic hit, because of the fact that a dire and immediate need was felt in the worldwide lockdowns, to ensure least possible or no human contact, this paved the way for the rise in demand of a consumer shopping experience which was completely automated.

Among other motivations were, the idea of lower human resource expenses for retailers, the ability of the stores staying open for longer hours without human intervention, speed and accuracy of digitized checkout systems, and rising consumer affinity towards mechanized shopping experience among others.

As the discussion progressed, we learned from Prof. Soucie that her perspective was greatly shaped by the shopping experience, consumer expectations and the general societal envelope of Croatia where she is located, which in our humble opinion was a privilege being geographically located far from her. Prof. Soucie introduced us to the concept of the Mediterranean shopping experience, which is influenced by the Collectivist ideology, where the epistemological embodied experience of shopping is shared with family members, friends and other members of the community. The shopping experience is usually local which means that the employees at the grocery stores or supermarkets would know the regular customers, or people who live in the vicinity. This familiarity greatly shapes the shopping experience for example, if a person was to make a return for a product in store, they would generally know the person at the customer service desk of their local store, it would not be very difficult to establish credibility in this circumstance since parties involved already know each other. In sharp contrast, a completely automated shopping experience would have no sense of familiarity or community or even human assistance in the store in case something goes wrong, most stores still do not have a very well-defined methodology for returns in the absence of human employees. In case of Amazon go, to quote, returns are made completely remotely, and in case of a confusion, a query or disagreement with the store or company policy, the consumer has little or no say. This can be very frustrating for the consumer. Prof. Soucie also mentioned that, technological affinity as a driver of automation of Public Services is limited to a very small target demographic and is indicated that it can be an exclusionary practice since a majority of the population may lack the sophisticated digital skills to accomplish a completely automated shopping spree.

Yet another concern voiced by Prof. Soucie, was the fact that, in her opinion, the Pareto Principle has applied and to a large extent still does, to shopping experiences. She mentions that 80% shopping is done in stores where it is relatively easier to facilitate the shopping experience and create demand for other products by creating a good environment of atmosphere, music,

display, human assistance, and the ability to be able to try on products. She opines that it would be detrimental for the industry demand, to lose this envelope of in-store customer experience to mechanization.

For the next part of the discussion, a very interesting anecdote happened to Dr Schreder, while still in the Web Conference. Their home fire alert system had a false alarm, and this pushed us to the next series of concerns about technological failures, privacy concerns and disruptions and how they would impact the functioning of completely mechanized stores and the shopping experience. This brought to light the compliance with GDPR guidelines on privacy, and how the vending machine business model is currently the predecessor for the after-shopping experience of completely automated stores.

Prof. Esposito, in the next part of the discussion shed some light on our transition towards a self-service society and what implications it has on human behaviour. One of the most interesting revelations from this part of the discussion was the fact that, something as mundane as buying groceries has vital lessons in evolving sociology in our post cyborg microcosm. Prof. Esposito talked about impulse control, and how it can stem from the post-cyborg need for escaping from each other as fellow human beings. They questioned the end goal of our civilization in its contemporary phase, and questioned whether our end goal is to live a hyper-urban lifestyle is natural or a construct. They also raised concerns about the link between sustainable development goals and employability, and how the complete mechanization of societal experiences will lead to exacerbation of poverty, homelessness and other economic pitfalls.

With all of these incredible windows into the thought processes of our esteemed guests, the discussion came to a conclusion with the subject of payment method, physical access, store design limitations acting as an impairment to the inclusion of a wider demographic in such experiences, the issue of digital literacy and it creating a pressure be connected to the grid all the time and eventually the fact that these experiences are tailored for the demographic of a certain economic background which can further ameliorate social class vulnerabilities.

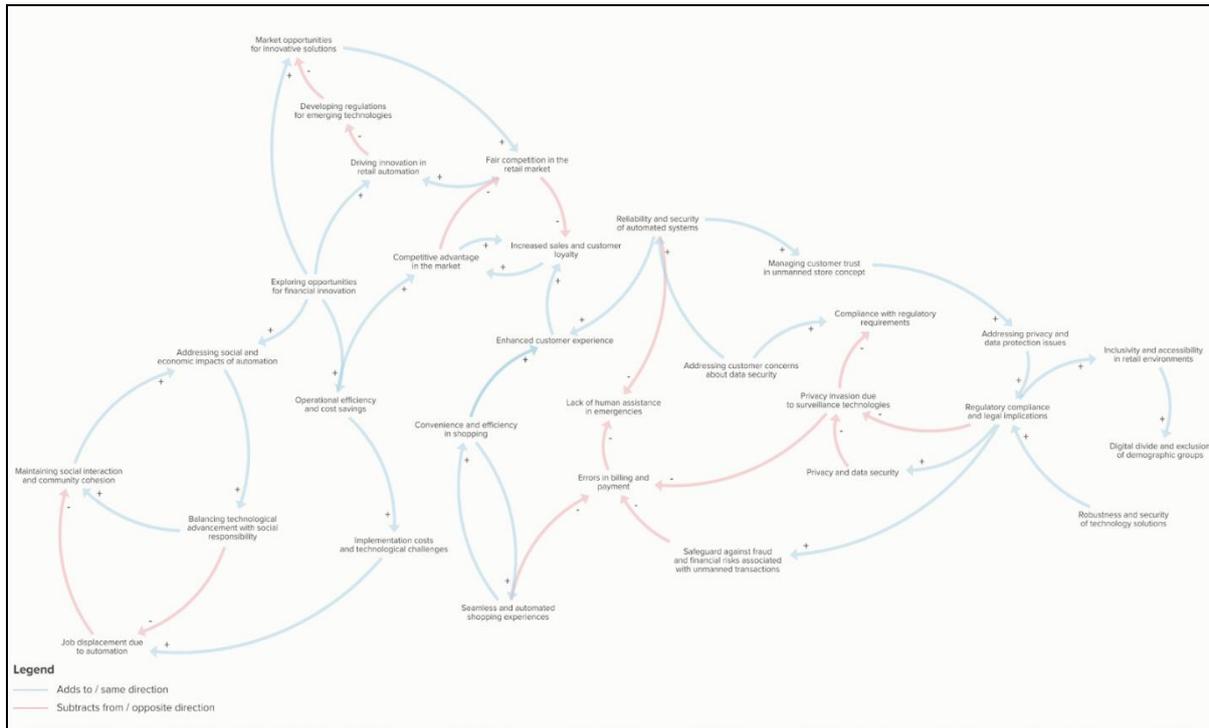
Updated System Model

Updated Stakeholder Analysis

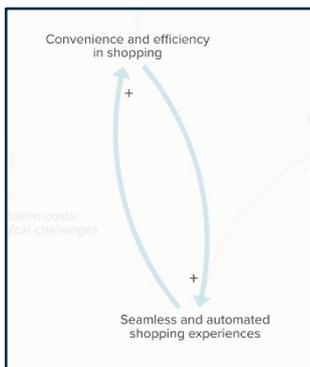
Stakeholder	Interests	Concerns
Consumers	Convenience, speed, and efficiency in shopping. Desire for seamless and automated experiences.	Privacy invasion due to surveillance technologies. Potential errors in billing and payment. Lack of human assistance in case of emergencies or issues. Accessibility for people with disabilities

Retailers	Increased operational efficiency and cost savings. Competitive advantage in the market. Leveraging technology to enhance customer experience. Potential for increased sales and customer loyalty	Implementation costs and technological challenges. Managing customer expectations and trust in the unmanned store concept. Regulatory compliance and legal implications. Ensuring the reliability and security of the automated systems.
Technology Providers	Market opportunities for providing cutting-edge solutions. Driving innovation in retail automation technologies Establishing long-term partnerships with retailers	Ensuring the robustness and security of their technology solutions. Addressing potential privacy and data protection issues Meeting regulatory requirements and industry standards.
Regulatory Bodies and Government Agencies	Ensuring consumer protection and safety standards. Regulating data privacy and security in unmanned retail environments. Promoting fair competition in the retail market	Developing and enforcing regulations for emerging technologies. Monitoring compliance with data protection laws. Addressing potential social and economic impacts of automation on employment and society.
Community and Society	Balancing technological advancement with social responsibility. Ensuring inclusivity and accessibility for all members of society. Minimizing negative impacts on employment and local economies	Potential job displacement due to automation. Widening the digital divide and exclusion of certain demographic groups. Maintaining social interaction and community cohesion in retail spaces.
Financial Institutions	Facilitating secure and seamless payment transactions in unmanned stores. Exploring opportunities for financial innovation and digital banking services.	Safeguarding against fraud and financial risks associated with unmanned transactions

Updated System Model Map



System Model Loops



Feedback Loop 1 outlines the interplay between convenience and efficiency in shopping with seamless, automated shopping experiences. Streamlined checkout, easy navigation, and personalized recommendations drive customer satisfaction and loyalty. On the other hand, disruptions such as technical glitches can interrupt the process, impacting both customer experience and satisfaction and operational efficiency, highlighting the importance of balancing automation with a human touch.

Feedback Loop 2 highlights how unmanned and cashless grocery stores can leverage technology and automation to achieve a competitive advantage in the market through efficient operations and cost savings. The stores offer seamless experiences, encouraging customer return and loyalty through faster

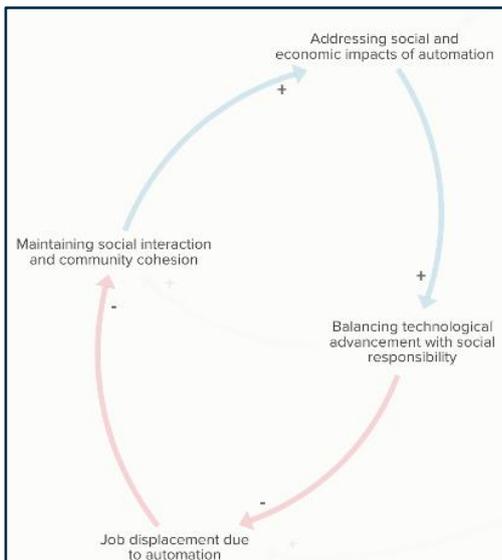
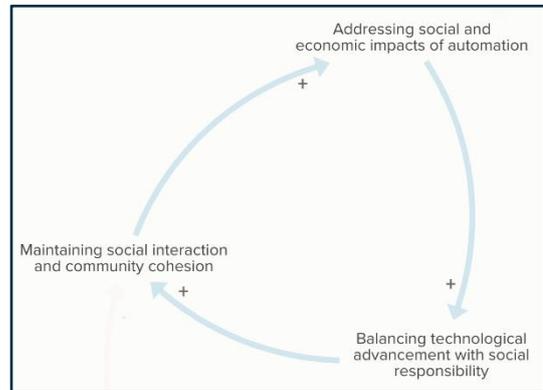


transactions and reduced wait times. The more the client is satisfied, the more the service provider is going to be ahead of the competitors, thus gaining a position of advantage useful to provide a better service for the costumers.

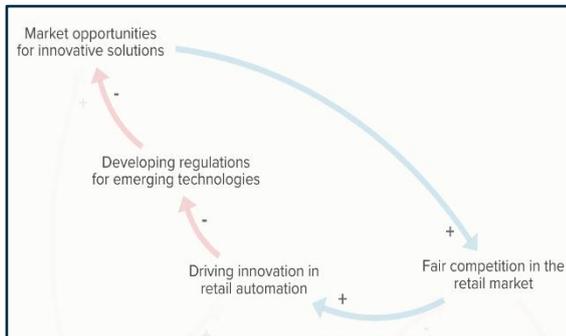


Feedback Loop 3 emphasizes the importance of fair competition in retail operations, ensuring equal opportunities for all players. Fair competition results in more and better choices for customers together with competitive prices, leading to increased sales and customer loyalty. This feedback loop paint the necessity of a healthy market that enhances individual business success by reinforcing customer satisfaction and a positive reputation.

Feedback Loop 4 stress the need to address the social and economic impacts of automation in retail operations. Advanced automation can lead to reduced human interactions and quality of holistic community welfare. Balancing technological progress with social responsibility is essential. Responsible implementation of automation must consider ethical and social implications in the everyday life of the citizens and their interactions together with, ensuring that advancements enhance rather than replace social connections for community cohesion.



Feedback Loop 5 builds on Loop 4, adding the dimension of job displacement . It deepens into the economic impacts of automation and emphasizes the need for balance. While automation can improve efficiency, it may also lead to job displacement and shifts in economic structures, requiring attention to social responsibility. Responsible implementation should consider economical implications and worker rights.



Feedback Loop n.6 in retail operations focuses on market opportunities for innovative solutions and the need to balance them with regulation. Retailers pursue technological advancements and emerging trends to address customer needs, while governments and industry bodies establish rules to govern these new technologies. Continuous innovation in retail automation enhances efficiency and personalization while maintaining fair competition ensures a level playing field and benefits consumers.

Stakeholders Questions

For our inquiry to be complete, we considered it essential to combine the perspective of retail companies to the previous activity. We have tried to reach out to companies that currently dispose of self-check-out stores, such as *Amazon Go*, *Tesco*, and *NanoZabka*. Unfortunately, even if initially they seemed available to be interviewed, none of the companies accepted to participate, although we guaranteed full anonymity. Nevertheless, we want to display the questions we would have addressed to them, may they be useful for further studies.

1. What is the motivation behind your stores?
2. Who is your most common type of customer?
3. Which time is the busiest at your stores in terms of footfall?
4. What happens if a customer needs help or has a question while shopping?
5. What are your policies to ensure customers are adequately informed about the functioning of the service you offer?
6. What is the process of making a return? What is the refund process like?
7. Have you ever had any incident at your stores? What were the issues and how did you deal with them?
8. What safety measures are in place for customer safety at your stores?

Conclusion

The investigation outlined in this report delves into the realm of self-service technologies (SSTs), emphasizing unmanned self-checkout stores, providing a thorough examination of the evolving landscape of digitization and automation within the retail sector. The prevalence of SSTs, notably in European retail contexts, underscores their transformative potential in reshaping business operations and elevating customer experiences through personalized service delivery. However, our inquiry transcends superficial observations, delving into the intricate nuances and vulnerabilities inherent in SST adoption.

Through a meticulous examination of the customer journey map, our research unveils the multifaceted dimensions of SSTs, elucidating various stages and associated challenges. From

technological concerns encompassing surveillance, privacy breaches, and glitches to behavioural implications such as encouraging indiscriminate shopping and perpetuating social exclusion, our analysis exposes the intricate interplay between technology, consumer behaviour, and regulatory dynamics. Critically interrogating our guiding question, "Unmanned self-checkout stores: shopping experiences of the future or a recipe for automation disaster?", our study contributes to a nuanced understanding of the complexities surrounding SSTs. The findings of the interviews with the researchers challenge conventional narratives regarding the universal benefits of automation, stressing the significance of ethical considerations, regulatory frameworks, and inclusive design principles in guiding the development and deployment of automated systems. Stakeholder inquiries into the motivations behind automation reveal a multifaceted landscape driven by factors such as the imperative arising from the COVID-19 pandemic, cost reduction for retailers, extended operational hours, and the allure of streamlined checkout processes. Nevertheless, discussions underscore that geographical and cultural contexts, exemplified by the Mediterranean shopping experience, profoundly influence consumer expectations and preferences, underscoring the necessity of considering local socio-cultural factors in automated system implementation. Concerns regarding technological failures, privacy issues, and societal implications underscore the imperative for comprehensive regulatory frameworks and ethical considerations in deploying such technologies. The discourse also sheds light on the impact of automation on human behaviour and societal dynamics, emphasizing the intricate interplay between technology and social structures. Importantly, our analysis challenges earlier assumptions regarding the universality of automated experiences and underscores the importance of embracing diverse perspectives in understanding the implications of digitization and automation. This report elucidates the limitations of current automated systems in catering to a wider demographic, particularly those with limited digital literacy or physical access. Ultimately, our analysis contributes to a deeper understanding of the vulnerabilities inherent in self-checkout stores and underscores the necessity of a nuanced approach that considers socio-cultural, ethical, and economic dimensions in the digitization of public services.

Through rigorous examination of the scope, generalizability, and scholarly contributions, the analysis enriches scholarly discourse within the realms of public services and retail management, paving the way for future research endeavours aimed at mitigating vulnerabilities and maximizing the societal utility of digitization and automation initiatives.

Solutions - Recommendations

1. To mitigate any misunderstandings in providing information related to fields such as privacy, service provided, and possible in-store incidents, companies may implement a thorough terms and conditions checklist for users to understand in detail how their data will be processed and to prevent any possible incident where they could be involved during their purchases
2. Companies could consider a “trial-and-error approach” as suggested by Prof. Ranchordas (2020) in relation to the digitisation and automation of public services. Applied to the context of self-check-out stores, if the in-store incidents rate is low, customers could be ‘forgiven’, reached out to explain any eventual mistakes they were accountable for and not charged for reparation if this is their first time; only in the eventuality of another incident they would be asked to cover the amount due to repay for the damage created.
3. We support the creation of a legal framework specifically related to self-check-out stores to regulate their functioning and to guarantee the data protection of customers.
4. Our recommendation to companies who want to make use of these technologies within their retail offer is to closely work with consumer’s protection bodies to ensure a transparent and safe user experience.

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