



Grzegorz Chodak

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# The Future of E-commerce

## Innovations and Developments

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# Introduction

The growth of e-commerce over the past three decades has significantly changed the trading environment. During this time, consumers have gone from novice internet users to experienced e-consumers, eager to take advantage of the ever-emerging e-commerce innovations. The last decade or so has seen the revolution of m-commerce and the dynamic development of many online technologies. Recent years have seen the emergence of large language models and the spread of artificial intelligence solutions. The future promises to be truly fascinating.

This book describes the evolution of key areas of e-commerce, showing innovative solutions and technological developments. The book examines innovations in the areas of the online shop user interface, electronic payments, as well as parcel delivery. Among others, technological innovations such as the use of augmented and Virtual Reality in e-commerce and drones and autonomous vehicles for product delivery are discussed, and areas of artificial intelligence applications are analysed. The book aims to equip readers with a profound understanding of opportunities, and trends that define the future of commerce in the digital age. The author uses various research methods, including extensive bibliographic

research, statistical data analysis, surveys, and experimental research, as well as extended interviews with experts to provide a broad picture of e-commerce transformation and different points of view. During the research, the author draws on his twenty-five years of experience as an e-commerce researcher.

The subtitle of the book contains two important words: innovation and development. As innovation, the author adopted the classical approach introduced by Schumpeter, where innovation is understood as the initial unveiling of a novel product, process, method, or system. This characterisation underscores innovation's twofold aspect: it is simultaneously a procedure (the act of introducing) and a result (the new product, process, method, or system introduced) [Quintane et al., 2011]. Examples of innovations discussed in this book include the use of drones for deliveries, a new payment method based on social media activity, the use of Virtual Reality goggles in e-commerce, or applying Large Language Models to content creation. The second word used in the subtitle is development, which is defined as the process in which something grows or changes and becomes more advanced [Cambridge Dictionary, 2024]. It involves the advancements and improvements of ideas, technologies, products, or methods. Development can mean incremental improvements or major breakthroughs that lead to improvements in existing conditions, the introduction of new capabilities, or the solution of problems. The book describes many areas of e-commerce development from showing the development of delivery and payment methods through the development of augmented reality technology to the development of social commerce.

In this book, the author has focused primarily on online sales of goods, while sales of services or digital goods will not be the focus of this book. This choice is dictated by the author's research specialisation in the sale of physical goods over the Internet, and therefore the book extensively discusses order delivery.

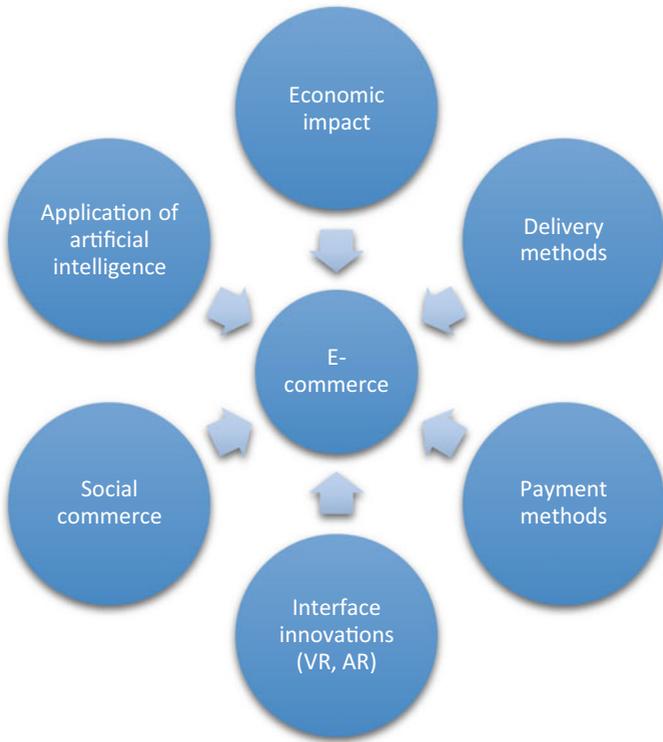
In writing about the future of e-commerce in the first chapter, the author has aimed to show how important e-commerce is for the economy and how it plays a key role in many areas of the economy. The aim of the first chapter is also to show global e-commerce development trends using a few selected time series of data as an example. The following chapters

(from the second to the seventh) discuss the key areas that the author believes will determine the future of e-commerce (Fig. 1). The selection of these areas is subjective and obviously not exhaustive of all aspects of e-commerce. However, in the author's opinion, the area of customer logistics service, the sphere of payments, and the way customers order, i.e., the interface in the broadest sense, including the use of Augmented Reality and Virtual Reality, are three key areas of e-commerce development. Analysing probable e-commerce evolution scenarios, the author concluded that social commerce is a key direction of e-commerce transformation. The penultimate chapter on the use of artificial intelligence in e-commerce seems to be a necessary choice, given the growing role and extremely dynamic development of artificial intelligence tools in the last few years. The last chapter ties all the considerations from chapter two to chapter seven together.

The detailed structure of the book is as follows.

Chapter 1 lays the foundations for further exploration by looking at the impact of e-commerce on the economy. Data analyses show the impact on various aspects of economies, including labour market implications and the far-reaching impact on the globalisation of trade. In addition, the chapter analyses how e-commerce promotes the reduction of barriers to entry, extends the life of products, shapes the development of online shop software, and drives innovative forms of online advertising. Furthermore, the impact of e-commerce on the privacy of internet users is analysed, changing shopping habits are looked at and its impact on tax avoidance is briefly examined.

Chapter 2 introduces readers to innovative logistics solutions in e-commerce, exploring their impact on the postal and courier industry. The development of point-of-sale delivery methods to solve the last mile problem comes to the fore, including home-access delivery, mobile parcel kiosks, pick-up points. The next part of the chapter examines other innovative delivery methods such as drones and autonomous robots. The final part of the chapter analyses the trend towards shorter delivery times and demonstrates the growing importance of reverse logistics and 3D printing as a delivery method for goods, as well as examining the need for innovative reusable boxes.



**Fig. 1** Areas covered in the chapters

The development of e-commerce payment methods is analysed in Chapter 3, which focuses on a range of current and new payment platforms. The chapter looks at the wide range of electronic payments used in e-commerce from PayPal to BLIK payments and cryptocurrencies, the development of e-wallets, and deferred payments. The final section of the chapter proposes visionary payments linked to social media promotion as an insight into the future of e-commerce transactions.

The concept of virtual commerce (V-commerce) takes centre stage in Chapter 4, with a thorough examination of the conditions required for its diffusion. The most important part of this chapter presents the results of two studies, users of Virtual Reality (VR) headsets in the context of the potential use of such devices in e-commerce. The studies, conducted

on a sample of users from all over the world (26 countries) and users from Poland, show the richness of the market for Virtual Reality hardware, software, and various applications. It also analyses the potential advantages of using VR goggles for e-commerce and looks at the risks involved.

Chapter 5 introduces the integration of Augmented Reality (AR) in e-commerce, demonstrating its advantages and addressing potential disadvantages and risks. Readers will be introduced to inspiring examples of the use of AR in e-commerce, while also getting a glimpse of new trends in AR.

Chapter 6 explores the potential of social commerce, highlighting the impact of user-generated content in shaping purchasing decisions. The importance of social media influencers in e-commerce is presented. The growing potential of e-commerce on social media platforms is also shown. The final section of the chapter outlines future potential development trends in social commerce.

Artificial intelligence (AI) takes centre stage in Chapter 7, which explores its various applications in e-commerce. Readers gain insight into AI-based order fulfilment, inventory control, chatbots, personalisation, automated ordering systems, and AI-based advertising. Furthermore, an interview with ChatGPT provides valuable insights into AI-based content generation tools, along with a discussion of their advantages and potential risks. The future of AI-based content generation tools and their impact on search engines is discussed. The final section of this chapter presents the results of experiments on the use of large language models in SEO.

Chapter 8 provides insights from expert interviews on the future of e-commerce, offering a broad view and variety of visions. The second part of the last chapter presents likely scenarios that will shape e-commerce in the coming years, touching on customer ordering methods, evolving delivery trends and innovations in payment systems.

This comprehensive book serves as an essential resource for academics, researchers, managers, and policymakers interested in e-commerce. It presents a broad view of the future of e-commerce and its impact on the economy and society. The content presented in this book points to directions that illuminate the way forward in the world of e-commerce.

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# 1

## Measuring the Impact of E-Commerce on the Economy

The share of e-commerce is growing year by year, and the Covid-19 pandemic has accelerated this process (Zumstein et al., 2022). E-commerce was booming in many countries during the Covid-19 period, for example, in 2020, twelve thousand new Polish online shops were registered. Meanwhile, in the same year, Polish entrepreneurs suspended the activities of nearly 19 thousand enterprises related to retail sales in stores (Bisnode & Bradstreet Report), which is over 7 per cent of all brick-and-mortar stores on the market. At the beginning of 2021, the number of online shops in Poland was estimated to be 44.5 thousand (Bisnode & Bradstreet Report). Whereas in the United States 12,200 retail stores were closed in 2020, according to a compilation released on Wednesday by commercial real estate firm CoStar Group (Wahba, 2021).

These data show that retail trade has shifted from a brick-and-mortar model into a click-and-mortar (omnichannel business) model that incorporates both physical and online stores. Some brick-and-mortar businesses have gone even further, resigning from traditional channels, and thus becoming players offering products purely via online distribution channels. E-commerce rapid growth is significant for the entire economy because: firstly, the technological infrastructure for the

entire retail pushed rapidly to online by COVID-pandemic. Even the most traditional groceries or restaurants started working in the new business model: order online pick-up offline—simply—to survive. Secondly, because of the increasing hegemony of such giants as Amazon, eBay, Alibaba grew faster and stronger.

What it all means for economies? The observed almost for each business activity change of distribution and communication channel, and the increasing influence of e-commerce called the need for change in business models (Kucharska, 2019). This chapter aims to present the tremendous impact of e-commerce on economies.

## 1.1 Measuring the Impact on the Economy

Electronic commerce (e-commerce) is an attractive way for business organisations. The Web-based economic model is more efficient, considering the transaction cost level. It also provides cost-effective marketing and a disintermediation of costly distribution channels, as well as allows organisations to expand their business reach. One of the key benefits of the online trade is access to and from global markets. The e-commerce eliminates several geographical barriers for corporations that want to conduct global commerce (Khan & Motiwalla, 2002). The e-commerce enabled to create global brands like Amazon, Alibaba, or eBay. Such businesses usually started in their home country and then enhanced the scope of operation into new regions.

Anvari and Norouzi (2016) claim that even though there are many studies regarding the impact of information and communication technologies (ICT) on GDP growth and trade, but there are few scientific publications which clarify the influence of e-commerce on economic development. Sharma and Gupta (2003) proposed a framework for investigating the socio-economic influences of e-commerce adoption. Considering economic indicators, these authors distinguished the following economic areas of e-commerce impact: organisational changes (influence on productivity and competitiveness), employment and community life, employment and labour policy, impact on prices,

impact on taxes, trade and regulatory policies, impact on SMEs. Moreover, Willis (2004) analysed the impact of e-commerce on productivity and inflation.

The e-commerce changes the way companies operate by transforming key areas of business activities as product design process and development, production, inventory, distribution, after-sales service support, etc. (Terzi, 2016). Hoq et al. (2005) claim that e-commerce has an impact on companies' internal production as well as transaction costs. The costs which are influenced by e-commerce may be divided into three categories: (1) the cost of executing the sale process, (2) costs which are associated with the procurement of production inputs, (3) costs which are associated with producing and delivering the product (Hoq et al., 2005).

To measure the impact of e-commerce on economies, it is important to consider how to carry out the measurement process. The impact can be strong or weak. However, it should exist the measure of the power of the influence. This measure can consider the percentage of sectors of the economy or percentage of customers which are influenced by e-commerce development—e-commerce can affect the entire economy or only selected areas of it. The power of influence can be measured in statistical analysis using correlations between variables concerning e-commerce and the economy. For instance, Qu and Chen (2014) analysed the correlation between GDP and five e-commerce development factors such as number of Internet domains, number of Internet users, number of e-commerce businesses, number of online shopping users, and value of e-commerce transactions in China.

The impact of e-commerce on the economy can be measured from the macroeconomic (e.g., influence on economic growth, GDP (Qu & Chen, 2014), employment (Anuj et al., 2018), inflation (Willis, 2004)) or microeconomic (e.g., influence on selected branches, costs (Hoq et al., 2005), logistics (Terzi, 2016) or customer decisions) perspective. In this chapter, both microeconomic and macroeconomic approaches are applied.

On the other hand, the impact can be measured in short term (temporary) or long term. In this chapter, most analysis is focused on short-term

impact. However, some analysis concerning further future is also carried out.

Moreover, the impact can be easily measurable or hidden. In this book, the author will focus mainly on measurable impact that can be documented by certain economic facts or data. There are other scientific methods to study the impact of e-commerce on the economy, e.g., by measuring the opinions of consumers or producers, e.g., using surveys or interviews. However, this chapter is focused on reality observation and data analysis as the research methods.

In this chapter author proposes the division of e-commerce influence on ten selected areas, namely: employment, trade globalisation, logistics and also development of e-shop software, decrease in entry barriers, extending products life, development of innovative forms of Internet advertising, loss of privacy of Internet users and tax avoidance.

## 1.2 Transition to E-Commerce—Selected Data

Before presenting the impact of e-commerce on selected areas, data on the development of the e-commerce market will be presented. The pandemic situation has significantly encouraged this trend, making e-commerce not only a very convenient shopping channel, but simply the safest. Such big e-commerce brands such as Amazon, Alibaba, JD.com have seen significant year-on-year growth in turnover (Table 1.1). As you can see, the world's two largest e-commerce retailers almost doubled their growth rate when comparing 2019 and 2020. Shopify, a major e-commerce software brand, also almost doubled its growth rate in 2020. Pinduoduo did not copy the above trend, but it is a much newer company (it was founded in 2015) and although the percentage change in gross merchandise value (GMV) in 2020 is smaller than in 2019, the nominal change of 96 billion is also impressive. Summarising the data in Table 1.1, it can be concluded that the Covid-19 pandemic has significantly accelerated the transition from traditional to e-commerce.

Global retail e-commerce sales CAGR (Compound Annual Growth Rate) forecast from 2021 to 2025 is anticipated to be 6.29%. The

**Table 1.1** Top B2C e-commerce companies by GMV—pandemic acceleration of e-commerce growth

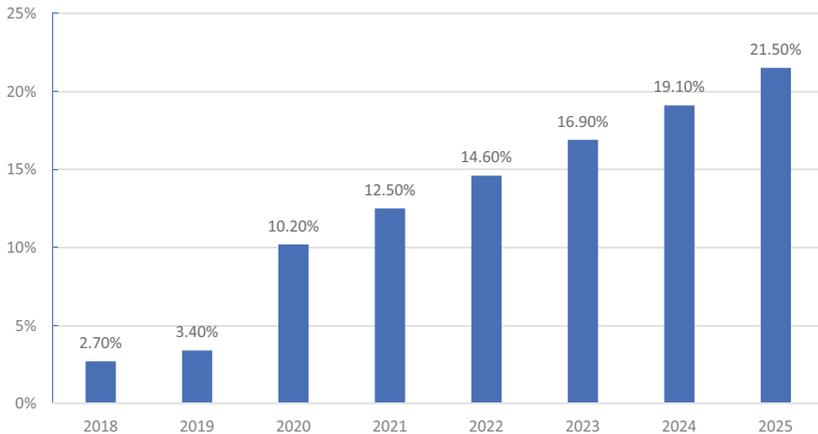
Rank by GMV	2020	2019	Company	HQ	Industry	GMV (\$ billions)				GMV change (%)
						2018	2019	2020	2018–19	
1			Alibaba	China	E-commerce	866	954	1145	10.2	20.1
2			Amazon	USA	E-commerce	344	417	575	21.0	38.0
3			JD.com	China	E-commerce	253	302	379	19.1	25.4
4			Pinduoduo	China	E-commerce	71	146	242	104.4	65.9
5			Shopify	Canada	Internet Media & Services	41	61	120	48.7	95.6
6			eBay	USA	E-commerce	90	86	100	-4.8	17.0

Source UNCTAD based on company reports. <https://unctad.org/news/global-e-commerce-jumps-267-trillion-covid-19-boosts-online-sales>

Note Alibaba year beginning 1 April, Walmart year beginning 1 February. GMV = Gross Merchandise Value

largest CAGR, considering selected bigger countries, will be in Turkey (14.59%), Argentina (12.76%), Indonesia (10.21%), South Africa (10%), India (9.58%), Brazil (7.2%), China (6.73%) ([https://www.statista.com/forecasts/...](https://www.statista.com/forecasts/)). Such a high compound annual growth rate in this important sector must have an impact on these economies as well as on global markets.

The transition from traditional trade to e-commerce, which has already been going on for 26 years, seems inevitable. This process occurs in parallel with diffusion of information and communication technologies, especially internet and smartphones proliferation (Lechman, 2017). It is still unknown what percentage of traditional trade will remain and in which areas traditional trade will continue to dominate. Until a few years ago, grocery sales seemed to be quite resistant to the e-commerce transition, but the Covid-19 pandemic has changed that perception a lot. In 2020 e-grocery share of all grocery sales in the United States increased almost three times from 3.4% to 10.2% and is expected to increase to 21.5% in 2025 (Fig. 1.1) (<https://info.mercatus.com/egrocery-shopper-behaviour-report>).



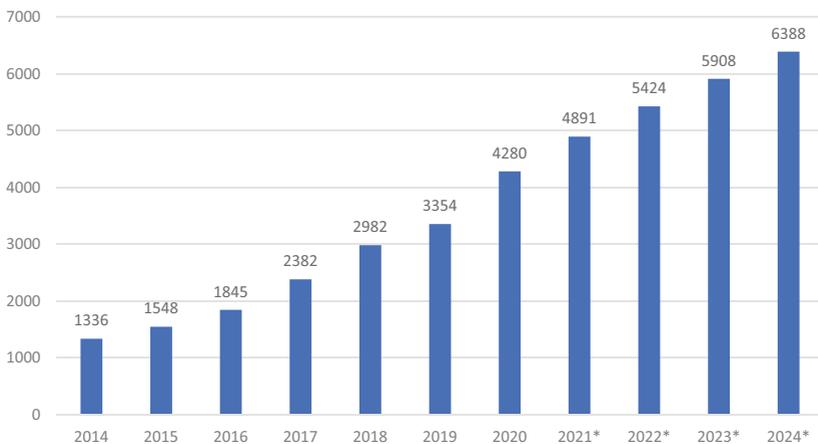
**Fig. 1.1** E-grocery share of all grocery sales in the United States from 2018 to 2020 with a forecast for 2021 to 2025 (Source Own elaboration based on: <https://www.statista.com/statistics/531189/online-grocery-market-share-united-states/>)

Figure 1.2 presents data on the volume of retail sales in the Internet channel, showing a continuous increase in the value of online sales also considering the forecasts for the next 3 years. It is also worth paying attention to the increase in the dynamics of the value of e-commerce in 2020, caused by the Covid-19 pandemic. In 2020, the year-on-year increase was 27.6%, while in 2019 the increase was 12.5%.

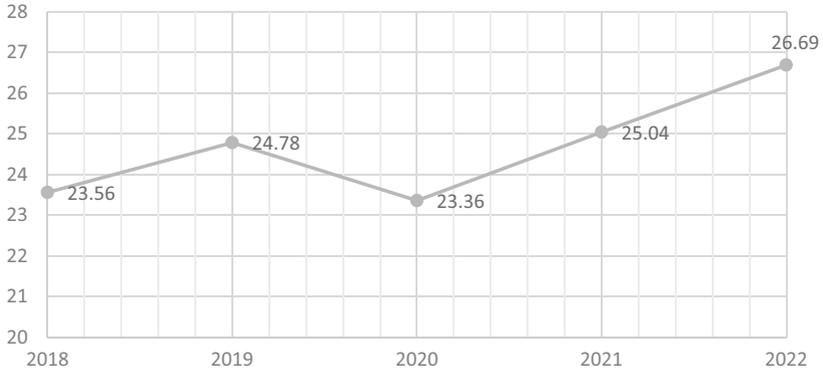
World trade in goods has increased significantly over the last two decades, rising from about US\$10 trillion in 2005 to more than US\$18.5 trillion in 2014 to then fall in 2016 and reach US\$18.8 trillion in 2019. Trade in services greatly increased between 2005 and 2019 (from about US\$2.5 trillion to close to US\$6 trillion) (United Nations Report, 2020).

Analysing total retail sales worldwide from 2018 to 2022 shows a decline in 2020 and growth in the following years (Fig. 1.3). However, 2020, which proved to be a down year for global retail due to the development of the Covid-19 pandemic, proved to be a watershed year for e-commerce.

The year 2020 can be considered a breakthrough in the context of the increase in the share of e-commerce in the entire retail trade. It is worth noting that in 2019 this increase was less than a percentage point, while



**Fig. 1.2** Global retail e-commerce sales 2014–2024 (Source <https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>)



**Fig. 1.3** Total retail sales worldwide 2018–2022 (Source <https://www.statista.com/statistics/443522/global-retail-sales/>)

in 2020 it was 4.8%, i.e., the percentage change increased five times (Table 1.2).

Obviously, the reason was an exceptional, pandemic situation, but considering the scale of the world, not a single country, this is a really impressive increase.

Later in the chapter, selected areas where e-commerce has a significant impact will be presented. These are: labour market, trade globalisation, reduction of market entry barriers, the impact of e-commerce on extending products life, the development of different logistics sectors, development of online software systems, influence of e-commerce on

**Table 1.2** The share of e-commerce in total trade in 2018–2022

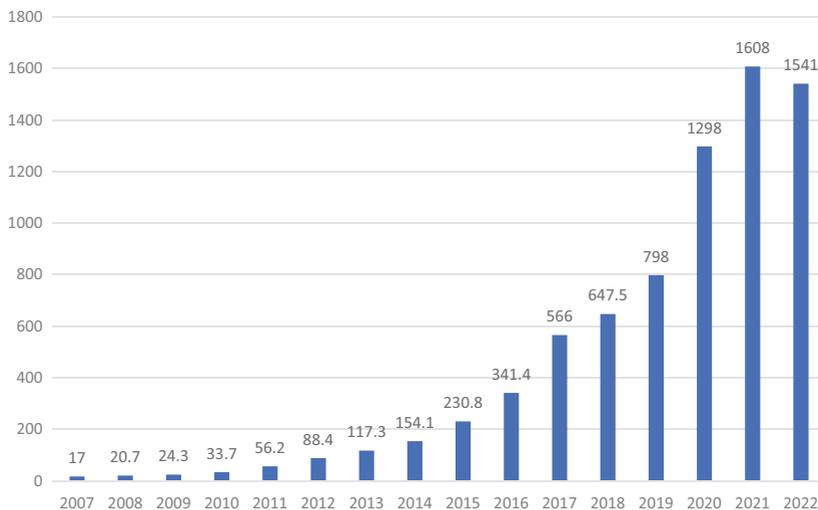
	Total retail sales	E-commerce sales	E-commerce/Total retail sales (%)
2022	26.69	5.424	20.3
2021	25.04	4.891	19.5
2020	23.36	4.280	18.3
2019	24.78	3.354	13.5
2018	23.56	2.982	12.7

Source <https://www.statista.com/statistics/443522/global-retail-sales/>

the development of innovative forms of Internet advertising, the influence of e-commerce on tax avoidance, and the impact on Internet users. The author is aware that these are only selected areas, but fascinating to analyse.

### 1.3 The Impact of E-Commerce on the Labour Market

When determining the impact of e-commerce on the economy, the question arises what size of enterprises generate employment in this sector. Anuj et al. (2018) analysed the correlation between the unemployment rate in India and B2C e-commerce as a percentage of GDP. However, such analysis is very disputable as there are a lot of internal and external factors which influence the unemployment rate like business cycles, industrial restructuring, migration of workers, minimal wage policy, and many others. Therefore, it is more convincing from a scientific point of view to analyse the number of workplaces in the e-commerce sector. Considering, the number of employees of e-commerce companies has been growing rapidly in recent years. This increase is especially noticeable in 2020 during the Covid-19 pandemic. To show the scale of growth, data from the two largest global e-commerce brands in the world, i.e., Amazon and Alibaba Group, will be presented. As it can be seen in Fig. 1.4 the number of [Amazon.com](https://www.amazon.com) employees increased from 17,000 in 2007 to 1,298,000 in 2020 ([Amazon.com](https://www.amazon.com) annual report 2020). In 2021, Amazon's workforce reached its zenith with a total of 1,608,000 full- and part-time employees, excluding external contractors. Nonetheless, the following year, in 2022, the company's headcount witnessed a decline, settling at 1,541,000 employees. Especially the increase in 2020 is really impressive—half million in one year! The number of full-time employees at Alibaba increased from year 2013 to 2021 over ten times (from 20,674 to 251,462) (Alibaba Group). This number shows that employees who are fired in traditional shops can find jobs in the e-commerce sector.



**Fig. 1.4** Number of [Amazon.com](https://www.amazon.com) employees from 2007 to 2022 (in thousands) (Source <https://www.statista.com/statistics/234488/number-of-amazon-employees/>)

Many more areas of e-commerce's impact on the labour market could be mentioned, such as the emergence of new professions such as shopping influencer (<https://influencermarketinghub.com/live-shopping-influencers/>), SEO copywriter, online shopping assistant, live chat shopping assistant, omnichannel manager, and many others. Some of these professions, such as SEO copywriters, despite having been created in the last two decades, are likely to disappear in the coming years with the development of artificial intelligence tools such as ChatGPT. It is also worth mentioning the strong impact of e-commerce on job creation in sectors providing services to e-commerce such as logistics and IT sector (software and hardware).

## 1.4 The Impact of E-Commerce on the Trade Globalisation

The globalisation of trade and the impact of e-commerce on it are very broad topics, so only selected aspects relevant to the future of e-commerce are covered in this subsection. Electronic commerce, unlike traditional, requiring the physical presence of the customer in the store, favours international trade. In the case of multilingual interfaces of online stores, or the use of automatic site translation tools currently available in web browsers, orders can flow from all over the world, as long as the online store provides such an opportunity. Global brands like Amazon or Alibaba are present in many countries either in local internet domains (i.e., Amazon.de, Amazon.fr) or multilanguage platforms as aliexpress.com. The contribution of global brands to the economy of their country of origin was analysed in many aspects in (Kucharska et al., 2018), but their strong influence on trade globalisation is indisputable. Millions of products are becoming available for customers via the aforementioned platforms, which favour the free flow of goods between countries.

However, when looking at the global export value data (Fig. 1.5), a certain stagnation can be observed in terms of export growth in the last decade. It can be concluded that other factors, such as economic fluctuations, fluctuations in the export of certain raw materials, such as oil and gas, have a greater impact on the level of global exports than the internationalisation of e-commerce.

Currently, internationalisation is viewed as a crucial element in enhancing innovation for small and medium-sized enterprises (SMEs). Nevertheless, innovating with international clients is frequently challenging for SMEs due to limited accessibility to foreign markets. Unlike conventional market entry strategies, cross-border e-commerce, known for its affordability and significant control, can aid in overcoming some obstacles to internationalisation for SMEs (Pan et al., 2022).

Among the features enabling the globalisation of e-commerce is the possibility of opening local websites (e.g., stores, auction sites) in many countries under a well-known worldwide brand. This strategy is used by, among others, eBay and Amazon.com. The advantage of this type



**Fig. 1.5** Trends in global export value of trade in goods from 1950 to 2020 (in billions U.S. dollars) (Source <https://www.statista.com/statistics/264682/worldwide-export-volume-in-the-trade-since-1950/>)

of website is their national character (language, methods of contact with the client), with the simultaneous possibility of using IT tools created for the home website. In these types of local sites, it is possible to contact databases in other parts of the world (in cloud hosting) and redirect to other sites in case of problems with product availability in a particular country. The costs of opening local websites are incomparably lower than in the case of opening traditional branches of companies with a network of local showrooms. In the case of e-commerce, there are much lower barriers to entering new markets (Chodak, 2010). Ahmedov (2020) claims that digitalisation of international trade leads to the inclusion and considerable democratisation of the economy and the involvement of small and micro firms as well as households in the process of international trade in various parts of the world. Cassia and Magno (2022) pointed out diverse impacts of information technology, global marketing, and export operation skills on the strategic and financial outcomes of e-commerce. Additionally, the use of third-party e-commerce platforms such as [Amazon.com](https://www.amazon.com) diminishes the effect of exporters' information technology competences on their economic results.

The basic feature of the Internet is its availability 24 hours a day, 7 days a week. This is an especially important feature in international trade because it removes the time zone barrier. Online stores can trade around the clock, and the time shift does not play any role here. It should

be remembered that the ordering process is fully automated and does not require human intervention. The only problem may be communication with the online shopping assistant, e.g., via live chat, to obtain professional advice related to the selection of products. Providing full 24/7 online customer service requires global online shops to employ shift workers or staff living in different time zones, or to use intelligent chatbots to replace a human shopping assistant.

The important barrier to the development of e-commerce on a global scale is the high cost of courier and postal services for international shipments. In countries characterised by enormous competition on the courier market, such as the United States, and highly developed air transport, the prices of international shipments are lower than, for example, in Poland, despite differences in income levels. The prices of international courier shipments vary significantly in different countries, and depend not only on the distance between countries, but also on the political and economic situation and geopolitical zones (e.g., the cost of a courier shipment from Poland to Portugal is several times lower than for shipments from Poland to Switzerland, although Switzerland is much closer to Poland than Portugal, but is not a member of the European Union).<sup>1</sup>

In summary, it can be said that e-commerce has and will continue to have an impact on trade globalisation, but the key to further growth will be lower international shipping costs and the removal of customs barriers.

## 1.5 Reduction of Market Entry Barriers

E-commerce enables new entrants to the market that do not have significant capital or need to have advanced IT knowledge. The development of such software solutions such as WooCommerce or Wix Stores, which do not require advanced expertise, significantly reduces the entry barriers

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<sup>1</sup> Prices were compared using courier brokers websites e.g., <https://www.globkurier.pl/>, <https://www.ipparcel.com/>, <https://www.easyship.com/>.

to the market for new entities. The combination of this type of IT solution with dropshipping logistic model allows opening a new online store without almost any starting capital in a noticeably short time.

The author of this book had the opportunity to conduct classes with students of non-IT faculties, whose task was to configure an online store, based on selected online store software such as WooCommerce or PrestaShop in any chosen business sector. For some groups of students, this task, along with filling the store with sample categories and products with descriptions and photos and configuring all needed aspects as the available shipping and payment methods, took only a few hours. This shows how low are the barriers to entry in e-commerce, compared to traditional commerce, in which a few hours would not even be enough to arrange the goods on the shelves, not to mention all the processes related to the preparation of exhibition space.

Using e-commerce platforms (which can be called in this context third-party platforms) such as Amazon, Allegro, eBay, Taobao, Tmall, a company can start selling online without having its own sales site. Third-party platforms have exceptionally low barriers to entry and offer a huge number of potential customers by charging sellers various types of fees, usually commission on sales. These platforms require little initial investment in technology as they provide readily available technology features, standardised online store templates, and easy-to-use administrative functions (Wang et al., 2016). Third-party platforms are an excellent choice for entrepreneurs looking to enter the e-commerce market who are concerned that they will not be able to cope with the technical aspects of running an e-shop.

## 1.6 The Impact of E-Commerce on Extending Products Life

Thanks to the reduction of distribution costs due to the lack of the need of having exhibition space in e-commerce, it is possible to offer goods that rotate very rarely. Such stock keeping units (SKUs) are known as slow-moving products or shelf-warmers (Chodak, 2020). Traditional

commerce requires that the shelf space “earns” itself, the goods are therefore carefully selected in terms of turnover and profitability. The cost of “shelf space” in e-commerce is close to zero because it only comes from the cost of adding to an offer and keeping a record in the database. As a result, there is no need to withdraw from sale of the goods whose trading volume is decreasing, and thus allows extending the life of the products on the market (Chodak & Kudryńska, 2012).

The electronic market is characterised by lower costs of information distribution. Search engines, including those on websites of online stores, make it possible to find a specific product even when the store has many millions of SKUs. This makes it possible to sell not only the bestsellers, but also niche products or those that have already had their peak sales behind them. It is worth noting that lowering the search cost allows the customer to review a wider offer and, consequently, to better match the product to his expectations (Bakos, 2001).

Other features of e-commerce, which significantly extend the average product life cycle, relate to the elimination of geographic barriers to accessing the online stores. By removing geographic barriers, online stores can boast a greater variety of customers than traditional stores. This means broadening the range of tastes, interests, and needs of potential consumers. Therefore, online stores have a much wider range of products, and the variety of customer needs favours the sale of not only bestsellers, but also niche or declining items that are usually not available in traditional stores. The greater diversity of customers is also conducive to extending the life cycle of a product because customers from various parts of the world may be interested in a product because of local fashion, generating demand for goods for which the global fashion has passed.

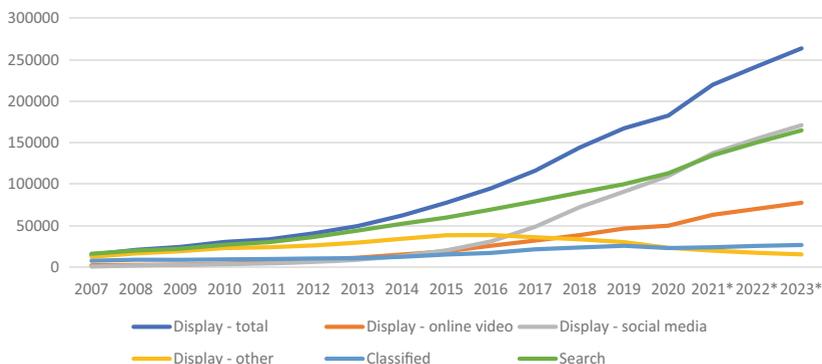
## 1.7 The Impact of E-Commerce on the Development of E-Shops Software

A particularly essential element of conducting e-commerce is e-shop software that allows placing orders by customers and managing these orders by employees of the online store. The last three decades have been a continuous development of software dedicated to online stores. The front-end is becoming increasingly tailored to a specific user, using increasingly advanced algorithms to adjust to client needs and preferences. The development of recommendation systems using increasingly sophisticated artificial intelligence algorithms allows for very precise selection of the assortment presented to the customer. But it should be remembered that the software for an online store is also a back-end—a management panel, offering more and more advanced functions, such as full integration with payment systems, courier companies, price comparison websites, social networks, 3PL (third-party business partners logistics) or 4PL (fourth-party logistics), website traffic tracking systems such as Google Analytics or advertising systems such as Google Ads. There are currently many different systems for running online stores on the market, the most popular brands are: WooCommerce, Shopify, Magento, PrestaShop, and others (<https://trends.builtwith.com/shop>). The number of software solutions for e-commerce is huge and new developments are emerging all the time. The software must be adapted to local conditions, such as courier companies or payment systems available in a given market. The changing e-commerce environment requires frequent software changes and updates. All of this creates numerous jobs for programmers, graphic designers, and system designers, who must satisfy the growing demands of the market.

## 1.8 Influence of E-Commerce on the Development of Innovative Forms of Internet Advertising

Growing competition among online stores forces the use of more and more advanced forms of Internet marketing. There are two important trends in internet advertising in the last decade. The first is advertising in social media. Current social media systems, such as Facebook Business Suite, allow creating product ads automatically containing a button leading to a specific product page in an online store. These are targeted ads, precisely tailored to the interests of customers. Facebook, having a huge database of more than 2.8 billion monthly active users (<https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/>) can use artificial intelligence algorithms offering targeting accuracy at an unprecedented level of accuracy. The second trend visible on the market in the last decade is product advertising displayed in search engines, in particular in the Google search engine. Automating the process of displaying product ads using the Google Merchant system allows online stores to present their offer with a photo and price (and other additional information) in the search engine to those customers who have expressed interest in these products by entering keywords in the search engine window. Google collects information about its users, using not only the search engine, but also the entire set of tools offered by Google, such as Gmail, the Android system installed on smartphones, Google Docs, and many other tools. Having precise knowledge about users allows better match the ads displayed, not only in the search engine, but also on partner websites via the Google AdSense system and on YouTube. As evidenced in Fig. 1.6, the fastest growing forms of online advertising in the world are display (especially in social media) and search advertising.

The development of internet marketing caused by the development of e-commerce leads to another effect, this time a negative one, which is the loss of privacy, what will be discussed in the next point.



**Fig. 1.6** Internet advertising spending worldwide from 2007 to 2022, by format (in millions of U.S. dollars) (Source Own elaboration based on <https://www.statista.com/statistics/276671/global-internet-advertising-expenditure-by-type/>)

## 1.9 The Impact on Internet Users—Loss of Privacy

The advanced methods of targeting online advertisements, to reach customers of online stores, force the collection of more data and meta-data about Internet users. The leaders collecting enormous amounts of data about their users are the largest IT brands: Google, Facebook, Amazon, Microsoft, and Apple. By using an increasing number of devices connected to the Internet, i.e., smartphones, smart TVs, smart refrigerators, smart vacuum cleaners, smart security systems, etc., users get rid of their privacy and allow this data to be used for marketing purposes. Users also risk their sensitive data falling into the wrong hands of hackers or data thieves. The idea of the Internet of Things (IoT) is becoming increasingly popular. Smart devices enable automatically make an order in online stores using an interface which is built in them. One of the challenges of IoT is to enable the connection of everyday objects to the Internet. However, the IoT is not only about connectivity, but also about the pervasive collection and sharing of data towards a common goal. Since people are surrounded by smart things, the development of sensing technologies in IoT systems will pose a threat to individual privacy (Lopez et al., 2017). The convenience of automatically ordering goods

through smart devices, unfortunately, requires the collection of information about customers' purchasing preferences and involves a sacrifice of personal data.

Loss of privacy also occurs when online shops using remarketing build customer bases using Google Ads tools, whose behaviour is constantly monitored in order to offer them the right offer at the right time, increasing the likelihood of a purchase from the online shop in question. The innovation proposed by Google is Smart Ads (Smart Campaigns or Max Performance Campaigns) (<https://support.google.com/google-ads/answer/7652860>), an advertising system managed by Google software that allows optimisation not only rates for displaying or clicking an advertisement, but also dynamic creation of advertisements and selection of their recipients. All an online store owner has to do is configure the transfer of data about the current offer to the Google Merchant system and define the daily advertising budget. The rest is managed by Google algorithms, based on a huge amount of data about its users. It could be said that today's e-commerce customers using mobile and other smart devices are doomed to lose their privacy and share their data with aforementioned IT concerns.

## 1.10 The Change in Shopping Habits

Lots of data available on the Internet environment leads to the change of consumers' purchase decision-making processes. Chen (2009) suggests a two-phased information search and evaluation model of online customer behaviour. In this proposed model, customers who shop online are more focused on different marketing mix elements in each phase. Most online customers assess the product in the first phase and then compare the prices in the second phase (Chen, 2009). Shergill and Chen (2005) classified online buyers into four categories: trial online buyers, occasional online buyers, frequent online buyers, and regular buyers; based on purchase frequency. However, nowadays trial online buyers' category is shrinking, and regular buyers are more frequent. In the area of consumer behaviour research, exist general models of buying behaviour that describe the process of making a purchase decision by customers.

These models make possible to predict consumers' purchase behaviour (Shergill & Chen, 2005) using different techniques and AI methods, e.g., association rules (Suchacka & Chodak, 2017).

Customers are more willing to use both online and offline channels, and therefore some online retailers are eager to introduce an offline presence to enable a positive physical shopping experience in their services. For instance, big brands such as Amazon, eBay, and Alibaba have all launched physical stores, giving an option to clients to complete purchases with smartphones in showroom centres (Orendorff, 2018).

On the other hand, offline retailing merchants are looking for online opportunities. The big retailers such as Walmart, Argos, and Suning Appliance are examples of companies that match prices of their products in their online and offline shops. This is evidence that some retailers are moving to exploit the advantages of online and offline operations, making the integration of online and offline channels (Yang, et al., 2020).

Such activities lead to a mixture of customers purchasing models as: ROPO (research online, purchase offline), reverse ROPO (research offline, purchase online), and also research online, purchase online, but in physical store (to get the products immediately), and pure online purchases.

## 1.11 The Influence of E-Commerce on Tax Avoidance

More areas of e-commerce's impact on the economy could be identified, but due to the limited volume of the book, the most important or interesting ones have been selected. The final aspect to be addressed in this chapter is the impact of e-commerce on tax avoidance. Argilés-Bosch et al. (2020) analysed the influence of e-commerce business practices on tax avoidance, motivated precisely by the ongoing debate on the opportunities afforded by e-commerce for tax avoidance. E-commerce firms have the advantage that location does not condition their activity to the extent that it does that of traditional firms with physical locations. Transfer pricing is a well-known method of tax avoidance. In

e-commerce, tax avoidance practices are characterised by the fact that elements of taxation can be easily changed or moved. Using a sample of European parent firms in the retail trade industry from twenty-two different countries, Argilés-Bosch et al. (2020) found empirical evidence that e-commerce firms were significantly more tax avoidant than traditional firms. From an economic point of view, e-commerce has the effect of distorting competition between firms, putting traditional firms disadvantaged because of their higher tax bills as well as it influences loss of government tax revenues (Argilés-Bosch et al., 2020). E-commerce enables tax optimisation to a much greater extent than traditional trading and many businesses, especially large and medium-sized ones, take advantage of this.

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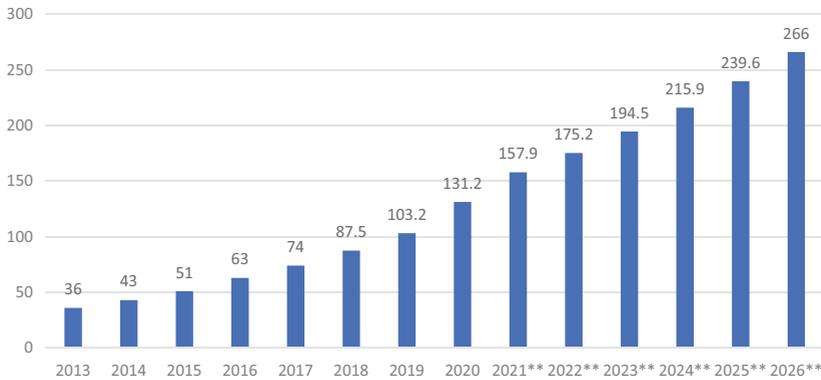


# 2

## The Development of Different Logistics Solutions in E-Commerce

Logistics is a key element of e-commerce, playing a crucial role in the smooth functioning of this dynamic field. The continuous evolution and development of e-commerce sectors has a multifaceted impact on various aspects of logistics.

From a logistics management point of view, e-commerce of physical goods is characterised by numerous shipments to customers. The vast majority of orders in online stores are sent to customers with the help of courier and postal companies. As can be seen in Fig. 2.1, the number of parcels sent has been steadily increasing in recent years and an increase is also forecast in the coming years. The growing number of shipments generates a revenue stream that allows investments and the development of innovative forms of delivery, which will be discussed in the next sections.



**Fig. 2.1** Global parcel shipping volume between 2013 and 2026 (in billions of parcels)\* (Source <https://www.statista.com/statistics/1139910/parcel-shipping-volume-worldwide/>)

## 2.1 Development of Point Delivery Approaches as a Method of Solving the Last Mile Problem

One of the key problems associated with the delivery of an order in online shops is the delivery to the final retailer. This issue is referred to in the literature as the last mile problem (Lee & Whang, 2001; Punakivi & Tanskanen, 2002).

The causes of last mile problems can be divided into two subcategories (Chodak, 2014): problem of recipient's absence during standard delivery hours and untimely/delayed delivery. The reasons for delayed delivery may lie with the online shop, the carrier, the customer, or may be external causes. The last mile problem generates specific costs, both for the e-shop, the carrier, and the customer.

Considering the costs of the last mile problem incurred by the e-shop, the following types of losses can be distinguished (Chodak, 2014):

- A reduction in future demand in the e-shop. Dissatisfied customers who are unlikely to buy products from this e-store again.
- An increase in the number of returns. A customer who does not receive his order on time may cancel it.

- Additional labour costs for handling complaints, informing customers of consignment note numbers, carrier contact numbers, etc.
- Damage to the health and psychological well-being of employees exposed to dissatisfied customers. The customer service department is directly exposed to the resentment of customers who have not received on time the package they ordered.

The customer's costs for the last mile problem arise from having to collect the parcel from the courier company's premises themselves (if enabled). This is a waste of time and money for the customer.

The costs of the last mile problem for the carrier relate to courier costs, fuel costs, and dispatcher costs. The high percentage of parcels that cannot be delivered on the courier's first visit disorganises the courier's work and causes additional work in the dispatch centre. It is also worth mentioning the stress factor related to phone calls from dissatisfied customers waiting for their order to be delivered.

Due to the aforementioned disadvantages, methods have been invented to deal with the last mile problem. The solutions, which are or were used in business practice, are the following (Fernie et al., 2010):

- Giving the delivery courier internal access to the home or an outbuilding.
- Placing the delivered parcel at a home-based reception (drop-box).
- Leaving the parcel at a collection point.
- Delivering the parcel to a local agency, which stores it and then delivers it when the customer is at home.

The fourth method mentioned requires additional costs and is not a de facto solution to the last mile problem and will therefore not be discussed further. The first three methods will be characterised below.

## **Delivery with Access to a House or Part of a House**

The ability for a courier delivering a parcel to access a house or part of a house is a simple solution to the last mile problem. This type of solution has been trialled in the United Kingdom and involved allowing

access to a garage or part of a house based on providing a special PIN or a physical key contained in a secure box opened by a code. However, companies have backed away from the commercial use of this type of solution, explaining the security of customers' assets (Rowlands, 2006).

There are also innovative systems enabling the shipment to be left when the recipient is unavailable, such as eDoor and eBox (<https://www.springwise.com/security-system-incorporates-smart-technology-to-protect-home-deliveries/>). However, the uptake of such solutions in e-commerce is still very low.

## Parcel Collection Boxes, Portable Parcel Machines

Another solution to the last mile problem is to facilitate leaving parcels at home, i.e., parcel collection boxes at home or inside the home, but not requiring access to the home for the courier. In general, private parcel boxes can also be divided into those requiring mobile access and those not requiring mobile access. In addition, private parcel boxes can be divided into outdoor and indoor (located inside the house or flat, but not requiring access to the house for the courier, due to the use of an access channel).

These can take the form of a private parcel box or be dedicated to a certain group of residents (e.g., people living in the same stairwell). These are special boxes that open with a code held by the courier, or that allow a parcel to be dropped inside in the manner of a mailbox. There are also devices that communicate electronically with the addressee of the package, e.g., sending an email and SMS when the courier delivers the package. However, the more technologically complex solutions that have been implemented in the United Kingdom have not been more successful, due to higher costs (Rowlands, 2006). The downside of this type of solution is the need to purchase, or lease, a private parcel machine and to install it on site, which can be problematic in blocks of flats.

Portable (mobile) parcel machines are also possible to be applied for e-commerce deliveries. Such sophisticated boxes are brought by the courier and left by him in a security module at the house. Due to their size, private mobile parcel kiosks are more suited to homeowners.

Both methods mentioned above require the courier to travel to the end recipient. They only solve the problem of the recipient's absence, but do not shorten the courier's route. Therefore, more attention will be paid to parcel collection delivery points.

## Collection Delivery Points

Collection delivery points (CDPs) are places where goods can be collected from specific locations. This is an extremely popular and widespread method of dealing with the last mile problem. Two types of CDPs can be distinguished: self-service CDPs and CDPs that require staff to deliver the parcel (Weltevreden, 2008). The main problem with CDPs is to ensure dense coverage of the national area with such points, which implies a significant investment.

The first type of serviced collection point may be a neighbour who has been designated as an additional recipient of the parcel, since he or she is commonly at home (e.g., a pensioner). "Neighbourly" form of parcel collection is commonly used in courier practice, but formalising it requires signing an appropriate agreement with the neighbour in case the person who collected the parcel does not want to return it.

The second type of local collection point is a specific location from which the customer can collect the parcel, located near his or her home. This could be, for example, a postal agency, a newspaper distribution point, or a petrol station with which the courier company or online shop has signed a contract. Two models of courier operation can be considered here. The first, which can be described as "attempted delivery", involves treating the local agency as a point where the parcel should be left only if the customer is not at home. The second model, which is more efficient, assumes that the parcel is immediately directed to the local agency, which reduces delivery costs. The customer is informed electronically that the package is available for collection at the local agency. In the first case, the local agency has only an ancillary function in the distribution channel, while in the second it is an integral part of the distribution chain. The choice of a local agency as a pick-up point implies a wide network of outlets, which should cover the whole area of the country. The choice

of logistics partner is of course also conditioned by its willingness to cooperate, based on economic considerations. Here, resistance may be encountered due to the low profitability of this type of activity, as well as the organisational problems that may arise in the implementation of the reception and delivery of parcels. The need to have free storage space in which to store parcels to be delivered should also not be overlooked. The main difference between this form of delivery and the others is the necessity for the carrier to cooperate with an external company, which may give rise to additional problems related to the flow of information, capital (in the case of cash on delivery), and security issues, including parcel insurance.

Self-service collection points are parcel machines also called delivery lockers whose network covers an area of potential delivery of goods, usually a country. Delivery lockers can be divided into externally located and internally located. External parcel kiosks are small facilities that are a collection of collection boxes that are accessed by the customer using an access code they obtain, usually from the courier company that owns the parcel machines. Internal parcel kiosks are usually located in easily accessible buildings that are open 24 hours a day, such as petrol stations, or at least most of the day, such as retail chains. There is also the possibility of a mixed solution, where some parcel machines are located outside, and some are located indoors.

InPost is the leader brand of the collection market at the point, with the use of parcel machines in Europe. In 2020, InPost increased the volume of parcels by 115% to 310 million, and the parcel locker network increased by 47% to 12,254 machines <https://inpost.pl/aktualnosci-juz-9000-paczkomatowr-inpost>. Due to the huge interest in this form of parcel collection during the Covid-19 pandemic and the problem with overcrowded parcel machines, the company implemented the Multipack service, which allows placing several parcels intended for one customer in one parcel locker. Another innovation of InPost was the implementation of a mobile application that enables the opening of the locker with a smartphone, without having to touch the numeric panel. During a pandemic, this type of solution allowed the parcel collection from the locker (most often standing outside) without the risk of contracting the virus by touching the panel for entering the parcel code. AliExpress,

a Chinese internet shopping platform, is set to increase its European delivery locker network by nearly half. Their goal is to establish approximately 47,500 collection sites by the close of 2022, a significant rise from the existing count of around 36,000. AliExpress claims that the key benefits of delivery lockers are generating 21% less carbon emission compared to delivery to homes and a significant decrease in delivery time (Dawson, 2022). It is worth mentioning that this expansion started very recently, as the first delivery locker from AliExpress appeared in Warsaw in 2021 (<https://www.bankier.pl/wiadomosc/AliExpress-pierwszy-automat-do-odbioru-zamowien-8069941.html>).

Another option is to deliver to a local agency that will deliver the parcel when the recipient is present at home. This solution requires a contract with a subcontractor of the service, e.g., a chain of shops or petrol stations that has a high coverage rate of the national territory. This solution is similar to the pick-up point described earlier, but the main difference is that the parcel is delivered to the customer by an employee of the local agency. It is therefore a delivery to door service and not, as in the case of the previously described, parcel pick-up point (delivery to CDP). It is therefore a form of logistics outsourcing that is unusual in that the parcel delivery company delegates part of the logistics process associated with the last mile problem to an external company that takes responsibility for delivering the parcel directly to the customer. Thus, it is double outsourcing in this case - the first occurs when the online shop outsources the delivery of parcels to a courier or postal company, the second when the courier or postal company outsources the delivery of the parcel to the end customer to another company.

The summary is that, observing the market dynamics, parcel machines will be a key delivery method for e-commerce parcels. Perhaps parcels will be delivered to them by autonomous cars and drones will continue to deliver them to customers who so wish.

## 2.2 Other Innovative Methods of Delivery

The growing number of shipments favours the development of this industry, as well as the emergence of innovative logistics solutions that have already been implemented, such as pick-up at the point or parcel locker. Other forms of delivery that are still being tested are drone or autonomous robot delivery, e.g., Amazon Scout (Scott, 2019). From 2020 to 2022, investors have invested more than \$8 billion into autonomous delivery companies (Banker, 2022). This includes autonomous cars, robots, and drones. Autonomous cars have been widely reported in the literature, not least in the context of e-commerce, and will therefore not be analysed in this book. The other two forms of delivery appear to have significant growth potential in e-commerce in the coming years and will therefore be discussed in more detail.

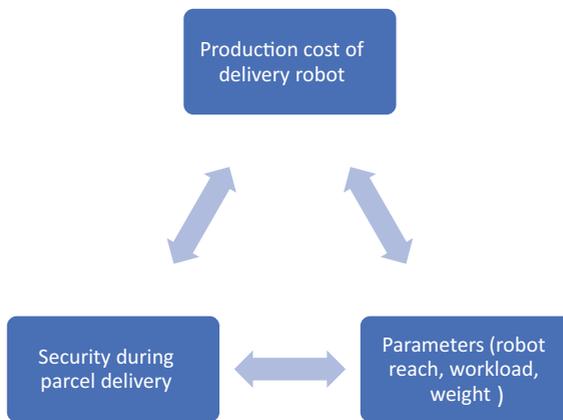
Delivery robots characterise with various parameters. Among these, the most significant are (Figliozzi, 2020; Simoni et al., 2020):

- coverage—the size of the area in which they can deliver parcels and their maximum reach,
- payload, which can be defined by the maximum weight and maximum volume of the goods to be transported,
- speed of motion—the average speed and maximum speed, which is more important during urgent deliveries,
- energy consumption per unit distance—which is connected not only to coverage, but also to operating cost,
- the size of the robot, which is important not only because of maximum preload but also due to mobility constraints,
- the ability to move across a wide range of surfaces. This is especially important because the main applications of the delivery robots are urban areas characterised by varied surfaces, high number of curbs, diverse types of railings, and other obstacles.
- additional functionalities such as refrigeration capability (delivery of goods requiring low temperatures such as food), ability to communicate with the receiver of the parcel, ability to recharge the battery itself in charging stations.

Improving the above parameters increases production costs. Companies are trying to find the golden mean, i.e., a solution that is acceptable in terms of functionality (range, payload, etc.) while keeping production costs as low as possible. It should also be borne in mind that these are autonomous robots whose primary condition for operation is to ensure safe movement in the field. Any accident involving an autonomous robot carries the risk of legislative solutions restricting the possibility of delivery by autonomous robots.

Depending on the specific application (type of product to be delivered, the specific characteristics of the delivery area), different features are crucial for delivery robots. It should also be noted that some of the parameters mentioned are difficult to reconcile, for example, increasing payload capacity is associated with decreasing range or with the need to increase the size of the battery, and this involves increasing the weight of the robot, increasing production costs, and decreasing safety during operation. Figure 2.2 outlines three key areas that need to be reconciled when deciding on technology choices in robot delivery.

When analysing the potential use of delivery robots in e-commerce, there are several important characteristics that are essential to ensure their suitability and efficiency. Here are some of the key features (Fragapane et al., 2021; Hossain, 2023; Rai et al., 2022):



**Fig. 2.2** Three key elements in the choice of delivery robots' solutions

- **Autonomy:** Delivery robots should be fully autonomous, meaning they can operate without human intervention. This includes navigating through different environments, avoiding obstacles (static and dynamic), and carrying out the delivery process from starting point (e.g., warehouse) to delivery point.
- **Safety:** As it was mentioned, safety is a critical feature of delivery robots, both for the robot itself and also, what is more important, for the people and objects around it. Delivery robots need to have various sensors and technologies which enable to detect and avoid potential hazards, such as pedestrians, traffic, and all other kinds of obstacles.
- **Reliability:** Delivery robots have to be reliable and consistent in their operations. This includes being able to deliver packages on time, as promised, and in the right condition.
- **Adaptability:** Delivery robots need to be adaptable to different terrains as well as various weather conditions. This includes being able to navigate through rain, snow, fog, or uneven and slippery surfaces.
- **Durability:** The delivery robots should be robust so that they can operate for an extended period of time, allowing the production costs, plus operating costs, to amortise over time, guaranteeing the profit level. It should also be able to withstand possible vandalism and harmful weather conditions—moisture and temperature fluctuations.
- **User-friendliness:** Delivery robots should be easy to use and understand for both customers and delivery personnel. This includes having clear instructions for package pick-up and drop-off, as well as easy-to-use interfaces for tracking and monitoring deliveries.
- **Efficiency:** Delivery robots need to be efficient in terms of cost and time. This includes being able to deliver multiple packages in a single trip, optimising delivery routes to minimise travel time, and reducing overall delivery costs.

Overall, these features are crucial to ensure the adoption and proliferation of delivery robots in e-commerce. As technology continues to evolve, we can expect to see further enhancements in these features and other areas related to delivery robots in the future.

## Autonomous Driving Delivery Robots

Autonomous delivery robots can be categorised into two classes. Sidewalk autonomous delivery robots are small-sized robots using sidewalks or pedestrian pathways. On the other hand, on-road or simply road autonomous delivery robots are vehicles that navigate on roads alongside traditional vehicles (Figliozzi, 2020).

Autonomous driving delivery robots are still in the phase of development. However, there are some companies that have proven they can offer ready to use solutions. The names of these leaders are following Starship Technologies, Nuro, FedEx, Roxo, Amazon Scout, Udelv, Kiwibot, and Coco (Banker, 2022).

Another company which is the leader in the delivery robots' market in China is Alibaba Group, which introduced a fleet of robots as an innovative fast and relatively inexpensive method to fulfil the increasing demand for online shopping in China. Alibaba deployed 1,000 delivery robots across Chinese university campuses and urban communities in 2021. The robots are called Xiaomanlv or *small donkey* in Mandarin, and can deliver about 50 packages at one time and 500 boxes in one day, covering 100 kilometres on a single charge (Ackroyd & Li, 2021).

An example of the appearance of an autonomous delivery vehicle is shown in Fig. 2.3. The image was generated using the OpenAI tool, so it can be concluded that this is how autonomous vehicles are seen by artificial intelligence, however, reviewing the solutions available on the market, the author noticed the greatest similarity of this robot to the Parcel delivery robot Camello from OTSAW Digital (<https://www.directindustry.com/prod/otsaw-digital/product-247586-2546784.html>).

## Deliveries by Drones

Drones, which are also called unmanned aerial vehicles (UAVs) (Lemardelé et al., 2021) can rise and lower as small helicopters, come in varied sizes depending on their cargo. Some are tiny and can only carry



**Fig. 2.3** Autonomous driving vehicle delivering parcels (Source Own elaboration with OpenAI tool <https://dreamstudio.ai/generate>)

cargo weighing less than five pounds. However, others, for example, electric vertical take-off and landing (eVTOLs) vehicles, can deliver parcels weighing even several hundred pounds (Kawamoto, 2022).

The high speed and low cost of delivery are factors which suggest that drones are potentially very efficient means of delivering parcels in e-commerce (Fig. 2.4). Moreover, the environmental and social sustainability factors are also increasingly important, mainly in urban zones. Therefore, the last mile delivery by drones is a worth considering solution in terms of delivery speed as well as sustainability. Since the drones which are electrically powered may reduce environmental impact. What is also important is that drones reduce road congestion as they do not interfere with terrestrial infrastructures. It can be expected that the last

mile delivery by drones can be effectively applied to deliver small size and light parcels (Borghetti et al., 2022).

Drones have many advantages in the context of e-commerce delivery. The most important are the following:

- **Speed:** Drones are capable of making deliveries much faster than traditional delivery methods, such as trucks or vans because they can avoid traffic and take direct routes to their destination. The speed of hybrid drones can exceed 100 km per hour, making them an extremely fast means of transport (Rai et al., 2022).
- **Cost-effectiveness:** Drones can potentially reduce delivery costs for e-commerce companies by eliminating the need for human drivers and their associated costs (Petroşanu & Pîrjan, 2022). Moshref-Javadi and Winkenbach (2021) have presented various calculations of the cost of drone delivery, which show that this cost is between four and even nine times lower than for van deliveries.



**Fig. 2.4** Presentation of drone during delivery (Source Own elaboration with OpenAI tool <https://dreamstudio.ai/generate>)

- **Flexibility:** Drones can be used to deliver packages to remote or hard-to-reach locations, such as rural areas or high-rise buildings (Rai et al., 2022).
- **Convenience:** Drones can deliver packages directly to customers' homes or workplaces, providing a higher level of convenience for the customer.
- **Efficiency:** Drones can potentially improve delivery efficiency by enabling companies to make multiple deliveries in a single trip, without the need for multiple drivers or vehicles (Petroşanu & Pîrjan, 2022).
- **Environmental positive impact:** Drones can potentially reduce the environmental impact of e-commerce deliveries by producing fewer emissions than traditional delivery methods. It can be stated that drone delivery is a form of green transportation solution (Xie et al., 2022).
- **Stronger GPS signal:** As flying objects, drones are less likely to lose their GPS signal than vehicles moving on the ground (Zhou et al., 2021).
- **Contactless delivery:** Drones can deliver e-commerce orders in a contactless way (Petroşanu & Pîrjan, 2022). Such a method of parcel delivery would minimise human-to-human contact, which is especially important in a pandemic time (Boysen et al., 2021).

There are also challenges and disadvantages associated with using drones for e-commerce deliveries, which are listed below:

- **Limited payload or carrying capacity:** Drones are limited in terms of how much weight they can carry, which means they may not be able to transport larger items or orders (Pugliese et al., 2020). Few drones can carry 20 kg of weight, and the vast majority of models have a maximum payload of less than 5 kg (Moshref-Javadi & Winkenbach, 2021).
- **Limited range:** Most drones have a limited range, and therefore they cannot deliver to remote locations far away from the distribution centre or warehouse (Benarbia & Kyamakya, 2021). Their travel

time is restricted because of the limitations of battery life (Archetti & Bertazzi, 2021).

- **Dependence on weather conditions:** Drones may be affected by weather conditions (Moshref-Javadi & Winkenbach, 2021), such as intense winds or heavy rain or snow, which could make it risky for them to fly.
- **Airspace restrictions:** Drones are still subject to airspace restrictions, which means they may not be able to fly over certain areas or at certain heights (Benarbia & Kyamakya, 2021). This could limit their ability to reach some customers.
- **Safety concerns:** There is always a risk of accidents or collisions when using drones for delivery, which could result in damage to property or injury to people. The damage caused by the drone's release or collision is usually proportional to its weight, considering also the weight of the payload.
- **Vulnerability to theft:** Drones could be vulnerable to theft, either by being shot down or simply taken by someone on the ground. This could result in lost or stolen packages. This disadvantage can be minimised by using localisers to determine the exact location of the drone and the parcel.

Hence, the development of drone-based delivery systems necessitates strategies to reduce the aforementioned adverse external effects and prevent the problems. This could be achieved by creating dedicated aerial routes and developing standardised routing protocols (Moshref-Javadi & Winkenbach, 2021). The adoption of drones as a part of everyday life is an extremely complicated matter as it should concern technical, regulatory as well as infrastructural issues (Silva et al., 2023).

Deliveries by drones are still struggling with some legal problems, and it is difficult to expect the dissemination of this type in the near future, even though the currently available technology already allows the implementation of this type of delivery. Therefore, autonomous robots seem to have a better chance of becoming widespread than drones in the next decade.

Combining a truck or van with drone transport can be an interesting option. Also, combining drone transport with delivery lockers seems to

be an attractive opportunity. Some concepts incorporating drones into parcel delivery processes are briefly characterised below.

### **Truck and Drone Delivery Model**

One potential future solution for courier companies is a combination of truck and drone. Such solutions are already being explored in the literature (Di Puglia Pugliese & Guerriero, 2017). There is the idea of autonomous drones which fly from delivery trucks and make the last mile deliveries. Kitjacharoenchai and Lee (2019) proposed a model, which considers the synchronised truck-drone routing by using many drones to fly from a truck, deliver parcels to customers, and return to the same truck for the package retrieval as well as battery swap. This model also considers trucks and drones' capacities to make sure that the number of loads carried by each drone should not exceed its capacity. Moreover, the total number of loads in each route should be less than the truck's capacity (Kitjacharoenchai & Lee, 2019).

### **Drone and Van Delivery model**

Another concept could be a combination of drone and van deliveries. In September 2017, a pilot project titled "Vans and Drones" was launched in Zurich by Mercedes-Benz Vans, U.S. drone systems developer Matternet, and the Siroop online marketplace. The groundbreaking concept involved using vans as mobile landing platforms for drones, aiming to evaluate on-demand delivery and its reception by retailers and the public. The drone and van model combines fast 3D mobility of drones with vans equipped with precision technology (Rai et al., 2022). Over the three-week trial, customers could order selected products for same-day delivery from the online marketplace that were suitable for drone transport, primarily consumer electronics and other small e-commerce items. The drones, loaded at the retailer's warehouse, flew to a van positioned at one of four predetermined points. The van's driver then took the product and completed the delivery to the customer, while the drone returned to the retailer (Roca-Riu & Menendez, 2019).

## Delivery Lockers and Drone Model

The book author's original idea, which the author has not encountered in the literature, is a combination of delivery lockers and drone delivery. This model could work on the following principle: a courier company delivers parcels to delivery lockers and then, the part of the customers that have chosen the door-to-door delivery option, when informed that the package is already in the delivery lockers, activates the drone delivery. The automated parcel machine gives the drone the parcel along with information with the parcel delivery address. The delivery time of the parcel from the delivery lockers to the customer's pick-up location (home, small landing in front of a block of flats) would be noticeably short, counted in minutes or even seconds. The advantage of such a solution would be that the customer does not have to go to the parcel locker to collect the parcel. The disadvantage is the need to automate delivery lockers and equip them with drones. Other disadvantages include the usual problems with drone delivery and the need to provide a separate place where the drone can land and leave the package. However, despite the disadvantages mentioned, the author presumes that, once the legal issues with drone delivery have been resolved, such solutions will be considered for implementation by companies operating delivery lockers, due to the high customer convenience.

## Autonomous Driving Robots vs Drones

Even though drones and sidewalk driving robots can be generally grouped under the term "automated delivery robots", numerous distinctions are apparent. Design-wise, robots boast higher capacities (20–30 kg versus 2–5 kg) and a potential for more compartments, allowing for multiple consecutive stops on their routes. Operationally, robots move at significantly lower speeds (5–10 kmph compared to 50–100 kmph) and have extended ranges (5–10 km versus 10–100 km) (Moshref-Javadi & Winkenbach, 2021; Simoni et al., 2020). Given these characteristics, robots are likely to be more fitting for delivering low-value items (like groceries or mail) in densely populated urban areas in the near future.

In contrast, drones might be better suited for transporting high-priority valuable goods (such as healthcare) in isolated or rural regions (Simoni et al., 2020).

## 2.3 Shortening of Delivery Times in E-Commerce

One of the frequently discussed disadvantages of e-commerce is the long waiting time for shipping (Niranjanamurthy et al., 2013). The most notable drawback for customers appears to be the delay between placing an order and the product's delivery time. To attract customers, some companies try to reduce this inconvenience by shortening delivery times. With same-day delivery, e-retailers can boost their portion of overall retail and promote the sale of product categories that are usually not sold online (Kawa et al., 2018). Researchers are also developing theories about same-day delivery and analyse different delivery models as point-to-point model or models which are based on the crowdsourcing or model which uses dynamic routing system (Kawa et al., 2018; Ulmer, 2020).

Same-day delivery usually involves an additional cost, but consumers are often willing to pay for expedited delivery. In a survey carried out by McKinsey across Germany, France, Sweden, and the United Kingdom, half of the participants expressed their willingness to pay EUR 6 to 7 for same-day delivery on an EUR 59 purchase (Hausmann et al., 2014).

In business practice, many companies are trying to implement even faster than one-day forms of delivery. At the end of 2021, CCC (ccc.eu) extended the same-day delivery option to another seven cities. Customers who choose this service will receive their order within 60 minutes. In total, residents of eight Polish cities will benefit from the new online shopping format. The race against time also continues among the platforms that deliver groceries. JOKR is the company, which promises delivery of the order within 15 minutes. The advertising slogan on this company's homepage reads: "Fresh products & favourite local brands delivered before the water boils" (<https://www.jokr.com/>). Shopping is

delivered even faster by well-known brand Glovo in Madrid. The new option guarantees the receipt of products within 10 minutes (<https://www.bankier.pl/wiadomosc/Zakupy-2021-10-zmian-w-sklepach-wywolanych-przez-pandemie-COVID-19-8117480.html>).

Expedited delivery is an option that is likely to attract customers, but it is important to remember that fast delivery options calculated in hours or minutes are only feasible if the goods are in warehouses within a short distance from the customer. It is therefore an option only for large urban areas and their surroundings. Perhaps in the distant future, delivery drones flying long distances at speeds of several hundred km/h will be available and then delivery in an hour from an automated warehouse will be possible, even for customers far away from the warehouses. What the costs of such delivery will be is difficult to forecast at the moment.

## 2.4 Reverse Logistics Development

The rapid development of e-commerce opens up a vast market of online business and modern logistics have a huge space for development. Simultaneously, e-commerce transactions cannot be the object of experience, the buyer often can only get commodities information from pictures and text descriptions, which exists a certain degree of deviation, so the returned volume of e-commerce increases (Xu & Jiang, 2009). Returns in e-commerce are much more frequent than in traditional commerce (Wang et al., 2021). Reverse logistics plays an important role in managing numerous inevitable scenarios related to e-commerce transactions. These situations include delivering the wrong products, customer actions, product damages, and delays in order processing, among others (Wang et al., 2020).

The lack of possibility to return the product to an e-shop is the reason for many customers to give up online transactions. Many well-known e-shops take reverse logistics strategy as an important tool to increase customer satisfaction and strengthen their competitiveness (Xu & Jiang, 2009). Therefore, the development of reverse logistics in e-commerce is expected in the coming years.

Reverse logistics solutions that will regularly appear in e-commerce include:

- reusable packaging allowing returned goods to be packaged.
- clear communication on the website of the online shop about the possibility to return goods without stating a reason.
- a flexible returns policy, i.e., an extended period for returning goods without stating a reason, fast payment returns, etc.
- various forms of returning goods—return by courier, return in the delivery locker.

Such solutions will encourage customers to buy and create a competitive advantage. Obviously, any customer convenience, such as free returns, is an additional cost to the shop, so the returns policy must be well-thought-out and adapted to the particular business.

## 2.5 The Development of Systems that Allow to Send Items Online

E-commerce is a combination of two areas of business—the area that is carried out in the physical sphere (storage, packaging, shipping, and delivery of goods) and in the virtual sphere, in which we deal with IT systems that allow customers to view the product range and generate orders. In the case of digital goods, all processes are carried out in a virtual environment, but it should be remembered that this applies to a very narrow area of the assortment, i.e., software, e-books, audiobooks, films, photos, and various other files. The vast majority of assortment types are sold and shipped in physical form. In the future, the development of technology related to 3D printers will make it possible to send online more product items in digital form and print them by the customer, but at present this option only applies to products with a rather monolithic structure made of materials such as plastic, metal, plastics. Industries such as fashion, jewellery, and toys can greatly be impacted by 3D (Turban et al., 2018). The increase in the market and the number of 3D printers sold is visible and in the coming years this trend can be

expected to continue. The global 3D printing market size in 2022 was valued at USD 16.75 billion and is expected to expand at a compound annual growth rate of 23.3% from 2023 to 2030 (Market Analysis Report). Examples of integrated approaches combining the capabilities of 3D printers with e-commerce can be found in the literature, such as an integrated approach to future jewellery e-commerce business using 3D printing (Kale, 2019). Therefore, it can be hypothesised that the development of e-commerce will favour the development of 3D printing technology.

Perhaps in the distant future it will be possible to develop the technology to teleport objects, but with the technology that currently exists, this option is still rather in the area of science fiction.

## 2.6 Innovative Reusable Boxes for E-Commerce Packaging

The packaging in which the shipment is delivered is constantly being improved, an example of which is the delivery in innovative boxes such as The Box LivingPackets (<https://livingpackets.com/>), with built-in GPS and sensors measuring temperature, humidity, and location. A reusable box of the future, made of sustainable biodegradable material, with built-in GPS could look like the one in Fig. 2.5. Such innovative boxes have a great chance to become the global well-known solutions in the nearest future. It should also be noted that reusable packaging is a greener solution. Of course, the ecological and economic feasibility of such solutions depends on their use in the long term.



**Fig. 2.5** Innovative box for e-commerce deliveries with digital display (Source Own elaboration with graphic tool DALL-E <https://chat.openai.com/>)

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# 3

## Current and New Payment Methods in E-Commerce

The development of e-commerce has proceeded in parallel with the development of various innovative forms of payment. In the early years of e-commerce, payment on delivery dominated. Subsequently, payment by credit card began to be most popular. In parallel, electronic banking developed, allowing payments to be made in the convenient form of an electronic transfer. Then came PayPal other electronic payment systems. One of the most important advantages of payment innovations was that money transfers could be flawlessly come across borders. PayPal was the first large company that made it possible for the e-commerce to cater to new customer bases by delivering the possibilities for international transactions, ushering in all sorts of other payment providers like Transferwise, Transfergo as well as Western Union (Wertz, 2019).

With the spread of mobile commerce, smartphone-based payments such as Apple Pay, Samsung Pay, and Google Pay became popular. As the number of possible forms of payment increased, payment integrators emerged to offer payments that represent a cross-section of the solutions available on the market.

### 3.1 Payment Methods Market Overview

In the contemporary digital environment, the e-commerce industry has witnessed an evolution in the way transactions are conducted, owing to the proliferation of innovative payment methods. The analysis of the e-commerce payment market begins by showing the popularity of the various forms of payment. Table 3.1 presents the share of payment methods as a percentage of total e-commerce transaction volume in various parts of the world. As it can be seen, digital/mobile wallet (later referred to as e-wallet) payments account for the largest percentage. In Asia, this type of payment accounts for as much as 69% of total transactions, while worldwide it is 49%. In second place in terms of popularity are payments via credit card/charge card. This type of payment is most popular in Latin America, the Middle East, and Africa. Thus, it can be seen that the world region varies considerably in the popularity of different forms of e-commerce payments.

Figure 3.1 presents the most recognisable brands regarding digital payments in the United States. As it can be seen, the leader is PayPal with 92% recognition. It is noteworthy that the first five positions were occupied by payment brands that can be generally described as e-wallets.

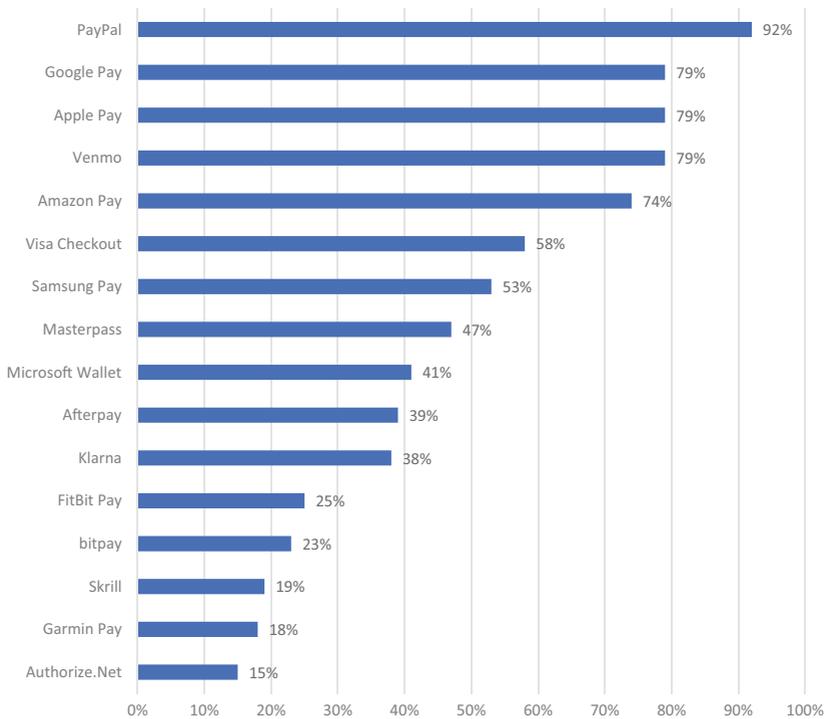
Market share data for online payment processing software technology worldwide, as of July 2023, provides insight into the competitive e-commerce payments industry (Fig. 3.2). PayPal's dominant market share of 40.52% underlines its importance as the preferred payment solution for a significant global user base. However, PayPal's market share declined by around 1.4% year-on-year in 2023. Stripe's significant share of 20.52% reflects its continued growth and importance as a powerful player in the industry (up approximately 1% year-on-year). The emergence of Shopify Pay Installments at 13.80% (an increase of more than 1% year-on-year) highlights the increasing adoption of installment-based payment options, catering to consumers seeking enhanced financial flexibility. Amazon Pay, with a 4.91% market share, maintains its presence but faces stiff competition. The presence of Afterpay at 1.58% signifies the existing popularity of buy-now-pay-later services. The remaining 18.67% attributed to "Other" underscores the diversity of niche and emerging players in the market. These data explain the competitive

**Table 3.1** Share of selected payment methods as percentage of total e-commerce transaction volume worldwide in 2021, by region

	Worldwide (%)	North America (%)	Latin America (%)	Europe (%)	Asia Pacific (%)	Middle East and Africa (%)
Digital/mobile wallet	49	29	19	27	69	17
Credit card/charge card	21	31	39	25	13	31
Debit card	13	21	18	17	8	13
Bank transfer	7	8	10	14	5	16
Buy now, pay later	3	4	0	8	1	1
Cash on delivery	3	2	4	2	3	14
Direct Debit	1	1	1	4		2
PrePay	1	2		1		2
Other	1	1	1	1	1	2
Pre-paid card	1	1	1	1		3
PostPay	1		7		1	

Source <https://www.statista.com/statistics/348004/payment-method-usage-worldwide/?locale=en>

dynamics in the online payment processing sector, highlighting the key role of the major players, while recognising the potential for innovation and market entry by newer, specialised players. Further analysis is warranted to see the changing trends and their implications for the future of e-commerce payment technology.

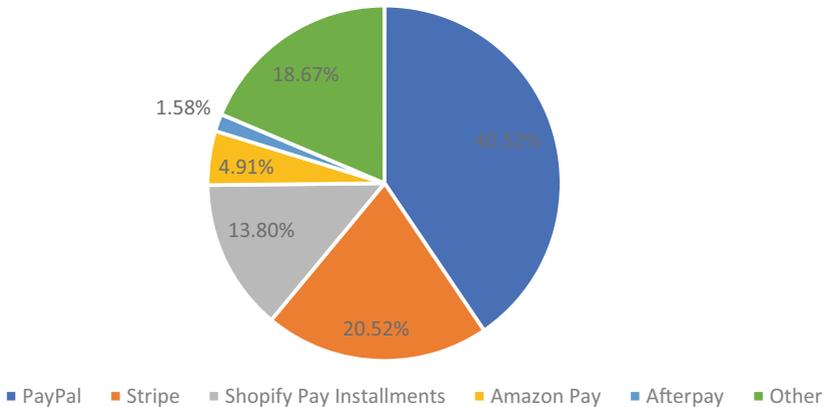


**Fig. 3.1** Leading digital payment brands ranked by brand awareness in the United States in 2022 (Source <https://www.statista.com/statistics/1339646/most-well-known-digital-payment-brands-in-the-united-states/>)

## 3.2 PayPal

PayPal is a digital payments company that allows people to send and receive money electronically. It was founded in December 1998 as Confinity by Max Levchin, Peter Thiel, and Luke Nosek. In 2000, Confinity merged with X.com, an online banking company founded by Elon Musk, and eventually became PayPal in 2001 (Forrest, 2014).

The main feature that has gained PayPal popularity is its simplicity. PayPal enables individuals and businesses to send and receive payments quickly, without the need to exchange sensitive financial information like credit card or bank account numbers. Users can create an account



**Fig. 3.2** Market share of online payment processing software technologies worldwide as of July 2023 (Source <https://www.statista.com/statistics/895236/australia-market-share-online-payment-platforms/>)

by providing their email address and linking it to their credit card, debit card, or bank account. Once the account is set up, users can send or receive payments using their PayPal balance or the linked payment method. Therefore, the second advantage is security: once a user signs up for a PayPal account and types in the credit cards and bank accounts to use for purchases one time on the PayPal system, never again have to reveal credit card information online. By paying with PayPal in online store, customer keeps credit card information confidential, which means that users can shop without being afraid of theft of a credit card number from an online merchant (Niranjanamurthy, 2014).

PayPal has grown to become one of the most popular payment methods on the internet, with over 435 million active user accounts in 2022 (<https://about.pypl.com/who-we-are/history-and-facts/default.aspx>). It is used by individuals and businesses all over the world (to be precise in 190 countries) to buy and sell goods and services and to transfer money.

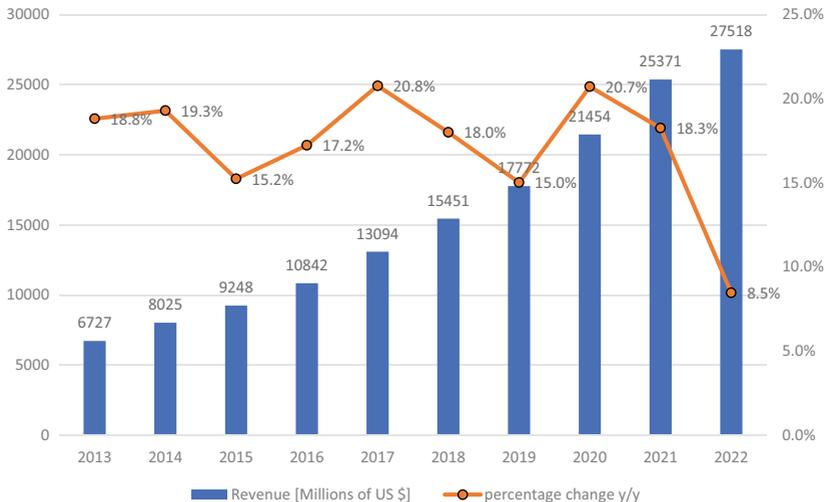
In addition to its core payment services, PayPal has expanded its offerings to include services like PayPal Credit, a digital line of credit for customers, and PayPal Business, a suite of tools for businesses to manage their finances and accept payments online. The company has

also made strategic acquisitions in the fintech space, such as Venmo and iZettle. PayPal also introduced in 2021 checkout with Crypto, offering customers an easy and seamless method to pay using cryptocurrencies (<https://about.pypl.com/who-we-are/history-and-facts/default.aspx>).

PayPal has had a significant impact on the e-commerce payments industry, substituting traditional payment methods like checks and money orders, and paving the way for other digital payment methods. Its success has also led to increased competition from other digital payment providers like Stripe, Square, and Google Pay or Apple Pay.

PayPal has been the leading platform for e-commerce for many years, but in 2022 a decline in the growth rate of this platform's turnover can be observed, which is probably due to the increasing popularity of competing solutions such as Apple Pay, Google Pay, Amazon Pay, and Samsung Pay payment systems (Fig. 3.3).

The question arises whether PayPal will be pushed out of the market in the coming years by solutions such as Apple Pay, Google Pay,



**Fig. 3.3** Revenue of PayPal from 2013 to 2022 and percentage change y/y (Source <https://www.macrotrends.net/stocks/charts/PYPL/paypal-holdings/revenue>)

Amazon Pay, or Samsung Pay. According to the author, PayPal's position will slowly weaken with the dominance of mobile payments. In the author's opinion, it is worth asking the Large Language Model (LLM) as ChatGPT, whose opinion, more or less representative, will reflect what is written on the Internet on this subject (of course, being aware that the answer is dependent on the data, e.g., the range of years on which the LLM was taught). The author asked ChatGPT with the following question: "Will PayPal lose its market share to Apple Pay, Google Pay, Amazon Pay and Samsung Pay?". The answer of ChatGPT is presented below.

It's difficult to predict the future of the payments industry and the specific market share of PayPal, Apple Pay, Google Pay, Amazon Pay, and Samsung Pay. However, it's worth noting that these companies operate in slightly different markets and have different strengths and weaknesses.

PayPal is a dominant player in the online payments space, with a large user base and a wide range of services. It is also used by many small and medium-sized businesses to accept payments online.

Apple Pay, Google Pay, Amazon Pay, and Samsung Pay, on the other hand, are primarily mobile payment solutions that allow users to make payments with their smartphones. Apple Pay and Google Pay have seen significant growth in recent years, with many consumers using these services to make in-store purchases. Amazon Pay, which is primarily used for purchases on the Amazon website, has also seen growth in recent years.

That being said, it's important to note that the payments industry is highly competitive, and all of these companies are likely to face challenges and opportunities in the coming years. Some factors that could impact their market share include user adoption rates, security and privacy concerns, regulatory changes, and technological innovations.

Overall, it's likely that PayPal will face increased competition from other digital payment providers in the future, but it's also possible that it will continue to maintain a strong market position due to its large user base and diverse range of services.

It is difficult to disagree with the view put forward by ChatGPT. According to the author, PayPal's future position in the payments market will depend not only on technological competitiveness, but also on

economic competitiveness, i.e., primarily on the level of transaction commissions charged. If PayPal ceases to be competitive with other solutions in this aspect, the author predicts a slow decline in its market share, despite its strong brand and popularity.

### 3.3 Stripe—Payments Software Infrastructure E-Commerce

Stripe is the producer of application programming interfaces (API) which can be applied by web developers to integrate payment processing into websites and mobile applications (Carr, 2012). One of the solutions introduced by this company in 2012 is Stripe Connect, which is a multiparty payments solution that enables developers to embed payment solutions natively into their products (Geron, 2012).

In 2018, Stripe expanded its services to include a billing product for online businesses, enabling companies to manage subscription recurring revenue as well as invoicing ([https://en.wikipedia.org/wiki/Stripe,\\_Inc.](https://en.wikipedia.org/wiki/Stripe,_Inc.)).

One of the key benefits of applying Stripe software in e-commerce is its ease of use. The platform is designed to be user-friendly and intuitive, making it affordable for businesses of all sizes to set up and manage their payment processing. Stripe offers a range of integrations with other popular e-commerce platforms, such as WooCommerce and Shopify, which can further simplify the payment process for businesses.

In terms of security, Stripe developed fraud detection and prevention systems. The platform uses advanced machine learning algorithms to analyse payment data and detect fraudulent transactions in real time (Lunden, 2018). Stripe also offers a suite of security tools, such as two-factor authentication and tokenisation (<https://stripe.com/docs/api/tokens>), to increase the security of its payment processing.

Currently, Stripe is the second most popular e-commerce payment software (cf. Figure 3.2). Table 3.2 shows ten countries with the highest number of merchants who use Stripe as a payment solution on their websites. As it can be seen, by far the highest number of merchants use Stripe solutions in the United States, however, the highest percentage of merchants from these ten countries presented is in France.

**Table 3.2** Number and share of merchants who use Stripe as a payment solution on their website across various countries and territories in the world as of 3 October 2022

Country	Number of users	Percentage of users
United States	625,121	5.59
United Kingdom	63,958	5.65
France	34,165	9.26
Australia	31,306	3.50
Germany	25,583	3.07
Canada	20,631	4.31
Italy	18,289	5.26
Spain	14,487	6.28
India	8269	4.19
Switzerland	7232	6.61

Source <https://www.statista.com/statistics/1340272/stripe-use-among-merchants-in-the-world>

Looking at the future of e-commerce, it is highly likely that Stripe will be a key player providing e-payment software for online shops.

### 3.4 BLIK Payment

An interesting solution that continues to gain in popularity is the innovative BLIK payment. BLIK was introduced in 2015 and since then, has continuously increased its market share and the scope of mobile payment solutions offered to the system participants (Błach & Klimontowicz, 2021). BLIK was created in 2015 by the company Polski Standard Płatności (ang. Polish Standard Payments—PSP), founded by the six largest Polish banks: PKO Bank Polski, Alior Bank, ING Bank Śląski, mBank, Bank Millennium, and Santander Bank Polska.

BLIK became the most popular solution used while making mobile payments in Poland and in 2020 38% of consumers used BLIK (<https://www.statista.com/statistics/1101542/poland-financial-products-used-for-in-store-mobile-payments/>) and remains the most frequently selected payment method. It is important that in 2020, BLIK joined the European Mobile Payment Systems Association (EMPSA), which incorporates thirteen mobile payment systems in Europe, uniting

more than ninety million mobile payment users. The main purpose of EMPISA is enabling seamless mobile payment across Europe by proposing roaming solutions among participants of payment systems (EMPISA, 2023).

In 2022, over 1.2 billion BLIK operations were recorded, worth PLN 163.9 billion (37 billion U.S. dollars). BLIK is most often used in e-commerce, with as many as 714.2 million payments made through this channel in 2022 (<https://blik.com/przelomowy-rok-blika-ponad-miliard-transakcji-i-blisko-13-mln-aktywnych-uzzytkownikow-na-koniec-2022-r>).

Considering the rapid growth in popularity of BLIK payments in Poland and becoming a leader in this market (<https://autopay.pl/baza-wiedzy/badania-i-raporty/blik-metoda-platnosci-deklaruje-inne-220709>), it can be predicted that if the system is implemented in other countries, it is also likely to gain popularity. However, for the moment (as of March 2023) its full functionalities are only available in Poland, so there is still a long way to go before it becomes a globally popular payment standard. In order to become a worldwide electronic payment standard like PayPal, for example, it is necessary to establish cooperation with global players in the payments market. The first step has already been taken, as of 14 December 2018—Mastercard and PSP, operator of the BLIK mobile payment system, have announced a strategic partnership. Under the partnership, BLIK should have provided a convenient and reliable mobile and online payment platform trusted by millions of Polish consumers. Mastercard should have provided innovative payment technologies, a globally recognised brand, and a global acceptance network (<https://www.blik.com/mastercard-i-polski-standard-platnosci-oglaszaja-strategiczna-wspolprace-zaoferuja-konsumentom-i-instytucjom-finansowym-nowa-jakosc-w-platnosciach>). So far, however, this strategic agreement has brought only the possibility to pay using BLIK in stationery shops, in some countries, while payments in online shops outside Poland are still not available. Therefore, the growth in popularity of BLIK payments in online shops outside Poland will require legal changes and agreements between significant players in the payment markets.

## 3.5 Cryptocurrency Payments

There is still debate whether cryptocurrency payments in online stores will become increasingly popular in the next years, as such methods of payment have several benefits not only for merchants but also for consumers. The examples of advantages of cryptocurrency payments are lower transaction fees, especially for international transactions, high accessibility (Jonker, 2019), faster transactions (comparing to traditional electronic bank payments), possibility of monetising new markets, and security (Ahamad et al., 2013). Merchants which accept cryptocurrency payments can treat it as a method to attract new customers and differentiate themselves from competitors.

The examples of online stores that have already accepted cryptocurrency payments are the following: Newegg (<https://kb.newegg.com/knowledge-base/using-crypto-on-newegg/>), Roman Gaming (<https://romangaming.store/>), and Crypto Millionaire (<https://www.crypto-millionaire.com/>), but there are also many other (Patel, 2023). It is worth mentioning that companies such as Visa or PayPal have also started to offer cryptocurrency payment to their clients.

The global cryptocurrency market is expected to increase its value in the next years. According to a MarketsandMarkets report, the market of cryptocurrency is projected to reach \$1.4 billion by 2024, with a compound annual growth rate of 6.18% from 2019 to 2024 (<https://www.marketsandmarkets.com/Market-Reports/cryptocurrency-market-158061641.html>). This value shows that the use of cryptocurrency as a form of payment is probably to continue to grow in the following years.

Despite the rapid growth of the cryptocurrency market in the second decade of the twenty-first century, only a small percentage of merchants accept cryptocurrency payments. Scepticism towards cryptocurrencies is primarily due to the high volatility of the exchange rate and huge fluctuations of most cryptocurrencies, making it difficult to determine cryptocurrency prices. Two other reasons for the relatively small proliferation of cryptocurrencies in commerce are the following (Mendoza-Tello et al., 2018):

- The characteristics as well as coverage capacities of blockchain technology are not well known (Vora, 2015), even by cryptocurrency users. The technological foundations of cryptocurrencies and their practical applications remain enigmatic to both novice users and emerging businesses (Dyhrberg, 2016).
- The second reason is a lack of perceived trust by the consumer that leads to their low acceptance (Gjermundrød & Dionysiou, 2014). The reliability of transactions is based on of a blockchain-based technology (Ghosh et al., 2020). However, people are unwilling to trust a faceless infrastructure (Gjermundrød & Dionysiou, 2014).

In conclusion, the widespread adoption of cryptocurrency payments in online shops is highly questionable.

### 3.6 E-Wallets

The e-wallet can be defined as a transaction structure where an internet application or service enables customers to handle data in a central place linked to acquisitions, affiliation, and finance information (Uddin & Akhi, 2014). The e-wallet behaves like a traditional wallet; however, the money is digital, and the phone has the e-wallet as an app (Alam et al., 2021).

E-wallets are widely used in e-commerce to facilitate payments, as they provide a secure and also convenient way to store payment information and complete transactions online. E-wallets, such as Google Pay, PayPal, and Apple Pay, are becoming more widely accepted as a method of payment in online stores. This form of payment offers convenience as well as security and therefore is likely to become even more popular in the future.

The players in the banking industry foresee that e-wallets will take over the use of cash and credit and debit cards by consumers in the near future (Chea, 2020).

In e-commerce, e-wallets are widely used for mobile purchases. E-wallets offer several advantages over traditional payment methods, including fast transaction processing and increased security. E-wallets

also remove the need for customers to repeatedly enter payment information, making the checkout process faster, more secure as well as much more convenient.

The advantage from the merchant side is that e-wallets provide access to a large customer base, as they can cater to customers who prefer to use such a digital payment method. Merchants also benefit from lower transaction fees (especially in international transactions) and reduced fraud risk, as e-wallets provide a high level of security.

Several types of e-wallets are available on the market, including closed, semi-closed, semi-open, and open e-wallets. Closed e-wallets are typically used for specific services, such as a particular merchant's online store, while semi-open and open e-wallets can be used for a broader range of businesses and customers (Chauhan et al., 2017).

Given the high popularity of e-wallet payments, it can be expected that this form of payment linked to smartphones and smartwatches will dominate the e-commerce market in the coming years.

### 3.7 Deferred Payments

Among the emerging payment methods, deferred payments have emerged as an innovative solution to attract new customers. Deferred payments refer to a transactional framework in which consumers have the option to defer their payment obligations to a future date, upon receipt of the goods or services purchased. This payment method represents a profound change from the traditional "pay now" model, offering consumers greater financial flexibility.

The origins of deferred payments date back to the proliferation of credit cards with deferred debt repayment in the 1970s (Williams, 2004), however the current roots of deferred payments in e-commerce can be traced back to the early twenty-first century when technological advancements and changing consumer preferences paved the way for novel payment solutions. The increasing number of internet users and then smartphone users all contribute to the growth of deferred payment acceptability (Sengupta et al., 2022). Next, the development of sophisticated payment gateways, secure online platforms, and data analytics

capabilities played important roles in facilitating deferred payment mechanisms. The growth of deferred payments has been greatly supported by the emergence of fintech startups that have used data-driven algorithms to assess consumer creditworthiness and build trust in deferred payment transactions. Furthermore, the integration of artificial intelligence and machine learning algorithms into e-commerce platforms has enabled the real-time evaluation of transaction risks, thereby enabling merchants to extend deferred payment options to a broader consumer base. The crucial factor that influences a deferred payment adoption is impulsive buying tendency via customers (Kim & Mo, 2022). As consumers increasingly seek financial flexibility and convenience when shopping online, the development of deferred payments could become part of the growth of e-commerce, just as credit cards have influenced the growth of commerce in the past, driving higher sales volumes and increasing customer loyalty. However, it is necessary to critically analyse the economic implications and potential risks of deferred payments to ensure their long-term sustainability and viability in the ever-changing e-commerce ecosystem.

It should be borne in mind that deferred payments can have a significant impact on the increase in the indebtedness of societies and the problems of the poorest consumers in repaying their debts. Deferred payment mechanisms exhibit reduced transparency during the initial stages of the purchase decision-making process. This is primarily due to the absence of any necessity for the consumer to make payment immediately. Consequently, the act of payment becomes disassociated from the act of purchase. Therefore, the discomfort associated with making the payment is deferred to a subsequent point in time. This deferred payment approach may hold a heightened appeal for individuals with lower incomes, as it allows for the separation (i.e., deferral) of the payment from the moment of consumption, potentially aligning more favourably with their financial constraints (Deufel & Kemper, 2018).

Therefore, regulations limiting the amount of consumer debt like those governing consumer credit seem advisable. From the perspective of consumer protection, such regulations should, among others, give

the consumer the possibility to withdraw from the contract. From the seller's point of view, credit information systems alerting the seller to the fact that a given consumer already has outstanding debts on time are important.

### **3.8 Payments Connected with Social Media Promotion—Proposal for the Future**

Social media has become a permanent feature of modern societies. Therefore, combining payments with social media activity seems to be a solution that could become popular in the future. The innovative form of payment that may be implemented in the next few years is the ability to pay for goods by promoting a brand or products on social media. Currently, this is a form that is often used by influencers who, in return for promoting a product on social media (e.g., on their YouTube channel, or on Facebook or Instagram), take payment in the form of a free transfer of the advertised products. This is a method of barter billing for advertising services. Perhaps in the future, what is currently available to influencers will be available to all active social media users. An innovative solution can be developed in which a customer ordering a product from an online shop receives a discount for promoting the shop or product on their social media profile. The size of the discount could be dependent on the number of friends or followers on the customer's profile. This type of partial or full barter settlement could be beneficial for both sides of the transaction. The shop would be assured of promotion and an influx of new customers, and the customers would be able to buy at lower prices.

Considering that Facebook's daily active users (DAUs) were 2.09 billion and monthly active users (MAUs) were 3.05 billion for September 2023 (<https://investor.fb.com/investor-news/press-release-details/2023/Meta-Reports-Third-Quarter-2023-Results/default.aspx>) the value of sharing information about the product, especially if the customer has many connected users, may be valuable for the producer or distributor of the product.

There are now instances of this type of billing. One example is influencer marketing, whereby various companies pay influencers on

social media to promote their products to their followers. However, such arrangements are not available to every social media user. Such a system of payments could potentially work through a loyalty or rewards programme, where customers are incentivised to promote products on social media in exchange for discounts, free products, or gratifications paid to their e-wallet. The system can use social media monitoring tools to track user activity connected with the promotion of a product, such as likes, shares, and comments. Users who meet certain criteria for promoting the product (e.g., have a high average number of post views or likes, etc.) could then be rewarded with discounts or free products.

The question remains as to how exactly to value a post shared on Facebook or Instagram (or other social media). A post valuation could be proposed here by assessing the reach that a post has achieved. Additionally, extra engagement could be valued: the number of likes, referrals, and comments. Another possibility would be a valuation based on the number of “friends” (connected people) of the person who recommended the product in question, i.e., the number of potential customers the information will reach.

The most restrictive form would be pricing based on the number of clicks on the link contained in the product description. This form of charging would be similar to the Pay Per Click (PPC) model but would involve getting “friends” to click on the link, which would probably be met with considerable resistance and reluctance by social media users.

A diagram of how such a payment system works is shown in Fig. 3.4.

Nevertheless, there are some potential challenges and concerns associated with this type of model, such as ensuring that the promotion is transparent and not misleading to customers, also concerns around privacy as well as data security. Therefore, any implementation of a payment system based on social media activity should consider these issues and ensure that appropriate safeguards are in place.



Fig. 3.4 Social media payment model

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# 4

## Virtual Commerce

E-commerce is constantly evolving. Originally, it occurred on static pages with forms. Then technology changed, and e-commerce sites became increasingly interactive, including more elements to adapt to the user. Afterwards, recommendation techniques based on various algorithms were developed. The next key trend was the use of mobile devices in e-commerce and the move towards m-commerce. Shop websites became responsive, i.e., adapting to the various devices used by customers (tablets, smartphones). Another milestone in e-commerce was the integration with social media, including customer acquisition through social media channels such as Facebook, Instagram, and Twitter.

We are now facing the next revolution in e-commerce, which will be the use of Virtual Reality. V-commerce, as e-commerce using Virtual Reality solutions is referred to, even though the technology has been around for several years, is still not very popular with both customers and retailers, who still do not provide interfaces tailored to shopping with VR goggles. Also, the percentage of customers using devices such as VR goggles or gloves is still low, however, the number of VR headset users is increasing rapidly. For example, in the United States from 2017 to 2020 number of VR headset users doubled from 11 million to 22.2

million [<https://www.statista.com/statistics/1017008/united-states-vr-ar-users/>]. In the United States, one in five residents (19%) have used VR goggles at least once (which does not mean they own one) [<https://www.oberlo.com/blog/virtual-reality-statistics>].

## 4.1 V-commerce Definition

Before defining V-commerce, it is needed to clearly present the definition of Virtual Reality. Velev and Zlateva (2019) claim that Virtual Reality is a combination of both terms for “virtual” and “reality”, where *virtual* is the adjective *near* and *reality* is what people experience as human beings. In this context, Virtual Reality can be treated as *near-reality*. Technically speaking, Virtual Reality is the term used to describe a 3D computer-generated environment, which can be explored and interacted with by a person (Velev & Zlateva, 2019) outfitted with equipment that allows the reception of Virtual Reality.

V-commerce (virtual commerce also known as vCommerce) can be defined as the process of the buying and selling of goods and services with using virtual and Augmented Reality technology [<https://rechargepayments.com/glossary/v-commerce/>]. Compared to traditional e-commerce, virtual marketplaces have advanced features such as stereoscopic 3D visualisation, immersion, and multisensory feedback (Price et al., 2013). De Regt and Barnes (2019) defined virtual commerce as electronically mediated commercial transactions that emanate from an alternate reality technological platform and encompass the exchange of either digitally generated or real-world products and services. V-commerce is also defined as a subset of the e-commerce business model, which is focused on the adoption of VR technology in order to enrich the online experience through the creation of Virtual Reality marketplaces (Luna-Nevarez & McGovern, 2021). V-commerce enables to present a 3D model of a product to a customer in a virtual environment. This enables customers to judge a wide range of product features before purchase (Ayush, 2019).

It should also be mentioned that V-commerce in literature has alternative meanings as virtual commerce or voice commerce, but these meanings will not be considered in the next analysis.

## 4.2 The Metaverse Concept and V-commerce

In 1992, American writer Neal Stephenson published a novel entitled *Snow Crash* (Stephenson, 1994). In it, Stephenson describes the adventures of a protagonist named Hiroaki Protagonist, who in the early twenty-first century lives in Los Angeles physically, but mentally often finds himself in a Virtual Reality known as the Metaverse (Kaplan & Haenlein, 2009). Stephenson's book popularised the concept of the Metaverse, although it should be remembered that many writers had written about virtual worlds much earlier, examples being Stanisław Lem and his 1964 book *Summa technologiae* (Lem, 2023) or many science fiction authors. The first, and very well known worldwide, attempt to create a hyper-reality is probably the three-dimensional virtual world *Second Life* (Boulos et al., 2007). Nowadays, however, *Second Life* is usually talked about as a historic, not entirely successful project. Perhaps the reason for the decline in *Second Life*'s popularity was the lack of available hardware technology to achieve an adequate level of immersiveness in the first decade of the twenty-first century. The next moment when the Metaverse hit the information mainstream was on 28 October 2021 when Mark Zuckerberg, CEO and founder of Facebook, revealed that the company would be renamed Meta. This new name not only symbolises the company's commitment to shaping the future, but also highlights its shift into the Metaverse (López-Díez, 2021). A major difference from the days of *Second Life*'s popularity is now the wide availability of Virtual Reality goggles offering a high level of immersion. Therefore, the virtual worlds that will now be created will be able to offer users a much more immersive experience. If we add to this the popularity of social media, it seems that the Metaverse created by Meta/Facebook or other companies

is also likely to become an important trading platform. V-commerce has the potential to become an important element of the Metaverse, although I assume that in the first stage of development V-commerce V-shops will function independently of the larger Metaverse-type environment.

### **4.3 Conditions that Must Be Met for V-commerce Proliferation**

The question arises as to what conditions must be met on the demand and supply side for V-commerce to spread. The following section will discuss the conditions identified by the author necessary for the spread of V-commerce by demand and supply side.

#### **Demand Side—Customers**

The development of advanced technical solutions does not yet guarantee market success. The condition for success is always customer acceptance. The following section analyses those factors that are important for the proliferation of V-commerce to occur, considering the demand side, i.e., the customers of the stores.

##### **1. The Price of VR Equipment**

For the demand side, one of the conditions is the availability of VR goggles (also referred to as VR headset or Head Mounted Devices). Currently, their price for the cheapest models (e.g., Oculus Quest 2 with 128 GB) oscillates around \$350–450 US. More expensive models of VR goggles (e.g., Meta Quest Pro or HTC Vive Pro 2) cost about \$1200 and even exceed \$2000, depending on additional equipment. Much cheaper are VR goggles that are an add-on to a smartphone, such as the Samsung VR Gear. The price range for this type of goggle starts at around \$50. These aforementioned prices are not a high barrier for gamers, who can pay much more for an additional gaming experience, however, for users who were to buy VR goggles just for shopping online, such an amount

seems a bit of a barrier, especially for low-income consumers. In general, however, a downward trend can be predicted when it comes to VR headset prices. In addition, there are more used devices available on the market sold by users who change goggle models to the latest ones. The price of used VR goggles is often as much as 50% lower than new ones. Meta Quest 3 has been released in October 2023, which will certainly reduce the price of previous versions. Thus, it can be predicted that the price of VR headsets will not be a significant barrier for most consumers in the future.

## 2. The Convenience of Shopping

The primary criterion for the spread of V-commerce among consumers is consumer benefits. From the standpoint of product pricing and assortment width, there should not likely be significant differences between e-commerce and V-commerce. It may be that some of the assortment will not be available initially in the V-commerce version, due to the need for additional costs regarding the presentation of the VR environment.

Consumer benefits, therefore, should be seen primarily in the convenience of shopping and the additional opportunities created by the V-commerce environment. These can include, among others:

- The ability to view products in three dimensions, as well as in their original environment, for example, seeing what the table looks like in the living room where it is to go, or how the TV looks on the wall on which it is to hang, or how the consumer looks in the shoes he intends to buy. It is also possible to see the product in the environment in which it is to be used, such as a tent standing in a mountain glade.
- The ability to touch and try out products with additional devices like VR gloves, VR shoes, VR suits, etc. The development of VR should go hand in hand with an increasing range and availability (including price) of peripherals to enhance the immersive experience. Full VR suits allow neural stimulation of the entire body, which should guarantee the possibility not only to touch the product, but also to try it on and to try it out. Of course, in such a case, the problem remains as

to how much the sensations generated by the peripherals will match the actual physical sensations. There may be a problem of inaccurate transfer of consumer sensations, which can be compared to the problem of inaccurate reflection of product colours on a monitor. This can result in complaints and returns of products that were not modelled correctly in the VR environment or the transfer of their physical characteristics using peripheral tools was inaccurate.

- The ability to talk to the seller's avatar (the seller's avatar can be modelled as a well-known figure like a celebrity, sports star, etc.). Thanks to the use of deepfake technology, it is possible to use the faces (with their consent, of course, obtained by signing the appropriate contract) of famous figures who can act as advisors in the v-store. For example, an avatar of Roger Federer, who recently retired from tennis, could advise on the choice of a racquet or tennis outfit, and a soccer outfit could offer an avatar of Cristiano Ronaldo.
- The ability to interact in the VR world with other shoppers. These last two capabilities of V-commerce, bring the shopping environment firmly closer to shopping in the physical world (in traditional stores), while retaining the advantages of e-commerce, such as the ability to shop anywhere, anytime. It seems that the creation of VR environment in which online shoppers can meet, talk to each other, and exchange opinions on products may convince those people who treated shopping in shopping malls as a form of leisure, with the possibility of meeting friends.

### 3. Barrier to Consumer Adoption of VR Equipment

The user's adaptation to VR goggles can be compared to when a user who previously used only computers started using their first smartphone. However, starting to use VR goggles not only requires adaptation to the VR controllers, but also an entire range of problems concerning the adaptation of our eyesight and vagus to the new environment. For some users, this process will go smoothly, while others will experience various side effects such as headache or nausea. Later in the book, the results

of a survey in which users of VR goggles identified the problems they encountered are described.

Like any electronic device, VR devices require a certain amount of technical knowledge to make them work. The technology acceptance model (TAM) is an extremely popular model in understanding the predictors of human behaviour towards potential acceptance or rejection of the technology (Marangunić & Granić, 2015). No advanced technical knowledge is required for VR goggles, but the initial launch process itself requires a certain amount of information, such as the use of paid app purchases. The easier and more intuitive it is to launch such devices, the lower the barriers for the consumer will be. Any configuration problems, the excessive number of options required to set up, the need to read a lengthy user manual, all make consumers discouraged by novel solutions. For example, such a barrier, quite troublesome from the user's point of view, could be the need for a Facebook account in the case of the Oculus goggles. Of course, given that the brand owner of Oculus and Meta/Facebook is the same, such a requirement is understandable, but for customers who are declared opponents of social media platforms, it can be a significant barrier.

#### 4. Spreading of Information About the Advantages of V-commerce

One of the prerequisites for consumers to decide to use new devices such as VR goggles is to know that they exist and to be aware of their potential benefits. The use of online marketing and social media allows to accelerate the process of informing customers about VR advantages; however, the effectiveness of the marketing efforts depends on whether consumers will be convinced to try this new VR equipment. According to the author, the ideal marketing channel for VR goggles would be to propose customers visiting a physical shop to try out how they could shop in VR goggles. Demonstrations of such goggles would give customers the opportunity to feel the thrill of shopping in Virtual Reality. Also, traditional marketing methods, such as lower prices in the virtual shop, additional affiliate programmes to reward the acquisition of new customers, a unique offer for VR customers, will probably be used by emerging V-shops. El Beheiry et al. (2019) claim that first-time usage

experiences with Virtual Reality are usually characterised by a surprise or *wow effect* by the user. This *wow effect* may be the reason that we will observe a proliferation of VR users driven by word-of-mouth marketing supported by photo and video coverage on social media.

## Supply Side—Online Shops and Marketplaces

In order for V-commerce to become widespread, it is necessary not only to convince customers, but also to ensure the supply side. In the following section, the factors determining the spread of V-commerce among retailers will be analysed.

### 1. Availability of V-commerce Implementation

The implementation of V-commerce by an online shop requires software that is compatible with VR devices. The availability of e-commerce implementations on the market that allow the exploration of their content using VR devices will allow this form of commerce to become widespread among small and medium-sized entities. Large shops are likely to implement such solutions themselves, possibly using components available in repositories. Looking at the history of e-commerce development, open-source software has played a crucial role in the development of this market. OsCommerce open-source software (<https://www.oscommerce.com/>) became the most popular e-commerce solution in the second half of the 1990s and the first decade of the twenty-first century. Part of its popularity was since a huge community of developers created thousands of additional functionalities by developing this software. Over time, hundreds of different implementations for online shops were created based on OsCommerce, as well as other such projects. At present, the V-commerce market has not yet developed implementations that could become worldwide standards, on the basis of which online shop owners could implement V-commerce into their e-shops at low cost. In the coming years, one can expect the emergence of such V-shops implementations, which will compete to become a standard. The coming

years will show whether an open-source V-commerce environment will emerge that is fully compatible with the VR goggle models available on the market.

## 2. Financial Benefits of Implementing V-commerce

The financial benefits of implementing VR solutions into an online shop can come from attracting customers—the innovation leader effect. The first shops in an industry to enable customers with VR equipment to shop in this environment will be able to achieve increased turnover resulting from attracting customers with this innovation.

The second aspect is the increased conversion rate compared to regular e-commerce. The authors of the text posted at <https://venturebeat.com/arvr/obsess-70-of-consumers-who-visit-virtual-stores-have-made-purchases/> claim that, in the cited survey by Obsess, 70% of consumers who visit virtual stores have made purchases. A conversion rate of 70% is practically unheard of in regular e-commerce. It usually oscillates between 1 and 5%, so raising it to a level of several tens of per cent would be a proverbial vein of gold for retailers. The high expected conversion rate in V-commerce is due to a different kind of experience, but also to the fact that customers shopping in VR would be able to boast among their friends about their purchases made in an unusual and innovative way. Collaborating with well-known celebrities and using their images as the avatars of the salespeople showing them around the shop would allow for higher margins and higher-priced sales, justified by a better level of customer service. One can imagine a consumer bragging to friends—“you know, I bought tennis shoes in the v-shop - they were expensive, but I was persuaded to buy by Serena Williams herself”. Just as in traditional retail, margins are often dependent on the prestige of the location, in the case of V-commerce, the prestige of the retailers’ avatars could allow for higher-margin sales. Of course, the use of celebrity images would come at a cost, so a higher level of margin would be necessary to cover these costs.

### 3. Type of Assortment

It can be hypothesised that not every assortment has the features that matter in V-commerce. In the case of an FMCG (fast-moving consumer goods) type assortment, the most important thing for the customer is the price and the speed and convenience of the shopping experience. In this case, V-commerce seems to be more of a handicap for the consumer, who has to put on VR goggles, and for the retailer, who will have to prepare 3D models of the assortment. Therefore, it seems that in the case of an assortment for which the retailer does not shape the attractiveness of the offer through the presentation of the goods, V-commerce may not be adopted.

On the other hand, an assortment in which the customer wants to see the product in detail and become familiar with as many of its features as possible is ideally suited for V-commerce sales. These include, but are not limited to the clothing industry, the home furnishing industry, the gift industry, the sports industry, the art industry, the specialist industry (e.g., medical), the gardening industry, niche, and collectible industries, etc. Wherever the customer prefers to touch the product before buying, to talk about it with the seller face to face, there is room for the spread of V-commerce.

### 4. Willingness to be the Market Leader

Innovation leaders design new markets. Firms that enter new markets first achieve, according to microeconomic theory, windfall benefits that disappear over time as new competitors enter the market (Begg et al., 2014; Etro, 2007). This theory, which demonstrates the functioning of competitive market structures (perfect competition and monopolistic competition), shows that if there are no barriers to entry, only the pioneers and innovators who first discover new market spaces stand a chance of making windfall profits. E-commerce markets have existed for 27 years, the V-commerce market can be said to be born in pain, but it has still not yet entered the dynamic growth phase. It is still a

stage where, theoretically on the technical side, most of the barriers and problems have been solved, but there is a lack of specifics and implementation. For the average consumer, V-commerce is still associated more with science fiction than with a shopping method that he or she would like to implement in his or her everyday life.

Companies that are first to offer consumers convenient V-commerce have the chance to become market leaders and, for an initial period, to make significant windfall profits. However, in addition to solving the technical problems, a marketing strategy to convince consumers that it is worth trying to invest in a VR device in order to shop in an innovative way seems equally important. Whether such leaders will be found in the coming years to attract the mass consumer, time will tell.

#### 4.4 Threats and Potential Problems of V-commerce

The use of Virtual Reality tools is associated with a considerable number of problems that are still unresolved from the technical point of view. The first problem, still occurring despite increasingly better VR tools, is a disease that occurs in some users, called Virtual Reality sickness. This is an illness with symptoms and causes similar to motion sickness. With VR sickness, the user starts to feel unwell when they see themselves moving while their body is standing still. The brain interprets such conflicting information as poisoning, and the body commonly reacts with nausea, which can escalate into vomiting if the VR user does not remove the VR goggles immediately. As the surveys presented later in the book show, these are not common problems, but if more than 15% of users are currently experiencing the issue, such an aspect cannot be overlooked when analysing the development prospects of the V-commerce market.

Excessive use of Virtual Reality can lead to addiction (see Rajan et al., 2018). The problem is the different sensation of time passing, which is due to the brain perceiving a different environment than the one in which the user is actually in. The attractiveness of this virtual environment can make the VR user reluctant to return to “grey reality”.

Another threat could be a hacking attack on a VR headset. An attacker who hacked a VR headset would have the ability to see the surroundings of the VR user, (e.g., the room or the office), from the VR headset camera. The attacker can also manage what the user sees and hears in VR goggles, with the overlay attacks (KürtünlÜođlu et al., 2022). This type of attack can lead to the user being shocked if some drastic content is presented to them.

It is also worth mentioning the problem of the lack of control over the passage of time of a user immersed in Virtual Reality (this was reported by more than a quarter of respondents in the research presented later in the book), which can result in excessive use of VR headset and, consequently, in addiction.

One important feature of the use of VR goggles that could be considered a risk, especially for children and young people, is the lack of third-party control over the projected image. In the case of a computer screen, third parties can see what content is being viewed by its user, in the case of VR goggles, the third party has no insight. This carries the risk of a lack of control over content viewed by minors.

The problems mentioned above apply to VR use in general, but the second problem may be particularly relevant to V-commerce, as it can lead to shopaholism (compulsive buying disorder—behavioural addiction characterised by the uncontrollable and excessive urge to shop and make purchases, often leading to financial, social, as well as emotional consequences—for more information about online shopping addiction see (Günüç & Keskin, 2016). If we combine a user's tendency to shopaholism in the physical world with a tendency to abuse computer games or electronic media such as smartphones or TVs, we get a potential shopaholic in V-commerce. The attraction of shopping in these environments, the well-modelled world, the professionally crafted avatars of the retailers can make not only the shopping time extended, but also the spending exponentially increased. It is important to remember that in a Virtual Reality, with a high degree of immersion, the user can lose control of their decisions and be very vulnerable to manipulation. A professionally designed virtual v-store world with trained salespeople, appearing as

attractive avatars, can lead to increased spending, in extreme situations, leading to the consumer spending all available cash, or worse, spending much more money if a deferred payment or loan mechanism is enabled.

## 4.5 Proposal for V-commerce Safeguards

Being aware of the numerous threats present in V-commerce, it seems advisable to propose safeguards that could protect users against these threats. It is also essential to spread awareness of these threats so that users who become enthralled with the technological novelty do not fall into a trap from which it is difficult to recover. Currently, the information presented on Virtual Reality in the mainstream media mainly presents the advantages and benefits of using a VR headset. The disadvantages and risks are commonly passed over in silence.

The first important safeguard concerns potential over-indebtedness in virtual shops. It seems that the prohibition of loan mechanisms during V-commerce purchases could provide protection against over-indebtedness, by consumers who have lost control of their decisions in VR. The second proposed solution is the possibility for consumers to withdraw from a distance contract, without giving a reason, as is the case, for example, in European Union countries for e-commerce. Once the VR goggles have been removed and the user has “returned to reality”, the user would be able to cancel those purchases that were made impulsively, during the lack of self-control in the VR world.

Another safeguard could be a timer displaying the time spent by the user in Virtual Reality. Displaying such a timer would allow for self-reflection and prevent the user from spending hours in VR without being aware of it. A stronger safeguard would be a mechanism to automatically turn off the vision after a parametrically defined period of time, e.g., after 1 hour of use. This type of mechanism would be useful especially for children, providing them with an obligatory break.

Another safeguard for the consumer’s interest could be the prohibition of subliminal manipulation mechanisms or other manipulation methods

using addictive or sexual elements by v-stores. Of course, it would be a legal problem to precisely define and specify the exact framework of prohibited manipulation methods in shops using VR.

## 4.6 Testing of Example VR Goggles

In order to get better acquainted with the Virtual Reality environment, the author tested the Oculus Quest 2 VR goggle device. The Oculus brand is currently the market leader, so the choice fell on these particular goggles. The author decided to test the following elements:

- ease of use and convenience.
- level of immersion into Virtual Reality, which is a perception of being physically present in a digital world. The author is aware that this is a very simplified definition of immersiveness; broader analyses of this concept can be found, for example, in Szabó and Gilányi (2020). This perception is created by surrounding the user of the VR system in graphics environment, sound, or other kinds of possible stimulation that provide an engrossing digital environment [[https://en.wikipedia.org/wiki/Immersion\\_\(virtual\\_reality\)](https://en.wikipedia.org/wiki/Immersion_(virtual_reality))].
- possibility of application in e-commerce.

The first step was the process of first commissioning and customising the device. Despite the information on the packaging that the device offers “easy setup”, the start-up process itself took about 30 minutes for a user who had no previous experience with this type of device. Once the goggles were up and running, the next problem was mastering the controls. The Oculus manufacturer provided a tutorial to master the primary actions possible with the controllers, such as grabbing objects, moving objects, etc.

It is not entirely clear why every user of the Oculus goggles must have an Android or iOS smartphone, and a Facebook account is also required. Of course, considering the buyout of Oculus by Meta (formerly Facebook), such a requirement seems obvious, but completely unjustified

from the point of view of the functionality of the device. Such a requirement is also a limitation for people who, for ideological reasons, do not want to set up a Facebook account.

To sum up the test, the author concludes that starting to use the goggles went smoothly, although the time to master the controllers to such an extent that they can be used proficiently is at least one hour, according to the author.

## 4.7 Surveys of VR Goggle Users

To explore the potential of using VR technology, including in particular VR goggles, for e-commerce, the author conducted two surveys of users of these devices. The aim of the research was to identify the potential use of VR devices for shopping. The following were taken as sub-objectives of the research:

- identification of the VR user profile.
- determining the extent to which VR goggles are used by users.
- determining which VR goggles and additional VR devices are used by users.
- obtain an assessment of the immersiveness, image quality, and ease of use of the VR controllers.
- identification of problems which users encounter when using VR goggles.
- identifying users' perceived advantages of VR goggles.
- determining whether users are willing to use VR goggles for shopping.
- evaluating users' attitudes towards communicating with celebrity avatars in virtual shops.
- determining users' awareness of the risks involved in V-commerce.

An additional aim of the research was to identify similarities and differences between VR users in Poland and the global population, as an exemplification of whether there are differences between the users of one particular country and the global population.

## Methodology of Research

The latter part of this chapter presents the methodology of the conducted survey research. The condition for taking part in the research was to be a VR user and more specifically VR goggle user, so the target group was obtained among users of these devices. Initially, it seemed extremely difficult to obtain a representative group of VR goggles users, since these devices are not in common use. The author decided to exploit the potential of social media, and a survey of Facebook interest groups on Virtual Reality in general and specific types of VR goggles in particular was conducted to conduct the research. The process of obtaining respondents is described in detail below. The proposed research methodology may be helpful for researchers who are planning research on a specific group of respondents that would be either impossible or costly to reach without the use of social media.

Firstly, research was started on a Polish group of people using VR goggles. Table 4.1 presents the groups on Meta/Facebook to which a request was made to be able to publish a post with a survey, together with a link to the post. The response was unexpectedly positive. As can be seen, the vast majority of groups allowed the post to be published. The author did not expect to collect more than one hundred completed surveys, all the more so as VR goggles are quite an expensive device in Poland, relating price to income level. For example, the cost of purchasing the cheapest VR goggles by Oculus is an expense comparable to the monthly minimum wage, while more expensive goggle models such as HTV Vive Pro 2 are an expense that far exceeds the average national net wage.

However, it is apparent that VR goggle user groups are incredibly supportive communities, on issues such as what software, games, or simulators are best, what additional VR devices are available, where to buy them, etc. The author has received many words of support and interest in the topic undertaken.

In parallel, just after research was started in a Polish population, the survey was made available in English and the author attempted to find as many active Virtual Reality worldwide groups on Facebook as possible.

**Table 4.1** Polish groups on Meta/Facebook concerning VR

Name of Facebook/ Meta group forum	Information about post acceptance or denial	Link to the post
Oculus Quest Polska	Acceptance	<a href="https://www.facebook.com/groups/2665512040231909/?multi_permalinks=5782356815214067">https://www.facebook.com/groups/2665512040231909/?multi_permalinks=5782356815214067</a>
VR Polska—Meta Quest PSVR Valve Index HTC Vive WMR   AR i VR	Acceptance	<a href="https://www.facebook.com/groups/1017551264923009/?multi_permalinks=6070243039653781">https://www.facebook.com/groups/1017551264923009/?multi_permalinks=6070243039653781</a>
Meta Quest Polska—Oculus Quest 2 Polska	Acceptance	<a href="https://www.facebook.com/groups/829464917886270/?multi_permalinks=1300298270802930">https://www.facebook.com/groups/829464917886270/?multi_permalinks=1300298270802930</a>
VR/AR Polska	Acceptance	<a href="https://www.facebook.com/groups/1038012212901004/?multi_permalinks=5889176531117857">https://www.facebook.com/groups/1038012212901004/?multi_permalinks=5889176531117857</a>
HTC VIVE POLSKA	Acceptance	<a href="https://www.facebook.com/groups/144135339563438/?multi_permalinks=1173004566676505">https://www.facebook.com/groups/144135339563438/?multi_permalinks=1173004566676505</a>
PLANETVR—Wirtualna Rzeczywistość	Acceptance	<a href="https://www.facebook.com/groups/1887008024712501/?multi_permalinks=5735684069844858">https://www.facebook.com/groups/1887008024712501/?multi_permalinks=5735684069844858</a>
Metaverse Polska/ Augmented Reality & Virtual Reality/AR/VR/ Quest	Acceptance	<a href="https://www.facebook.com/groups/595424071029381/?multi_permalinks=1354212191817228">https://www.facebook.com/groups/595424071029381/?multi_permalinks=1354212191817228</a>
Wirtualna i Rozszerzona Rzeczywistość w edukacji	Denial	
VR/AR—Wirtualna Rzeczywistość/ Rozszerzona Rzeczywistość	Acceptance	<a href="https://www.facebook.com/groups/512970582213460/?multi_permalinks=2377454802431686">https://www.facebook.com/groups/512970582213460/?multi_permalinks=2377454802431686</a>

Table 4.2 presents a list of VR-related groups around the world. Obviously, the number is much higher, but firstly not all groups are public, and secondly, not on every group there was an opportunity to publish posts.

The above group lists were selected using keywords such as VR and the brand names of VR goggles (Oculus, HTC Vive, etc.). For some of the groups, the Meta/Facebook recommendation system itself suggested joining and if thematically it was a group about Virtual Reality, a post with an invitation to fill in a survey was also placed on this group, if there was one, with the following content:

*Dear VR Users!*

*I am asking you to fill out the survey, which is an introduction to the ongoing research on the use of Virtual Reality (VR) in e-commerce. I am working at Wrocław University of Science and Technology in Poland. The survey is anonymous, and the results will be used in a scientific publication. It will take you less than 10 minutes to complete the survey.*

*The survey is only for VR headset users, Oculus, and others.*

In thematic forums for specific device brands, such as Oculus, the headline was modified, in the style of: Dear Oculus Quest Users! (Fig. 4.1), so that group participants feel that this request is specifically addressed to them.

Since the Meta/Facebook algorithms imply that, when numerous posts are published, a new post may disappear in a flurry of others, especially those characterised by high community engagement (a high number of likes, comments, shares), it is therefore significant to try to take care to establish interactions with the members of a given group after publishing posts. This allows to increase the number of comments and therefore better position the post asking people to complete the survey. Engaging in conversation with all comments (including critical ones), as well as liking these comments, increases the aggregate rating of a post and gives you the opportunity to reach more group members. Such actions are significant, especially in the case of very numerous groups with tens of thousands or even several million members where there is a risk that a

**Table 4.2** Worldwide groups on Meta/Facebook concerning VR

Name of Facebook group	Information about post acceptance or denial	Link to post
Oculus SidequestVR Official/Oculus Quest	Denial	
Meta Quest 2 Oculus Quest 2 Community	Denial	
Oculus Quest 2 Community	Acceptance	<a href="https://www.facebook.com/groups/376549296824806/?multi_permaLinks=886618869151177">https://www.facebook.com/groups/376549296824806/?multi_permaLinks=886618869151177</a>
Quest 2 Community	Acceptance	<a href="https://www.facebook.com/groups/345692809808462/?multi_permaLinks=878591856518552">https://www.facebook.com/groups/345692809808462/?multi_permaLinks=878591856518552</a>
Meta Quest 2 Community	Acceptance	<a href="https://www.facebook.com/groups/1036481137193256/?multi_permaLinks=1324409435067090">https://www.facebook.com/groups/1036481137193256/?multi_permaLinks=1324409435067090</a>
Meta Oculus Quest 2 Central	Acceptance	<a href="https://www.facebook.com/groups/354020959072689/?multi_permaLinks=875058120302301">https://www.facebook.com/groups/354020959072689/?multi_permaLinks=875058120302301</a>
Oculus Meta Quest 2—Referral & Discount Codes	Denial	
Meta Oculus Quest 2 Users Community	Acceptance	<a href="https://www.facebook.com/groups/1332302427260684/?multi_permaLinks=1504044073419851">https://www.facebook.com/groups/1332302427260684/?multi_permaLinks=1504044073419851</a>
Oculus Quest 2 VR Community	Acceptance	<a href="https://www.facebook.com/groups/4573065542723821/?multi_permaLinks=6078861188810908">https://www.facebook.com/groups/4573065542723821/?multi_permaLinks=6078861188810908</a>
Meta Quest Community	Acceptance	<a href="https://www.facebook.com/groups/316751118922471?multi_permaLinks=1229626304301610">https://www.facebook.com/groups/316751118922471?multi_permaLinks=1229626304301610</a>

(continued)

**Table 4.2** (continued)

Name of Facebook group	Information about post acceptance or denial	Link to post
Oculus Quest 2 VR live group	Acceptance	<a href="https://www.facebook.com/groups/679321686121968/?multi_permalinks=1160342434686555">https://www.facebook.com/groups/679321686121968/?multi_permalinks=1160342434686555</a>
Oculus VR Society	Acceptance	<a href="https://www.facebook.com/groups/2232577716803879/?multi_permalinks=5901585413236406">https://www.facebook.com/groups/2232577716803879/?multi_permalinks=5901585413236406</a>
Valve Valve Index	Acceptance	<a href="https://www.facebook.com/groups/1471505349545097/?multi_permalinks=6577406432288271">https://www.facebook.com/groups/1471505349545097/?multi_permalinks=6577406432288271</a>
HTC VIVE		
HTC VIVE COSMOS	Denial	
HTC VIVE (+PRO) and Cosmos Owners	Denial	
HTC Vive Flow Community	Acceptance	<a href="https://www.facebook.com/groups/1057181325097709/?multi_permalinks=1363447697804402">https://www.facebook.com/groups/1057181325097709/?multi_permalinks=1363447697804402</a>
HTC Vive Owners (Vive Pro, Focus, Flow, Cosmos)	Acceptance	<a href="https://www.facebook.com/groups/270990723281175/?multi_permalinks=1881197428927155">https://www.facebook.com/groups/270990723281175/?multi_permalinks=1881197428927155</a>
HTC VR Developers	Acceptance	<a href="https://www.facebook.com/groups/1614643982144942/?multi_permalinks=3441081569501165">https://www.facebook.com/groups/1614643982144942/?multi_permalinks=3441081569501165</a>
HP HP Reverb G2 Community	Acceptance	<a href="https://www.facebook.com/groups/910057472826926/?multi_permalinks=1531185787380755">https://www.facebook.com/groups/910057472826926/?multi_permalinks=1531185787380755</a>

(continued)

**Table 4.2** (continued)

Name of Facebook group	Information about post acceptance or denial	Link to post
HP Reverb/Reverb G2 owners' group	Acceptance	<a href="https://www.facebook.com/groups/324439365105609/?multi_permaLinks=1153480002201537">https://www.facebook.com/groups/324439365105609/?multi_permaLinks=1153480002201537</a>
Pimax PIMAX CRYSTAL and 12 K QLED USERS	Acceptance	<a href="https://www.facebook.com/groups/516638173686433/?multi_permaLinks=554525769897673">https://www.facebook.com/groups/516638173686433/?multi_permaLinks=554525769897673</a>
Pimax 12 K/8 K/5 K	Acceptance	<a href="https://www.facebook.com/groups/267521596949816/?multi_permaLinks=1866312290404064">https://www.facebook.com/groups/267521596949816/?multi_permaLinks=1866312290404064</a>
Pico Pico 4	Acceptance	<a href="https://www.facebook.com/groups/1284208962328872/?multi_permaLinks=1361286927954408">https://www.facebook.com/groups/1284208962328872/?multi_permaLinks=1361286927954408</a>
Pico 4 VR Community	Acceptance	<a href="https://www.facebook.com/groups/978344202711912/?multi_permaLinks=1294725077740488">https://www.facebook.com/groups/978344202711912/?multi_permaLinks=1294725077740488</a>
Pico VR Community	Acceptance	<a href="https://www.facebook.com/groups/476640033288829/?multi_permaLinks=1235084654111026">https://www.facebook.com/groups/476640033288829/?multi_permaLinks=1235084654111026</a>
Other Anyreality—Marketplace	Acceptance	<a href="https://www.facebook.com/groups/3353645471355817/?multi_permaLinks=5724306374289703">https://www.facebook.com/groups/3353645471355817/?multi_permaLinks=5724306374289703</a>
Flight Sim VR Club	Acceptance	<a href="https://www.facebook.com/groups/2158614584447190/?multi_permaLinks=2989248681383772">https://www.facebook.com/groups/2158614584447190/?multi_permaLinks=2989248681383772</a>

(continued)

**Table 4.2** (continued)

Name of Facebook group	Information about post acceptance or denial	Link to post
360° VR Video Professionals	Denial	
SteamVR	Acceptance	<a href="https://www.facebook.com/groups/1004735792916823/?multi_permalinks=6000289000028119">https://www.facebook.com/groups/1004735792916823/?multi_permalinks=6000289000028119</a>
Virtual Reality Creative Community	Acceptance	<a href="https://www.facebook.com/groups/624967057590067/?multi_permalinks=5781621705257884">https://www.facebook.com/groups/624967057590067/?multi_permalinks=5781621705257884</a>
VR Developers Community	Acceptance	<a href="https://www.facebook.com/groups/750222431747778/?multi_permalinks=5105483579554953">https://www.facebook.com/groups/750222431747778/?multi_permalinks=5105483579554953</a>
Virtual Reality News and Insights. Quest, Vive, Oculus, PSVR, MetaVerse	Acceptance	<a href="https://www.facebook.com/groups/905326459574239/?multi_permalinks=5674430262663811">https://www.facebook.com/groups/905326459574239/?multi_permalinks=5674430262663811</a>
PlayStation VR/PSVR (PSVR 2) Community	Acceptance	<a href="https://www.facebook.com/groups/1705218846431866/?multi_permalinks=3484268321860234">https://www.facebook.com/groups/1705218846431866/?multi_permalinks=3484268321860234</a>

published survey request will not be seen by the vast majority of the group's population.

Tables 4.1 and 4.2 present the groups on Meta/Facebook to which a request was made to be able to publish a post with a survey, together with a link to the post. As can be seen, the vast majority of groups allowed the post to be published.

## Survey Design

The survey consisted of a headline stating what it was about and who could complete it. The headline also stated that it was anonymous and that the results would be used in a scientific publication. A time limit for

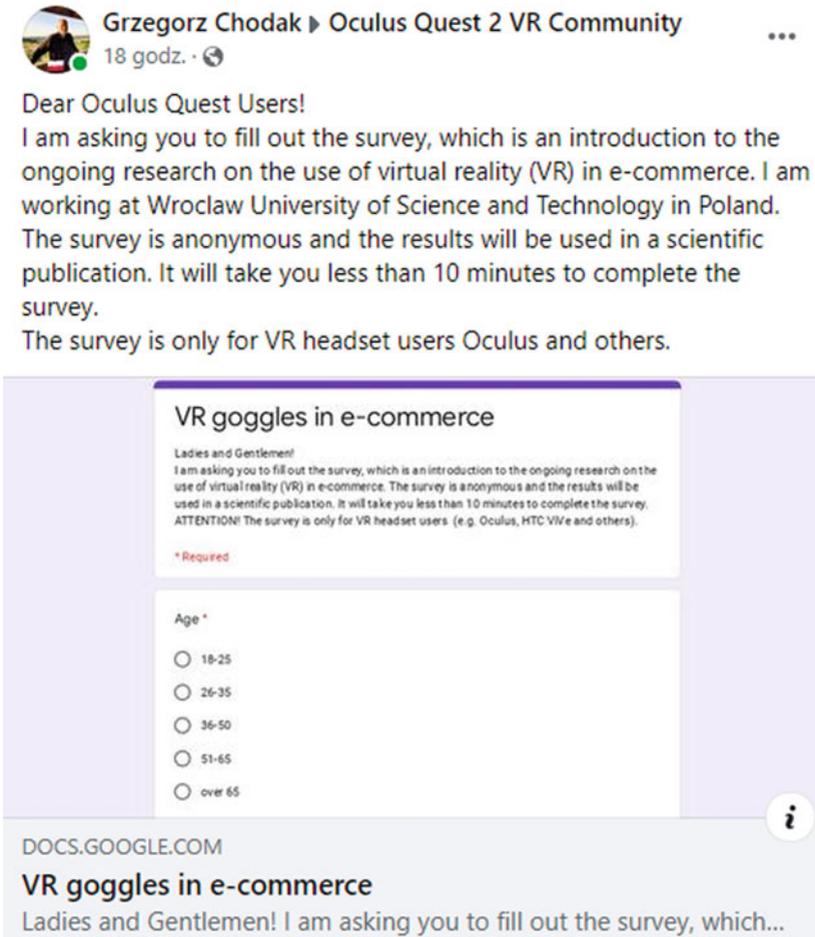


Fig. 4.1 Content of a social media post published on VR themed groups

completing the survey was also given (no more than 10 minutes), so as not to discourage users fearing a long survey.

The entire survey consisted of twenty-one questions, of which the first five questions were metric questions on gender, age, place of residence, labour market situation, and education. The additional question was a request to identify any comments on the survey.

The English version of the survey additionally included a question on country, but this question was specified as optional to ensure full anonymity for those concerned about their data. This may have been over-cautious given that it was only about the country, but in the author's opinion, the environment is cautious when it comes to giving out personal information.

The main part of the survey consisted of fifteen questions, of which eight closed survey questions and seven closed-open survey questions. In the closed-open questions, respondents were provided the opportunity to add their response option to the question.

The first question substantively sought to divide respondents by frequency of online shopping. The next nine questions focused on the use of Virtual Reality. This section included questions about the equipment used, evaluating the various features of the equipment, and rating the advantages and disadvantages of using VR. A further five questions concerned respondents' opinions on the use of VR for e-commerce. Obviously, the questions do not cover all aspects, but the author was keen that the survey should not be too elaborate so that it could be easily completed in less than 10 minutes.

## **Characteristics of the Survey Populations**

The first part of the survey comprised metric questions characterising the sample of respondents. These were, respectively, questions about the respondents' age, gender, size of place of residence, status on the labour market, and education.

### **Age of respondents**

The first question concerned the age of the respondents. The age range was only for adults (over 18 years of age), which on the one hand severely limited the research sample, as often people using VR goggles are underage. The decision to consider only adults was because minors in many countries do not have full rights to shop online (conclude distance contracts).

When asking about age, the author was under the belief that the vast majority of people using VR goggles are young. This thesis was only confirmed by the results from Poland, while considering the global population, it is apparent that VR is not only the domain of the noticeably young. It is worth noting that in the case of Polish users, there were no people over sixty-five at all, while in the global population, this group of older people accounted for 11.5%. The most numerous age group in the Polish population were people aged 18–25, who accounted for 43.8% of the population, while in the global population, the most numerous group (43.1%) were people aged 36–50 (Figs. 4.2 and 4.3).

A weighted average age was determined for the global population and the Polish population. To calculate the weighted average age, the sum of the product of the percentages of each age group and the average age of the respective interval was taken. For the last interval over sixty-five, an age of sixty-six was assumed. The weighted average age for the population was 30 years, while for the global population it was 48.8 years. Looking at these results, it can be concluded that VR users from Poland are mainly young and very young, while the global population is aged. Interestingly, despite such a significant age difference, the answers of respondents from

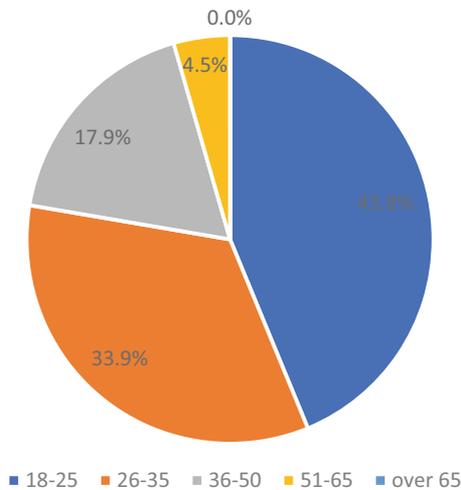
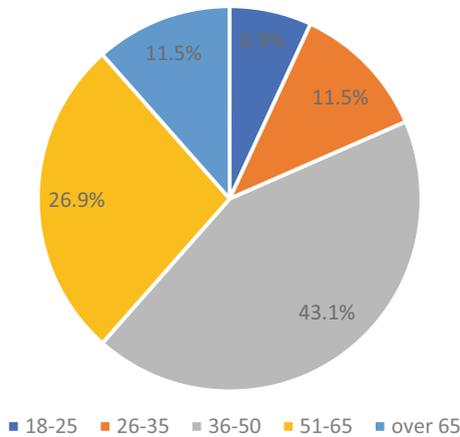


Fig. 4.2 Age of respondents in Poland



**Fig. 4.3** Age of respondents worldwide

Poland and the world in many questions are remarkably similar, which was confirmed further in the research by calculating Pearson's correlation coefficient. Thus, it can be concluded that VR users, despite significant age differences, view many aspects of Virtual Reality similarly.

### **Sex of Respondents**

When analysing the gender of the respondents, the predominance of men over women is evident. In the case of Poland, women accounted for about one-eighth of the respondents, while in the case of the global population, it was equally one-fifth (Figs. 4.4 and 4.5). It is difficult to determine unequivocally what is the reason for this, but it can be said with a high degree of probability that VR users of VR goggles are mainly computer gamers, and among gamers men dominate. This is confirmed by various statistics, such as those for the United States (<https://financesonline.com/video-game-demographic-statistics/>), which show that among video gamers, 41% are women.

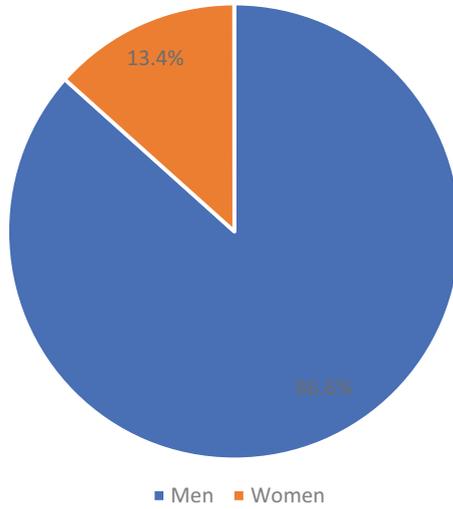


Fig. 4.4 Sex of respondents in Poland

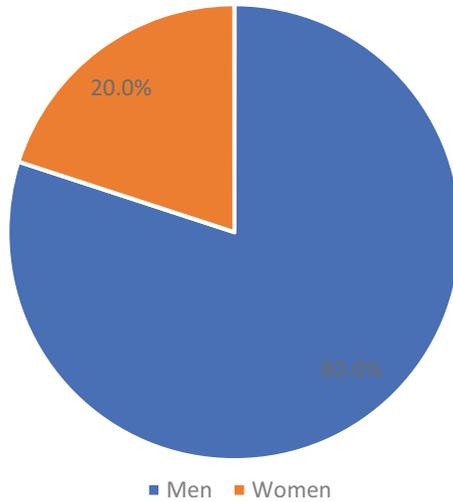
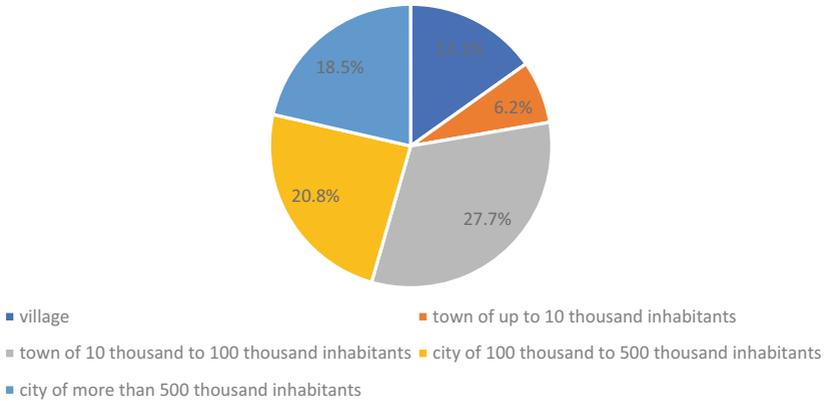


Fig. 4.5 Sex of respondents worldwide



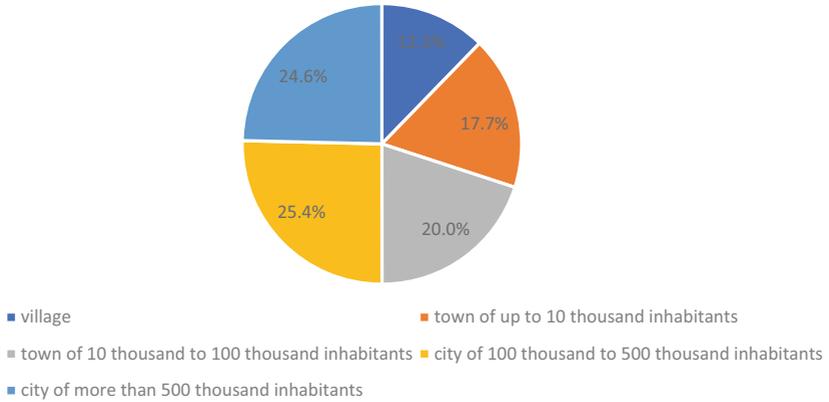
**Fig. 4.6** Residence of respondents in Poland

## Residence of Respondents

Analysing the place of residence of the respondents, a reasonably, although not perfectly even, distribution was obtained. In the world population, a slightly smaller percentage were people living in rural areas and small towns (12.3% and 17.7% respectively). In the case of Poland, the largest group was made up of people from towns with a population between 10,000 and 100,000 (27.7%), while the smallest percentage (6.2%) was made up of people living in small towns with a population of up to 10,000 (Figs. 4.6 and 4.7).

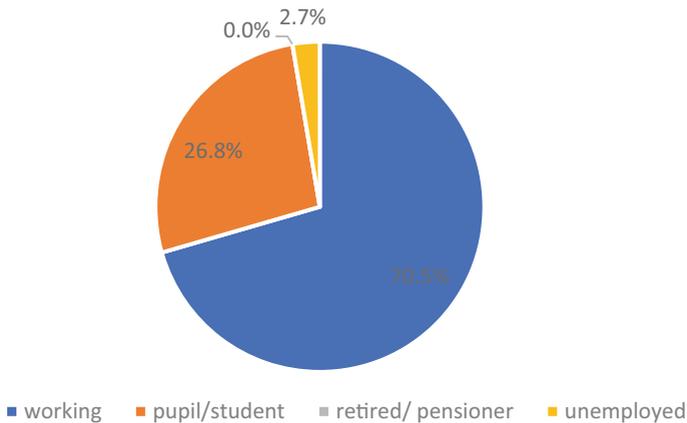
## Status on the Labour Market of Respondents

Analysing the status in the labour market, the largest group of respondents are working people. Considering the high cost of VR goggles, this is a result in line with expectations. The most considerable difference between the global and Polish populations is the share of students, which in the case of Poland is more than a quarter, while in the case of the global population, it is only 3% of respondents (Figs. 4.8 and 4.9). Another difference is the share of pensioners, who were absent in the Polish population and accounted for 18.5% of the world population. This is in line

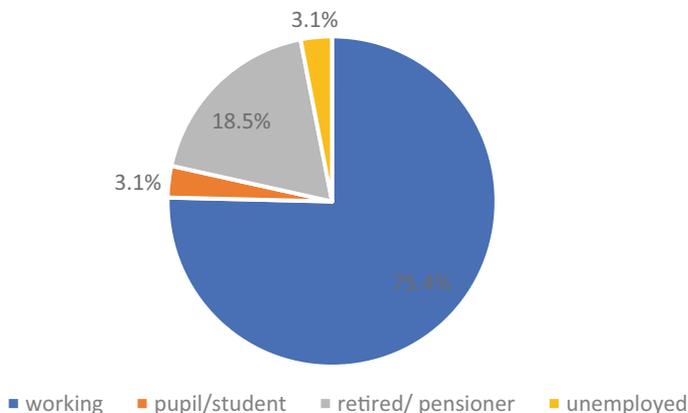


**Fig. 4.7** Residence of respondents worldwide

with the previously described results for age, where people over 65 years of age did not occur in the Polish population and accounted for 11.5% of the world population.



**Fig. 4.8** Status on the labour market of respondents in Poland



**Fig. 4.9** Status on the labour market of respondents worldwide

## Country of Respondents

For the global population survey, a non-compulsory question on the country of the respondent was added. As the survey was conducted in English, it could be expected that the largest group of respondents would be from English-speaking countries and those where learning English is compulsory. This was confirmed by respondents' country responses, with VR users from the United States (35%), United Kingdom (22.2%), and Canada (10%) in the top three places in terms of population share. However, a pleasant surprise was the diversity of respondents and the wide range of twenty-six countries (Table 4.3). Considering the methods of sourcing respondents, it can be concluded that the thematic groups on Facebook are international societies.

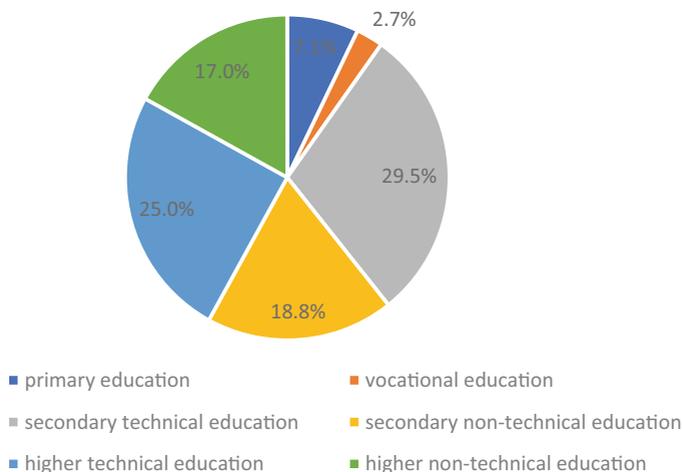
## Type of Education of Respondents

The type of education of respondents is presented in Figs. 4.10 and 4.11. As it can be seen, primary and vocational education in both groups were a distinct minority. In the case of Poland, these groups accounted for 7.1% and 2.7% respectively, while in the case of the world population, they accounted for 11.5% and 8.5% respectively. In

**Table 4.3** Country of respondents (concerning only respondents who decided to provide this information)

No.	Name of country	Number of respondents	Percentage
1.	Australia	2	1.7
2.	Belgium	3	2.6
3.	Canada	10	8.5
4.	Czech Republic	1	0.9
5.	Denmark	1	0.9
6.	Finland	1	0.9
7.	Germany	2	1.7
8.	Hungary	1	0.9
9.	Israel	1	0.9
10.	Italy	3	2.6
11.	Japan	1	0.9
12.	Malaysia	1	0.9
13.	Netherlands	1	0.9
14.	New Zealand	2	1.7
15.	Norway	4	3.4
16.	Poland	4	3.4
17.	Puerto Rico	1	0.9
18.	Singapore	1	0.9
19.	South Korea	1	0.9
20.	Spain	2	1.7
21.	Sweden	2	1.7
22.	Taiwan	1	0.9
23.	Thailand	3	2.6
24.	Ukraine	1	0.9
25.	United Kingdom	26	22.2
26.	USA	41	35.0

the case of Poland, the largest proportion (almost half of the population) of respondents were those with secondary education (29.5% secondary technical education, 18.8% secondary non-technical education). In the world population this was 13.8% technical education, 9.2% non-technical education, respectively. In the Polish population, those with tertiary education accounted for 43%, including 25% of those with technical tertiary education and 17% of those with non-technical tertiary education. In the global population, VR users with tertiary education accounted for 57%, including those with technical tertiary education 36.2% and those with non-technical tertiary education 20.8%. Overall, it can be concluded that in both populations, those with a technical



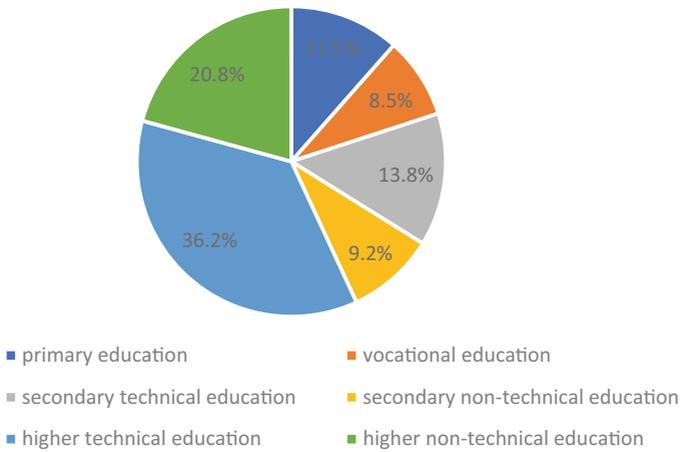
**Fig. 4.10** Type of education of respondents in Poland

education were the dominant group, which is natural considering that the survey was about an innovative device of a technical nature. The slightly higher percentage of people with higher education in the global population compared to the Polish population may be due to the lower age of VR goggles users in the Polish population, 26.8% of whom are students and pupils who have not yet graduated from university.

## Results of Surveys

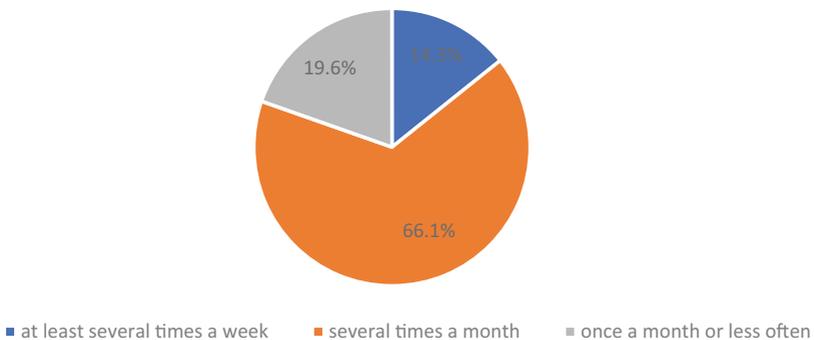
### How Often Do Respondents Make an Online Purchase?

After the metric questions, respondents were asked how often they shop online, the results are shown in Figs. 4.12 and 4.13. Among respondents from Poland, the most common answer was several times a month (66.1%), once a month or less was answered by 19.6%, and those shopping at least several times a week were only 14.3%. In the global population, several times a month was also commonly answered (46.9%), while at least several times a week was answered by 26.9%, indicating a

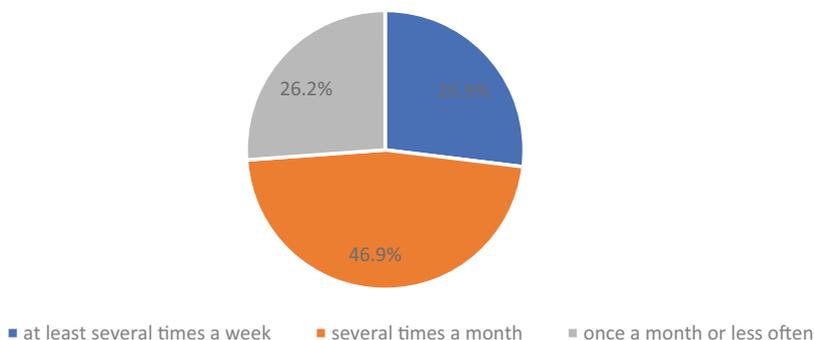


**Fig. 4.11** Type of education of respondents worldwide

higher frequency of online shopping than in Poland, especially in Anglo-Saxon countries. Once a month or less was often answered by 26.2% of those surveyed in the global population. Summarising the results of the responses to this question in the context of the research objectives, it can be concluded that VR users are online shoppers and further questions on the use of VR goggles in e-commerce were warranted.



**Fig. 4.12** How often respondents from Poland make an online purchase



**Fig. 4.13** How often worldwide respondents make an online purchase

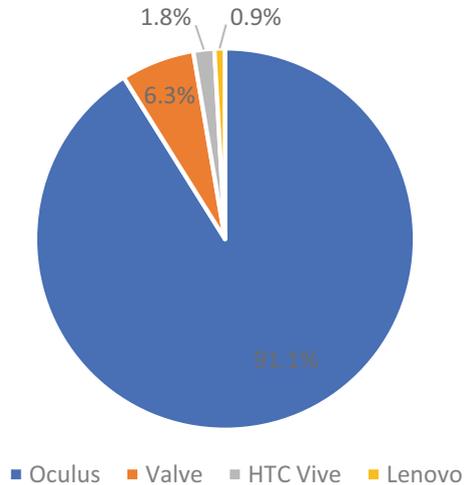
## Brand of VR Goggles

In order to determine which VR goggles users were using, the survey asked for the brand and model of the goggles. In the case of Polish respondents, the vast majority (91.1%) indicated that they are VR users of Oculus VR goggles (Fig. 4.14). The model indicated by far the most popular by respondents was Meta Quest 2, only five users indicated other models, namely: Quest 1 (2 users), Quest Pro (2 users), Rift S (4 users), Rift CV1 (2 users). From this data, it can be concluded that the vast majority of users own the latest model sold, the Meta Quest 2. Only two surveyed users opted for a solution four times more expensive for professionals (Quest Pro).

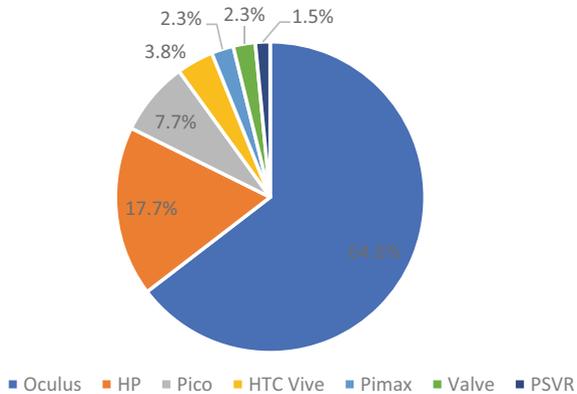
Of the other brands, Polish users indicated only Valve (6.3%) (all users indicated the Index model), HTC Vive (1.8%) (Cosmos model), and Lenovo (0.9%) (Explorer model).

As it can be seen in Poland, the Oculus brand seems to be dominant.

Much more diverse in terms of VR goggle brands used is the global user population (Fig. 4.15), nevertheless, here too, Oculus turned out to be the most popular brand (64.6%). Among Oculus goggles, respondents commonly pointed to the Meta Oculus Quest 2, of the other models only three users pointed to the Quest Pro, and two each to the Quest 1 and Rift S.



**Fig. 4.14** Brand of VR goggles used by Polish respondents



**Fig. 4.15** Brand of VR goggles used by worldwide respondents

The second most popular brand of VR goggles indicated by respondents was HP (17.7%). Almost all HP brand users indicated that they use the Reverb G2 model. Only one respondent indicated the HP Reverb G1 model.

In third place, respondents indicated the Pico brand (7.7%). All users of this brand indicated that they use the Pico 4 model. This was followed by the HTC Vive brand VR goggles (3.8%), with Focus 3 models (two users, and one user each of models: Vive Pro Eye, HTC Vive 1, Vive Cosmos Elite. The next brands were Pimax and Valve (2.3% each), with models respectively: Pimax 8KX (3 users) and Valve Index (3 users). Only 1.5% of respondents, or two users, indicated the PSVR (PlayStation VR) brand.

Summarising the results on VR goggles used by users, it can be seen that the leading brand is Oculus, which has become the forerunner of VR goggles available to a wide range of users. Of course, the results obtained in the survey regarding the brand of goggles are encumbered by the fact that respondents were sourced through interest groups on Facebook, which owns the Oculus brand, so an over-representation of the user group of this brand can be expected. Nevertheless, considering the history of the development of the VR goggles industry in the last decade, Oculus' position is due to the competitive advantage gained by offering innovative devices available at an attractive price comparable to that of a gaming console.

## **Immersion Evaluation**

In the next part of the survey respondents were asked to rate on a scale of 1 to 10 (10 means maximum immersion) how they rate the immersion of VR goggles. The immersion was described to respondents as the sensation of being fully in Virtual Reality. As it can be seen in Figs. 4.16 and 4.17 most respondents positively evaluated the immersion of the VR headset they use. The weighted average of the percentage of users who indicated a given level of immersion was 7.46 for the Polish users, while for the global users it was higher at 7.99. It can be concluded that both populations indicated an extremely high level of immersion, indicating that from the point of view of moving the user into the modelled world, the VR goggles fulfilled their role. It is worth noting that not a single user indicated an immersion rating of 1 or 2, and there was only one user in each population at levels 3 and 4. This result shows that in both

populations, the percentage of users who were unequivocally dissatisfied with the level of immersiveness was less than 1%. It can be expected that the next versions of the devices will be even more improved and, in the future, the maximum rating of 10 will be indicated by a higher percentage of users.

Analysing this result from the point of view of the potential use of VR goggles in e-commerce, it can be concluded that VR goggles are already capable of transporting the customer into a virtual shopping world so that they actually have the impression of being in that VR shop.

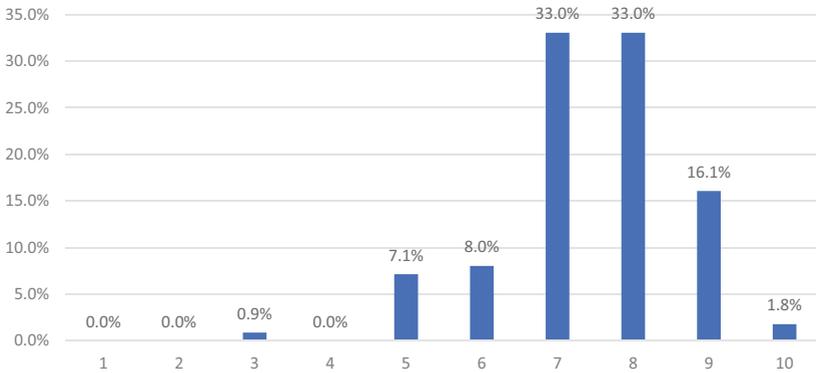


Fig. 4.16 The immersion evaluation by Polish VR headset users

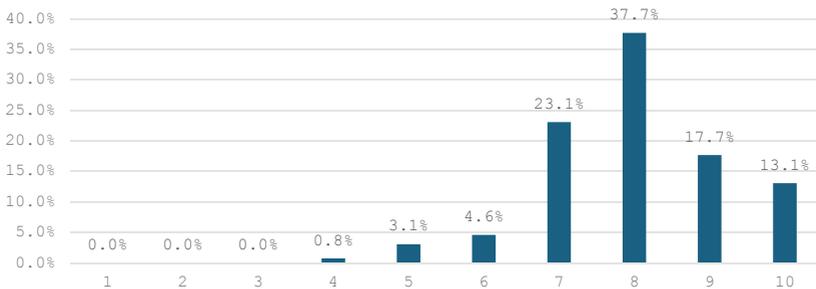


Fig. 4.17 The immersion evaluation by worldwide VR headset users

## The Quality of Virtual Reality Controllers

Respondents were also asked to rate the quality of the VR controllers on a scale of 1 to 10 (where 10 represents the maximum rating). This question was asked since controllers that are in addition to a VR headset are not typical devices as commonly known as a mouse or keyboard, so it was interesting to see the respondents' opinions on the solutions offered by VR hardware manufacturers. Figure 4.18 shows the controllers designed for the Meta Oculus VR headset. In their appearance, VR controllers bear only a slight resemblance to game controllers, such as those known from PlayStation or Xbox game consoles. Controllers from a considerable number of manufacturers (e.g., Pico, HP) have a remarkably similar shape to Oculus VR controllers, and some manufacturers (e.g., Sony PSVR, Pimax) differ in shape. Operating the controllers can be a problem for new VR users, so companies provide apps pre-installed on VR goggles to allow unpractised users to learn how to operate the controllers. For example, Meta provides Oculus First Steps software that allows users to master the controllers in a brief time. The author had the opportunity to test this software on himself, but also observed several other users who were dealing with VR controllers for the first time in their lives. These were users of different ages, but in each age group it took them no more than 15 minutes to master the primary use of the VR controllers. Both the results of this author's experience and the survey results for the two populations indicate that the evaluation of the convenience of using VR controllers came out unequivocally positive.

Figures 4.19 and 4.20 show the results of the evaluation of VR controllers by Polish and global VR users. Similar to the immersiveness evaluation, the ratings given by the respondents were also remarkably high. The average response-weighted score among Polish users was 8.17, while it was only slightly higher at 8.20 for global users. Negative controller ratings (values of 1, 2, 3) did not occur at all among global users, and only one such rating appeared among Polish users. Approximately one-fifth of both Polish and global users rated the controllers at the maximum possible rating (10). The results indicate a positive reception of the methods of steering the VR environment using VR controllers. These devices should also perform well during the shopping

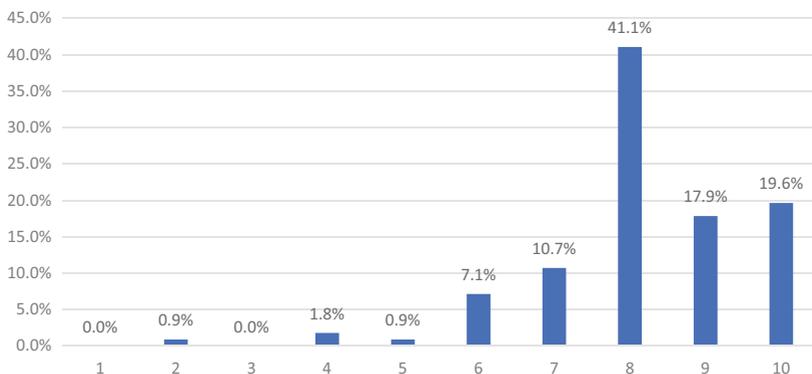


**Fig. 4.18** Meta Oculus VR controllers (*Source* Self-made photograph)

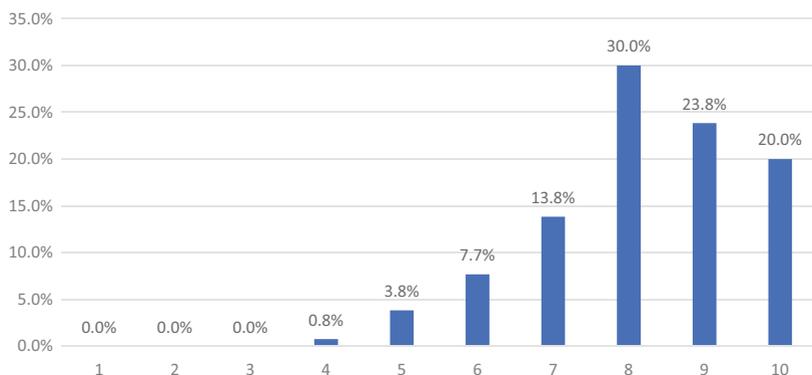
process in a VR environment, but a clear opinion on this would require further research in specific VR shop implementations. The author had the opportunity to test VR controllers in a ski shop in a VR environment. The functionality of the controllers allowed to perform the actions required in the shop, i.e., grabbing an item, moving around the shop, clicking on items, e.g., to change their colour. In the author's opinion, the VR controllers are a sufficient tool for the virtual shop to be operated by its customers, however, getting the full immersive experience of being able to touch purchased items will require additional devices such as VR gloves or a VR suit.

### **The Evaluation of the Vision Quality**

In the next step, users were asked to rate the vision quality in the VR goggles on a scale of 1 to 10 (a rating of 10 represents the highest image quality rating). This question was included in the survey because the VR environment requires specialised lenses. Refining the image quality



**Fig. 4.19** VR Controllers quality evaluation by Polish users



**Fig. 4.20** VR Controllers quality evaluation by worldwide users

was one of the main tasks of the VR headset designers. The results obtained in the survey indicate that VR headset users positively evaluate the image quality presented in the goggles. However, it is worth noting that these ratings are slightly lower than the immersiveness rating or the VR controllers rating (Figs. 4.21 and 4.22). The percentage-weighted average for the group of Polish users was 7.08, while for the group of global users it was 7.68. It can be seen that Polish users rated the image quality slightly lower. To determine the reason, the image rating of the different VR goggle brands was analysed. Tables 4.4 and 4.5 present a

summary of image quality ratings by brand. The reason for the slightly lower rating by Polish users may be the non-existence in the Polish user population of brands with the highest average image quality rating, such as Pico, Pimax, PSVR.

Analysis of the vision quality evaluation shows that, despite the satisfactory results of some brands, others still need to refine the optics of the devices. From the point of view of using a VR headset for the purchasing process, it is essential that the image be sharp and clear. When making purchasing decisions, any distortion or blurring of the image will deter users from spending time and money in VR shops. Considering that shopping can be a time-consuming process, especially when making difficult choices between close substitutes, or buying many assortment items, growth fatigue with blurry images will discourage shoppers from this innovative form of commerce.

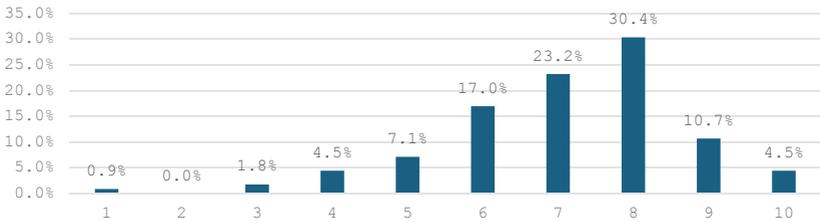


Fig. 4.21 Vision quality evaluation by Polish VR users

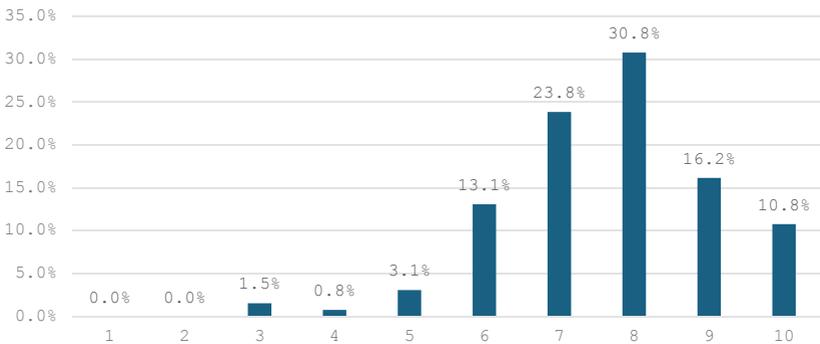


Fig. 4.22 Vision quality evaluation by worldwide VR users

**Table 4.4** Average vision quality evaluation by worldwide users

VR Headset brand	Average vision quality evaluation worldwide users
HP	8.00
HTC Vive	7.40
Oculus	7.57
Pico	8.30
Pimax	8.33
PSVR	9.00
Valve	7.67

**Table 4.5** Average vision quality evaluation by Polish users

VR Headset brand	Average vision quality evaluation Polish users
HTC Vive	7.00
Lenovo	7.00
Oculus	7.03
Valve	7.86

## Additional VR Devices

VR goggles are the primary, but not the only, device that can be used for Virtual Reality. In the future, more advanced devices can be expected to allow a more complete Virtual Reality experience, but the range of additional devices is already extensive. This is particularly relevant for the future use of Virtual Reality in e-commerce. In order to take full advantage of the benefits of virtual commerce, it is necessary to have additional devices that allow the ability to touch and feel the assortment being purchased.

According to the survey, the most common VR users declared owning VR controllers, which is in line with expectations, as it is now a primary add-on to VR goggles, usually sold bundled with them. With VR controllers, it is possible to operate the Virtual Reality environment in a basic way by clicking on objects, picking them up, moving them around and performing elementary operations that would be useful in a virtual shop. For a fuller Virtual Reality experience, additional devices such as VR gloves, VR outfits, or cybershoes for VR are required. Ownership of such devices was declared by less than 5% of VR users (both in Poland and worldwide), as illustrated by Figs. 4.23 and 4.24. As the number of

VR applications grows, including with the popularisation of commerce in VR, such additional devices should become increasingly popular.

In addition to VR controllers, add-ons for increased comfort, such as a specialised strap for VR goggles and specialised grips used in games, such as gun or handles, special handles for Best Saber game, and for table tennis and golf, were quite popular. The exact percentages of people with these types of devices are presented in Figs. 4.23 and 4.24.

The survey question on additional VR devices also included the option to enter other devices owned by VR users. The full list of devices, together with the number of users who declared ownership of a particular device, is shown in Tables 4.6 and 4.7. Other devices cited by users included special controller grips (commonly rubber) for increased comfort, as well as Rx lenses, additional trackers to full-body tracking, facial interfaces, and many others. For more specific VR devices, an attempt has been made to retain the original spelling given by respondents. It can be noted that global users declared a much greater variety of additional VR devices than Polish users. This is consistent with the fact that there is a much greater variety of VR goggle brands among global users, with each brand having its own dedicated VR headset devices.

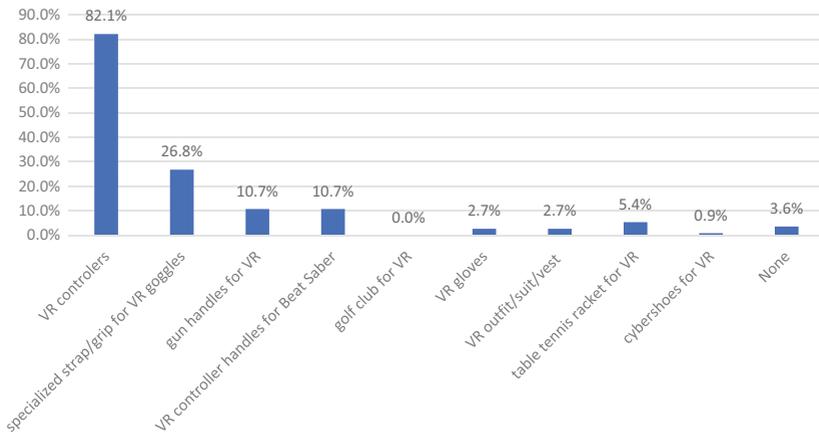
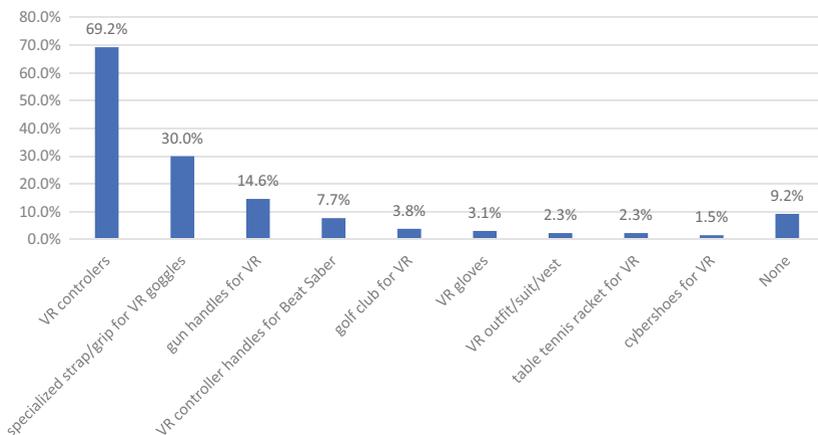


Fig. 4.23 Additional VR devices which possess Polish VR users



**Fig. 4.24** Additional VR devices which possess worldwide VR users

**Table 4.6** Additional VR devices pointed out by Polish respondents

Additional VR device	Number of users who have this device	Percentage of users that have this device
Grips for controllers	5	4.5
Steering wheel	2	1.8
Prescription/Rx lenses	1	0.9
Powerbank	1	0.9
Bobovr 2 Pro (belt + accumulator)	1	0.9
HTC Vive Tracker 2.0	1	0.9
Bobo M2	1	0.9
Oculus strap	1	0.9
Trackers to full-body tracking	1	0.9
Facial interface	1	0.9
PAD Xbox	1	0.9
Vive tracker × 3	1	0.9

## What Kind of Applications Do You Use with Your VR Goggles?

Another survey question on the use of VR goggles concerned the applications of the goggles. Users were asked to indicate which types of applications they use. This was a closed-open question, so in addition to

**Table 4.7** Additional VR devices pointed out by worldwide respondents

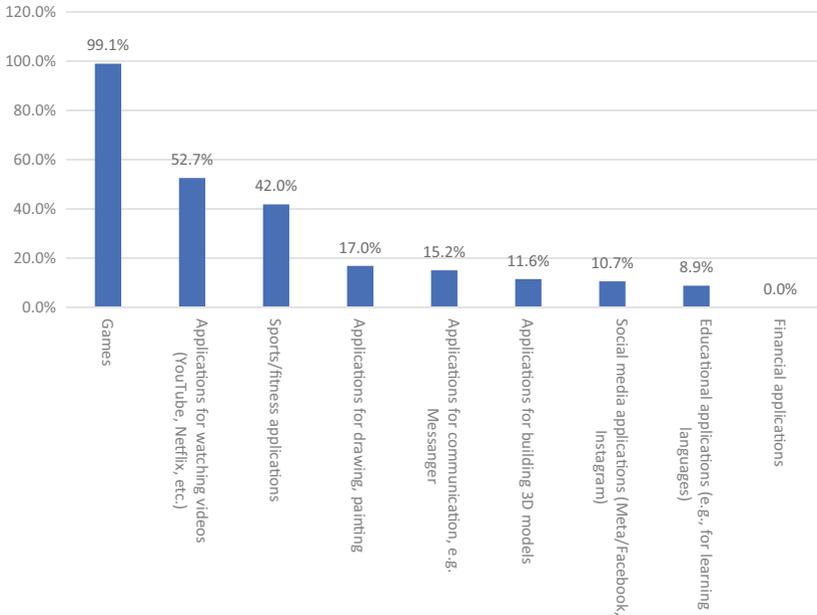
Additional VR device	Number of users who have this device	Percentage of users that have this device
Prescription/Rx lenses	3	2.3
Headset Fan	2	1.5
Grips for controllers	2	1.5
Third-party headstrap with a battery	2	1.5
VR cover facial interface	2	1.5
Knuckle grips	1	0.8
Charging station	1	0.8
Haptic belt	1	0.8
Elite strap with battery	1	0.8
Aftermarket batteries to extend playtime	1	0.8
Headphones that clip onto the side of the headstrap	1	0.8
Joystick and controls	1	0.8
Deluxe audio strap	1	0.8
Full 11 Point Tracking	1	0.8
Mouth Tracker	1	0.8
Leapmotion	1	0.8
Simshaker	1	0.8
Microphone	1	0.8
SteamVR Lighthouses for using Index controllers with G2	1	0.8
Stickers	1	0.8
Thumbstick covers	1	0.8
Streaming cable for PC VR	1	0.8
Wireless adapter for Vive	1	0.8
3rd party strap replaced mask to keep eyes closer to the lenses	1	0.8
PointCtrl	1	0.8
Shadow PC	1	0.8
PS MOVE	1	0.8

the uses listed by the survey author, users had the opportunity to indicate other applications. Unfortunately, none of the users indicated that they use VR goggles for shopping. This was as expected—since there are no functioning VR shops yet, or they are so poorly positioned in search engines that the author was unable to find them, VR goggle users are also not yet using V-commerce, but this will probably change in the near future.

Analysing users' responses to the question “What kind of applications do you use with your VR goggles?”, users overwhelmingly pointed to games (99.1% Polish VR users, 95.4% worldwide VR users). Therefore, it can be seen that games are the dominant functionality and arguably the purpose of purchasing VR goggles. However, it should be noted that other types of applications are also popular among users, which shows that the VR headset is not only suitable for games but also for numerous functional applications such as educational applications or sports/fitness applications. The percentage of VR users using different types of applications is shown in Figs. 4.25 and 4.26. Users were also provided the opportunity to enter additional applications they use when using the VR goggles—the list of applications entered by users is presented in Tables 4.8 and 4.9. In the names and types of apps, an attempt was made to preserve the original spelling given by the users. As already mentioned, none of the users indicated that they use shopping apps on their VR goggles.

### **The Advantages of Using VR Headset Pointed Out by Users**

Considering the advantages of using a VR headset as indicated by users, by far the largest percentage of users indicated the ability to play with the feeling of being inside a game world (Figs. 4.27 and 4.28). This is further confirmation that VR goggles are now primarily used for gaming. A high percentage of users (68.8% of Polish users and 70% of worldwide users) pointed to the following as an advantage, the opportunity to see places and situations where it would be difficult to be (e.g., faraway countries, space, flight over mountains). These figures confirm that, besides games, the second most popular use of VR goggles is watching videos adapted to



**Fig. 4.25** Types of applications used by Polish VR goggle users

the VR environment, i.e., recorded in 360 degrees, allowing the user to experience the feeling of being in the places they are watching. A substantial proportion of users also see the benefits of VR goggles for sports and fitness applications. A slightly smaller proportion of users see among the advantages of VR goggles, those that can be used in professional life, for example, the ability to train skills in virtual environments (such as driving a virtual car) or the ability to work in a modelled environment. Unfortunately, none of the users indicated among the advantages of VR goggles the possibility of using them in e-commerce, which is in line with the current situation, i.e., the lack of diffusion of ready-made virtual commerce solutions. Among other advantages, not mentioned in the survey, Polish users indicated (the original wording given by the respondents is presented):

- fitness improvement,
- reduction in reaction time,

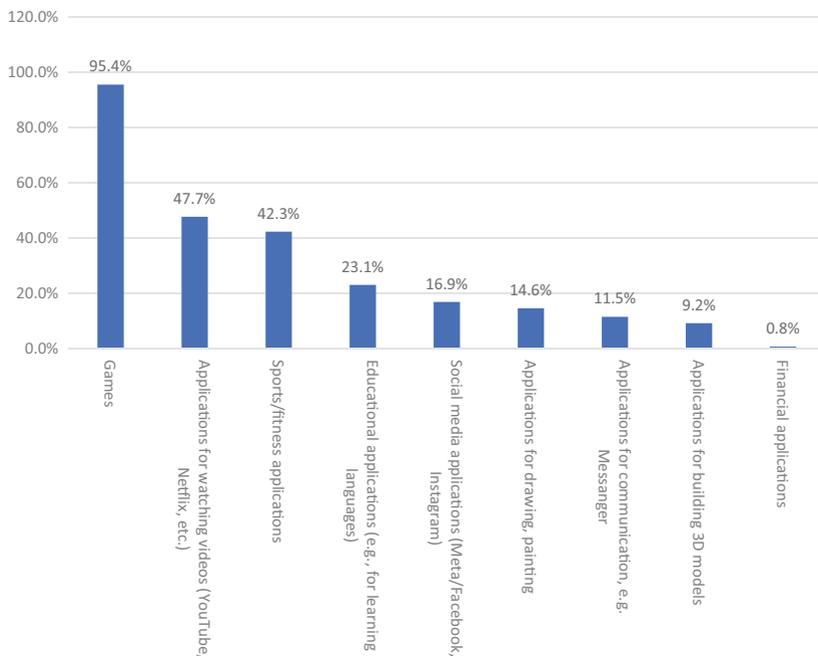


Fig. 4.26 Types of applications used by worldwide VR goggle users

Table 4.8 Additional types of applications used by Polish VR goggle users

Types of applications	Percentage of VR users	Number of VR users
Drum simulators	0.9	1
Google Maps	0.9	1
Multiple dashboards	0.9	1
Virtual office (immersed)	0.9	1
VR Chat	0.9	1
Google Earth	0.9	1
Wander	0.9	1
Web browser	0.9	1

while global users indicated:

- the ability to socialise and interact with new people across the world,

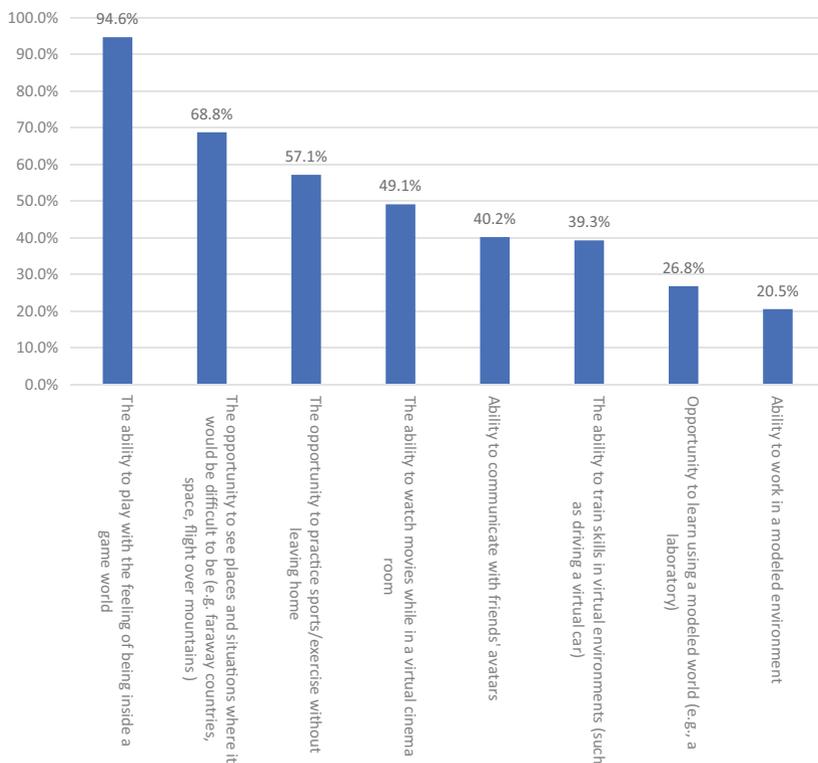
**Table 4.9** Additional types of applications used by worldwide VR goggle users

Types of applications	Percentage of VR users	Number of VR users
Travel applications like wander	1.5	2
Meditation	1.5	2
Space	0.8	1
Interactive stories	0.8	1
Social activities	0.8	1
Beginning to explore business collaboration tools	0.8	1
Virtual SNS	0.8	1
MSFS 2020	0.8	1
VRChat	0.8	1
VR Video, both 360 & VR180	0.8	1
360 3D Video/ Photo—Capture—Content Creation	0.8	1
Simracing	0.8	1
Google Earth (Street View)	0.8	1

- collaboration for remote work (respondent wrote that, for example, he worked with cybersecurity and that allowed them to virtualise a SOC during incidents as their team had mostly remote work),
- situational awareness,
- mental counselling.

One of the respondents wrote that “I get to be a Dog in VR Chat”, which normally would be treated as a joke, however in this context it can be real that in Virtual Reality this user can try to somehow feel like an animal, whatever strange it may sound.

It is worth noting the remarkably high concordance between the answers of users from Poland and the world, which is confirmed by the calculated Pearson’s correlation coefficient of 0.9896 with a *p*-value of 0.000003. Such a high concordance of answers, of two independent groups of respondents, is rarely encountered. In this case, it indicates that the advantages of using VR goggles are similarly perceived regardless of whether we survey a specific country or a worldwide population.

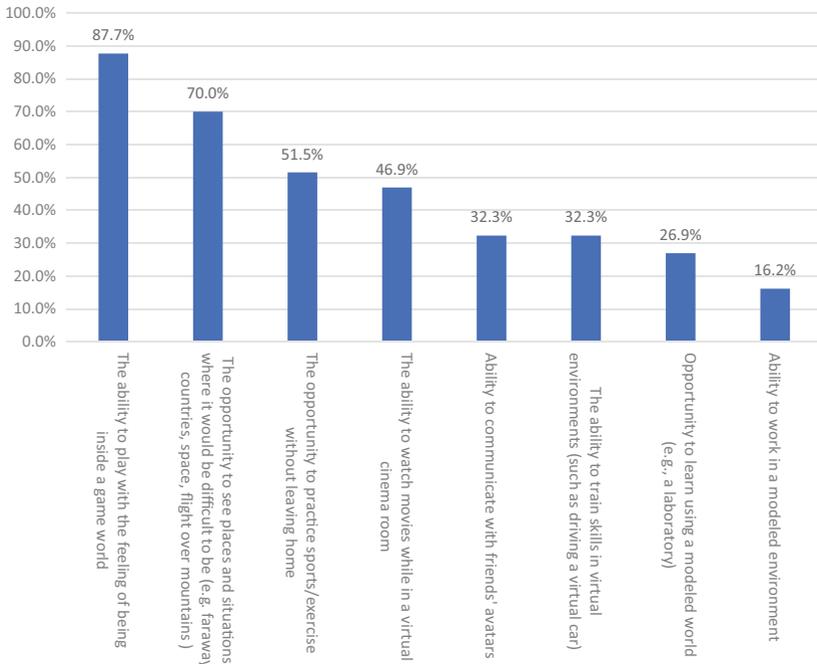


**Fig. 4.27** The advantages of using VR headset pointed out by Polish users

## Disadvantages Pointed Out by VR Headset Users

Truly relevant to the aim of the study was the question regarding the disadvantages of using VR goggles as perceived by users. It should be noted that these are not potential disadvantages, but actual disadvantages observed during use, as only VR goggle users took part in the survey. In the survey, the author identified six disadvantages that he felt were important, while there was an opportunity to list other disadvantages in the question, which respondents took advantage of in considerable numbers, as shown in Table 4.10.

Figures 4.29 and 4.30 present the percentage of users who indicated the occurrence of the problems mentioned in the survey with the use



**Fig. 4.28** The advantages of using VR headset pointed out by worldwide users

of VR goggles. Interestingly, unlike many of the previous questions, in this question the responses of Polish and worldwide users differed. This is confirmed by the Pearson's correlation coefficient calculation of 0.43 with a  $p$ -value of 0.33, so it can be concluded that this is a low, statistically insignificant correlation. Comparing the above Pearson's correlation coefficient value with the one obtained in the previous question on the advantages of VR goggles, it can be concluded that while the advantages are perceived almost identically before the two populations of respondents, there are significant differences in the disadvantages.

Equally, half of the respondents from Poland indicated as a disadvantage of VR goggles the problem that there is a risk of being injured in the goggles by hitting objects in the environment. Admittedly, VR applications have safeguards that require a collision-free area to be defined when starting to use the goggles, and this is an operation every time the goggles

**Table 4.10** Additional disadvantages of using VR goggles pointed out by Polish and worldwide users

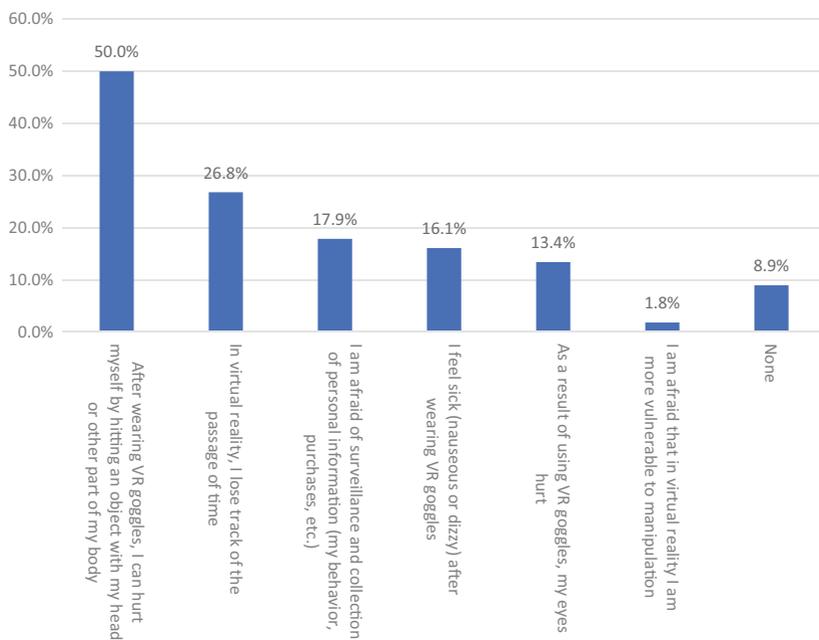
No.	Polish VR users	Worldwide VR users
1.	I fear that VR will absorb many people even more than smartphones, and they will be disconnected from reality	It came to my attention that VR leaves room for criminals to start grooming children who are given VR sets to play. Parents don't realise children can be approached in VR by strangers
2.	I am afraid of losing my eyesight	The virtual world seems better than my own environment
3.	Sometimes, after playing for a long time (more than 2 h) pain in the back of the head from the pressure of the strap	No resistance as there's nothing really there (when interacting)
4.	Comfort	No worse than any other online activity. it's just another interface
5.	Limitations in the form of a cable or short wireless time	Additional costs for applications and subscriptions
6.	For a long time, deterioration of vision	The headset, so bulky and awkward
7.	Notorious disconnection of the goggles from the computer	Inconsistent navigation in various environments
8.	Simulator sickness when moving quickly	Daughter has had an allergic reaction to the headpiece. The weight of it hurts
9.	No connection of vision defects as standard—possibly there are third-party lenses or a compulsion to use contact lenses	I might thump something and break it
10.	Image some not clear, at least not as it is in reality	Heat in the goggles
11.	After using the goggles, my neck hurts (heavy goggles)	Neck pain
12.	Sweaty face and skin irritation	One of the biggest problems is the comfort and the convenience of VR
13.	Lack of good presentation of what can be seen in VR for those next to me	After time, the headset and straps to hold it on start to hurt, my head
14.	Not comfortable after a long time	I'm a bit concerned about the blue light of the screens the VR screens emit

(continued)

**Table 4.10** (continued)

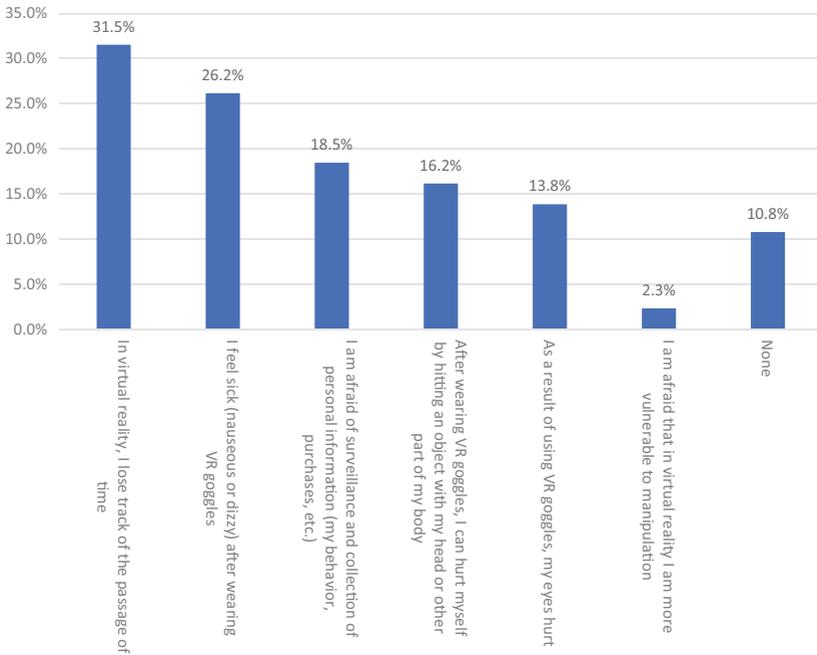
No.	Polish VR users	Worldwide VR users
15.	Commitment required (you won't play them typically for relaxation after a hard day like on a PC or console because of the strain of using them)	Hitting objects in real life while using, communication with people outside of VR
16.	Electricity and water bills (showering after some games is required)	Headache
17.	Glasses imprint on the face, glasses are uncomfortable due to uneven weight distribution	Eyes get dry
18.	Nausea due to the behaviour of the vagus when moving "on foot" in the VR world	It takes some effort to get into VR, I need to keep my headset charged, have a space free of obstacles. Often, I'm too lazy, for e-commerce it needs to have a big advantage compared to 2D shopping, to overcome my laziness)
19.	Back pain when using standing up after an hour or so	Peripheral vision is needed
20.		Headache or eyes watering
21.		Poorly designed VR games causing sickness/dizzy
22.		Discomfort
23.		People watching me whilst I'm immersed
24.		Can give me headaches after a while

are launched. Crossing this area automatically displays a quasi-frame showing the bounding area. Unfortunately, this does not protect against crossing the area during sudden body movements. This is particularly dangerous when operating the goggles in a small area. Perhaps the reason that users from Poland indicated this reason more often than users from the world (50% from Poland against 16.2% from the world—mainly from Anglo-Saxon countries) is that the average area of flats and houses in Poland is much smaller than in Anglo-Saxon countries. In Poland, the average area of a flat in single-family buildings is 133.5 m<sup>2</sup>, while in multifamily buildings it is 52.7 m<sup>2</sup> (Moneta, 2023), while in the United States, for example, the average home size is equal to 176.6 m<sup>2</sup>, while



**Fig. 4.29** Disadvantages of using VR goggles pointed out by Polish users

in the United Kingdom it is 147.7 m<sup>2</sup> [<https://www.point2homes.com/news/canada-real-estate/how-large-are-canadian-homes.html>]. A second hypothetical reason for such differences between the Polish and global populations, closely related to the above one, may be the fact that there are many more young people in the surveyed Polish population, including students, who tend to live either in dormitories or rent small flats that lack space for free use of VR. Of course, these are only hypothetical reasons, and its full confirmation would require further research, but it seems a fairly logical justification for this state of affairs. Undoubtedly, designers of user interfaces for VR goggles should take this data into consideration, bearing in mind that some users using VR goggles in small spaces are at risk of all sorts of injuries resulting from a lack of control over their position relative to other objects once the goggles are on.



**Fig. 4.30** Disadvantages of using VR goggles pointed out by worldwide users

Worldwide users commonly cited the problem of not being able to control the passing of time as the most common disadvantage of using VR goggles. This reason was indicated by 31.5% of users from the world, and for Poland by 26.8%. Perhaps the saying “time is money”, especially popular in Anglo-Saxon countries, had an impact on such a frequent indication of this seemingly harmless drawback. On the other hand, it should be borne in mind that the lack of control over the passing of time can lead to excessive use of VR goggles and all the consequences associated with this, such as addiction to games or addiction to being in a virtual environment and the problem of returning to reality (Rajan et al., 2018). In the case of the potential use of VR goggles for e-commerce, this drawback can lead to virtual shopaholism (addiction to virtual shopping), by spending excessive and uncontrolled time in virtual shops.

A topic commonly raised in discussions about VR goggles is the body’s adverse reactions to contact with Virtual Reality. In this research,

26.2% of worldwide users, and 16.1% of Polish users, indicated that they felt sick (nauseous or dizzy) after wearing VR goggles. This is a high percentage considering the potential use of the goggles for non-entertainment purposes such as work or shopping. This problem may be a reaction similar to motion sickness (Dziuda et al., 2014; Kim et al., 2018), but there may be many more causes and not all are fully diagnosed at present. However, considering the rapid growth of the VR goggle market in recent years and the increase in the quality and comfort of these devices, it is likely that the proportion of people experiencing unpleasant side effects from VR goggles will decrease with subsequent generations of goggles.

In third place, worldwide and Polish VR users (18.5% and 17.9% respectively) indicated that they are afraid of surveillance and collection of personal information (concerning behaviour, purchases, etc.). These concerns may also be compounded by the fact that, for example, Oculus VR goggles require a Meta/Facebook account, so the VR user cannot be fully anonymous. In addition, the goggles come with cameras and a microphone, which already means that they can potentially provide detailed information about the user's surroundings.

In fourth place, with a remarkably similar percentage among users from the world 13.8% and from Poland 13.4%, was the problem of eye pain resulting from the use of VR goggles. The author of the survey also experienced this problem, especially after using the goggles for longer periods of time, exceeding 30 minutes. From the responses of those surveyed, it appears that this is a problem for about one in seven goggle users, which is a definite minority, but for goggle applications requiring hours of use, this problem may be exacerbated.

A small percentage of respondents (2.3% of worldwide users, 1.8% of Polish users) indicated that they were concerned about being more vulnerable to manipulation when using VR goggles. This option was added by the author of the survey since, finding ourselves in a Virtual Reality with a high degree of immersion, our awareness of the decisions we make can be limited by the feeling of being in "another virtual world". The result indicates that either this immersiveness is not yet so high that users lose a sense of control over their behaviour, or they are not aware of this danger.

Some users (10.8% of global users and 8.9% of Polish users) indicated that they do not see any disadvantages of using VR goggles. These are probably uncritical lovers of the technology, for whom the advantages overshadow any disadvantages.

Among other disadvantages perceived by VR goggle users (Table 4.10), they pointed out both problems related to the inconvenience of using the equipment (e.g. neck pain, eyes get dry), and concerns that VR will absorb many people even more than smartphones, and they will be disconnected from reality because as pointed out another VR user, “the virtual world seems better than my own environment”. One user pointed out the serious risks regarding children—“children can be approached in VR by strangers”. While the disadvantages in terms of use are just a function of hardware inconvenience and will probably be resolved in the future, with the introduction of newer generations, lighter, more comfortable, and offering a better image of the goggles, the threats regarding the disconnection of VR users from reality and the dangers lurking for children in this environment, should definitely be taken seriously. In the author’s opinion, the better the quality of the goggles and the immersive nature of the VR environment, the greater such risks will unfortunately be.

One user mentioned that the disadvantage of the VR headset is the “lack of good presentation of what can be seen in VR for those next to me”. This disadvantage is especially important from the point of view of controlling the content viewed by children. Unlike traditional interfaces such as a monitor or smartphone, even being next to the person using the VR goggles, you do not know what images they are viewing unless the image is additionally transmitted to another device. Unfortunately, this can lead to a complete lack of control over the content viewed by the child and consequences such as addiction to violent games or pornography. Of course, the risks mentioned do not only apply to children, but the youngest users are particularly vulnerable to these dangers of using VR goggles.

When analysing the potential use of VR in e-commerce, it is worth noting the statement of one user who wrote that “it takes some effort to get into VR, I need to keep my headset charged, have a space free of obstacles. Often, I’m too lazy, for e-commerce it needs to have a big

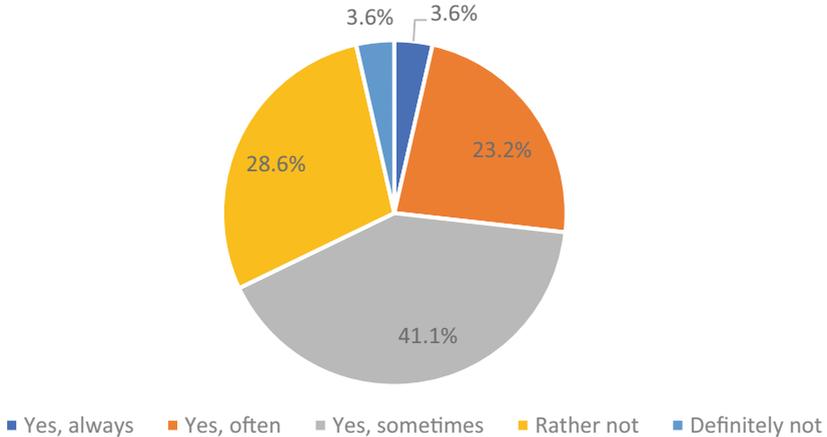
advantage compared to 2D shopping, to overcome my laziness”. The drawback regarding the starting conditions of VR use is truly relevant to the prevalence of virtual commerce. With a smartphone, the start-up barriers to start shopping are exceptionally low—we usually have our smartphone with us, it only takes a few clicks to enter the shop and shop. With VR goggles, the process to start shopping is at least a few minutes necessary to put on the goggles, get them up and running, etc. Obviously, the shopping process in Virtual Reality is only limited to places where we have goggles available. Perhaps in the future the VR interface will be significantly reduced to a goggle or lens format, but at present it is still a device, with a size that precludes carrying it around.

### **Attitude of VR Users to Virtual Shopping**

The next questions in the survey dealt with the core of this book, i.e., e-commerce. The author asked respondents the question: “If there were online stores that allow you to shop with VR goggles in a virtual environment, would you shop online at such stores?”. Respondents’ answers suggest that the option of online shopping is potentially under consideration and the vast majority of VR goggles users answered “yes”, although in both populations surveyed, the highest proportion received the answer “yes, sometimes” (41.1% for the Polish population, 52.3% for the global population), indicating that these users consider Virtual Reality shopping as an option they will use, but occasionally. The answer “Yes, always” and “Yes, often” was selected by 26.8% in the Polish population, while 23% in the global population (Figs. 4.31 and 4.32). That is, it can be concluded that approximately one in four respondents intends to use Virtual Reality shopping commonly. In the Polish population, 32.2% of respondents were sceptical about this new form of trade, while in the global population 24.6% were sceptical, with the Polish population having a lower percentage of those who answered “definitely not” (3.6%) and the global population (6.9%).

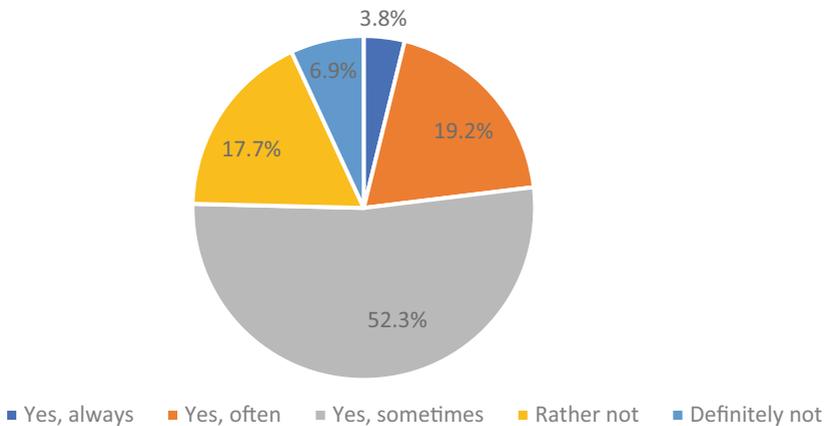
Summarising these results, it can be concluded that the vast majority of VR users will potentially use virtual shops once such solutions become

Answers of Polish users - If there were online stores that allow you to shop with VR goggles in a virtual environment, would you shop online at such stores?



**Fig. 4.31** Answers of Polish VR users concerning their attitude to v-shopping

Answers of worldwide users - If there were online stores that allow you to shop with VR goggles in a virtual environment, would you shop online at such stores?

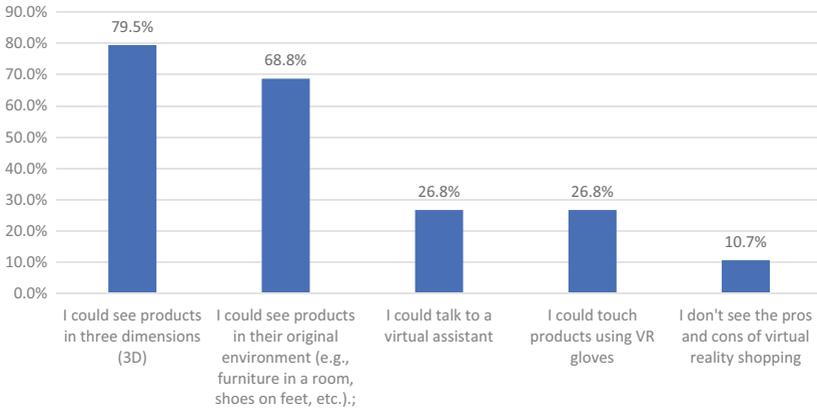


**Fig. 4.32** Answers of worldwide VR users concerning attitude to v-shopping

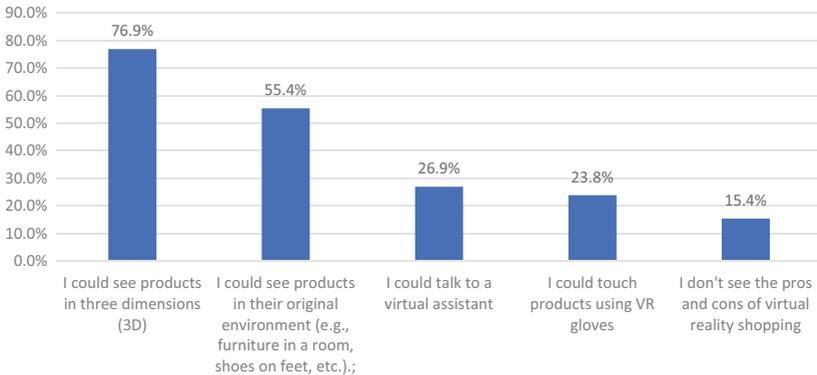
widespread in the market. However, these studies suggest that a considerable proportion of VR users are more likely to use Virtual Reality shopping intermittently. Of course, the popularity of virtual shops will largely depend on what proportion of current online and stationary shops will offer such an option in the future and the quality of these solutions.

### **Potential advantages of shopping online in Virtual Reality using VR tools (goggles, VR gloves)**

VR headset users were asked to point out the potential advantages of shopping online in Virtual Reality (Figs. 4.33 and 4.34; Table 4.11). By far the largest percentage of respondents indicated the ability to see products in three dimensions as an advantage (79.5% of Polish VR users, 76.9% of worldwide VR users). This seems to be an essential advantage, as flat 2D images do not always reflect the proportions, sizes, and other features of products. Similarly receiving a high percentage of responses was the ability to see products in their original environment (68.8% of Polish VR users, 55.4% of worldwide VR users). This is also a feature of VR that, when properly modelled in v-shops, can give great added value to customers. It is important to remember that VR allows you not only to see a product in its original environment, but also to give the v-shop customer the feeling that they too are in that environment. Trying on clothes virtually, or seeing furnishings, fittings, and furniture in a room where they can go are just selected applications of V-commerce. However, it is possible to imagine in the future much more advanced testing of products such as cars, allowing not only to see the interior of the car, but also to take a virtual drive. It can be expected that in the near future, most travel services will be sold using VR goggles, allowing customers to see places and hotels in a VR environment. Already, companies specialising in producing video content for VR are springing up like mushrooms. Examples include Immersion VR (<https://immersionvr.co.uk/about-us/>), GEMA (<https://gemadigital.com/about/>). Pestek and Sarvan (2020) present how VR changes tourism planning, management as well as consumer needs.



**Fig. 4.33** Potential advantages of shopping online in Virtual Reality using VR tools (goggles, VR gloves) pointed out by Polish VR users



**Fig. 4.34** Potential advantages of shopping online in Virtual Reality using VR tools (goggles, VR gloves) pointed out by worldwide VR users

Other answers were not indicated by such a high percentage of respondents. The possibility to talk to a virtual assistant was indicated by just over a quarter of VR users. A rather surprisingly low score was given to the possibility to touch products using VR gloves (26.8% of Polish VR users, 23.8% of worldwide VR users). This option seems especially useful when shopping in a virtual environment. Perhaps respondents did not indicate this option because few of them had been in contact with VR

**Table 4.11** Additional advantages and comments of shopping online in Virtual Reality using VR tools (goggles, VR gloves) pointed out by Polish and worldwide VR users

No.	Polish VR users	Worldwide VR users
1.	At this point, it seems to me that the technology is not perfect enough to influence my purchasing decisions	I would love to browse through combat gear like gloves and shin guards using VR
2.	I would sooner see the possibility of shopping with AR goggles/glasses. Superimposing a digital image over reality, appropriately scaling the objects viewed to the environment	No virus
3.	I would be able to judge the real size/size of a product	More realistic demonstration of how to properly use the product
4.	checking if tools or items will fit without measuring each item would be great... (Will the printer go into the cabinet, will the vase on the table bang against something...)	I could see products that are out of stock or not stocked by stores
5.		The online interface is usually lists upon lists of items. VR shopping would have the potential of the browsing experience in a shop but with the comfort of not leaving home
6.		VR is not comfortable enough to make my shopping on it in my opinion
7.		I wouldn't have to leave my home

gloves, so it was difficult for them to assess the usefulness and sensations when shopping with this equipment.

Some users (10.7% of Polish users, 15.4% of worldwide users) indicated that they did not see any advantages to shopping in a virtual environment. The cross-analysis indicated that 88.2% of them were users who answered that they rather or definitely do not intend to shop in a virtual environment. This was therefore a group of people who were generally sceptical about this form of commerce.

It is also worth noting the remarkably high concordance between the responses of the Polish and global user populations. The calculated Pearson's correlation coefficient, considering the percentage of options selected by the respondents in this question, was 0.98, with a  $p$ -value of 0.003. It can be concluded from this (of course, with full knowledge that only one country's population was surveyed in more detail) that the perception of the advantages of VR shopping does not depend on the place of residence of the VR user.

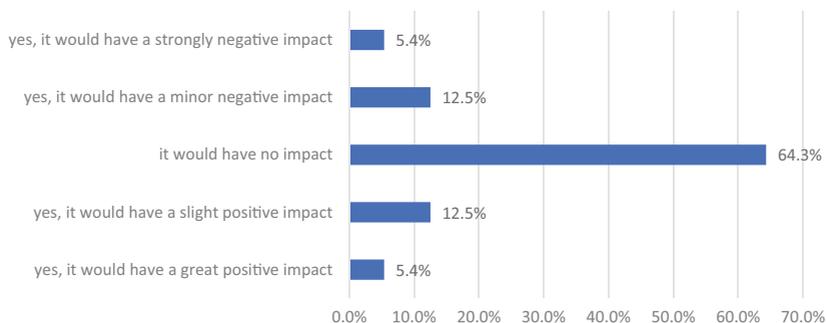
Users were also asked to list other advantages of shopping in Virtual Reality not mentioned in the survey (Table 4.11). Some respondents used this field to insert broader comments. One respondent indicated that VR shopping enables “a more realistic demonstration of how to properly use the product”. Another indicated that he “would be able to judge the real size/size of a product”, similarly another respondent wrote that “checking if tools or items will fit without measuring each item would be great”. One respondent referred to the rather poor presentation of goods in current online shops and the chances of improving this in VR shopping—“Online interface is usually lists upon lists of items. VR shopping would have the potential of the browsing experience in a shop, but with the comfort of not leaving home”. This indication that VR shopping has the potential to give customers a much more comfortable shopping experience is, in the author's opinion, significant, and well-articulated by one of the interviewees.

### **Attitude of VR Users to the Appliance of Celebrity Avatars in Virtual Store**

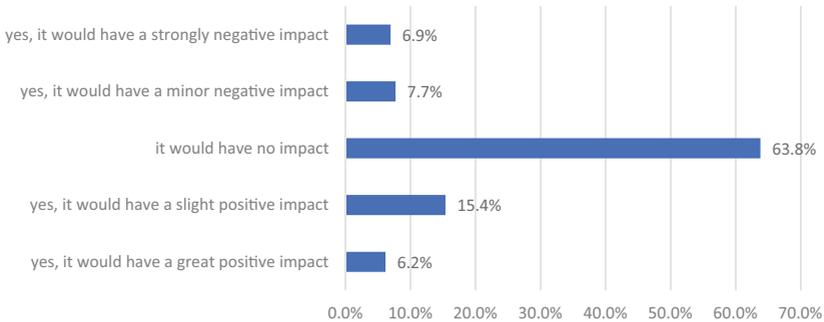
The next question concerned respondents' attitudes towards celebrity avatars that could be used in a virtual store. One of the possibilities of the virtual environment is to generate an image of virtually any character. Through the use of deep fake technology, such a character could be made to look deceptively like a well-known celebrity. Of course, the use of a celebrity's image would require the shop to obtain the appropriate consent (presumably for a fee) to use the person's image. An added value for the shop would be to have avatars that

look like celebrities. For example, a virtual sports shop of a well-known brand would “employ” avatars of Cristiano Ronaldo or Usain Bolt as customer advisors. Technologically, this is a workable solution, so the survey asked: “When shopping in a virtual environment, would an online store’s use of celebrity avatars (actors, sportsmen, musicians) influence your purchasing decisions?” The answers of the majority of users show that such a solution would not influence their purchasing decisions (Figs. 4.35 and 4.36). Only 17.9% of Polish VR users and 21.6% of worldwide VR users marked the answer that celebrity avatars would influence their purchasing decisions. It is also worth noting that some users (17.9% of Polish VR users and 14.6% of worldwide VR users) ticked the answer indicating that such a celebrity avatar would have a negative impact on their purchasing decisions. It is also worth noting the perfect symmetry of positive and negative responses from Polish respondents. Such results indicate that it may not be worth it for shops to invest in such solutions, especially if the fees for using the image are high.

However, the author expresses some scepticism about these answers. After all, it is one thing to consider an anonymous celebrity from a question and another to come face to face with a specific well-known celebrity in the form of an avatar. Therefore, in the author’s opinion, celebrity



**Fig. 4.35** Answer of Polish VR users to the question: When shopping in a virtual environment, would an online store’s use of celebrity avatars (actors, sportsmen, musicians) influence your purchasing decisions?



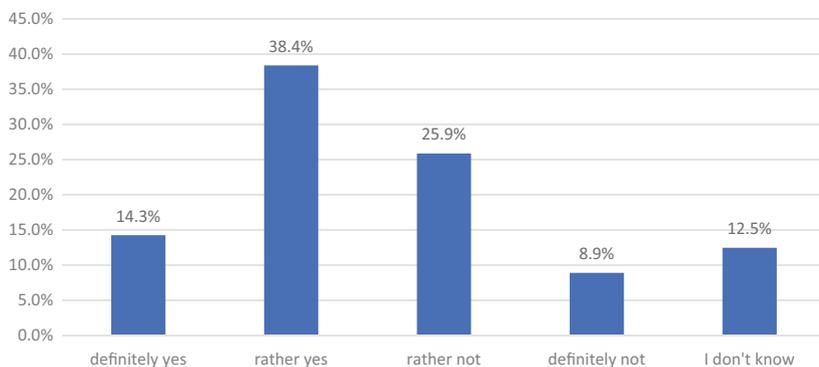
**Fig. 4.36** Answers of worldwide VR users to the question: When shopping in a virtual environment, would an online store’s use of celebrity avatars (actors, sportsmen, musicians) influence your purchasing decisions?

avatars will appear in the future in large virtual shops, but this is only a hypothesis that will be verified in the next decade.

When analysing the respondents’ answers, it is worth noting again the remarkably high concordance between the answers of Polish VR users and worldwide VR users. The calculated Pearson’s correlation coefficient was 0.99 with a  $p$ -value of 0.0007.

### **Opinion of Users About the Effectiveness of Recommendation Systems in Virtual Reality Environment**

Then, the respondents were then asked to give their opinion on the effectiveness of recommendation systems in a Virtual Reality environment. The recommendation systems in virtual stores will be able to make use of a lot of additional information resulting from the customer’s behaviour in such a shop, so an increase in their effectiveness can be expected, especially if they use artificial intelligence techniques such as deep neural networks. Analysing the respondents’ answers to the question: “Do you think that recommendation systems (suggesting other products in the

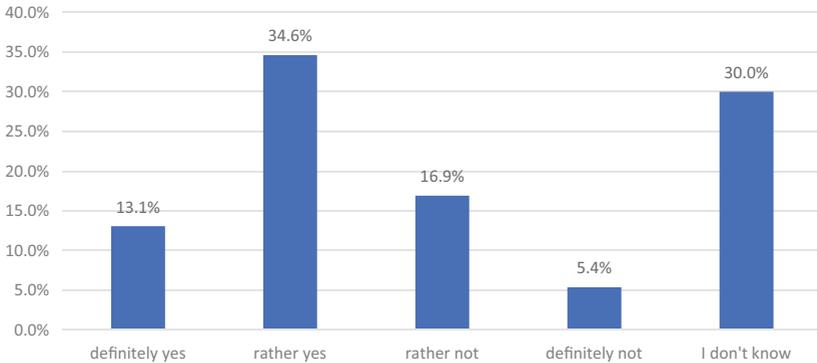


**Fig. 4.37** Answers of Polish VR users to the question—Do you think that recommendation systems (suggesting other products in the e-store) using artificial intelligence techniques would be even more effective in a Virtual Reality environment?

e-store) using artificial intelligence techniques would be even more effective in a Virtual Reality environment?” it can be seen that affirmative answers received a slightly higher percentage than negative answers. In the case of Polish VR users, “definitely yes” or “rather yes” was answered by 52.7%, while in the case of worldwide VR users, it was 47.7%. (Figs. 4.37 and 4.38). “Rather not” or “definitely not” answered 35.8% of Polish VR users and 22.3% of worldwide users. Interestingly, there were significantly more undecided respondents among worldwide users than among Polish users (30% vs. 12.5%). It is difficult to pinpoint the reason for such a high percentage of undecideds.

### **Susceptibility to Manipulation by Software Using Artificial Intelligence Techniques, Used in E-Commerce During Shopping in Virtual Reality**

The final question in the survey was: “Are you concerned that you would be more susceptible to manipulation by software using artificial intelligence techniques, used in e-commerce, when shopping in Virtual Reality?” This question was asked because in a Virtual Reality environment, if it reaches a high level of immersion, the user will be exposed to

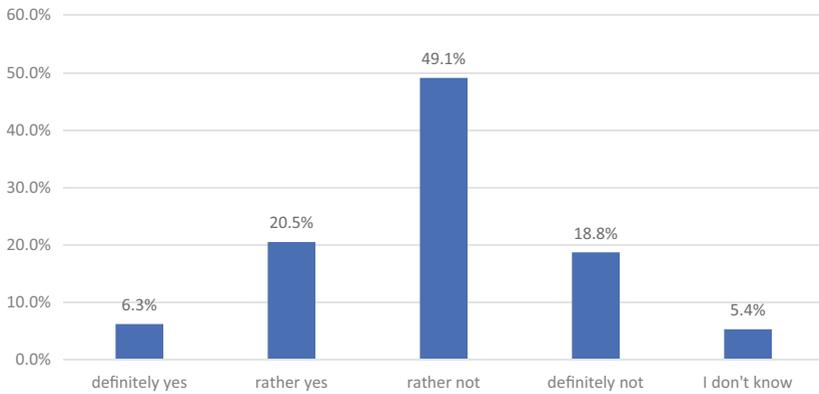


**Fig. 4.38** Answers of worldwide VR users to the question—Do you think that recommendation systems (suggesting other products in the e-store) using artificial intelligence techniques would be even more effective in a Virtual Reality environment?

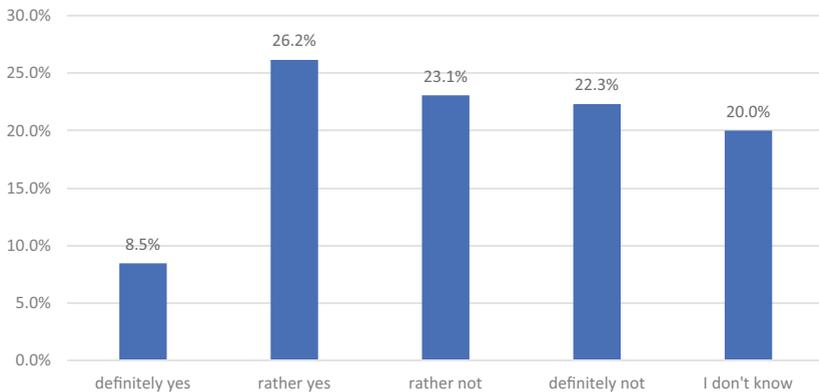
a stronger impact of various visual and auditory stimuli. Unfortunately, the deep immersion of the shopper in a virtual, immersive environment can result in susceptibility to all kinds of manipulation.

Responses from VR users from Poland and around the world differed on this question (Figs. 4.39 and 4.40). In the case of Polish users, 49.1% answered “rather not” and 18.8% “definitely not”, i.e., a total of 67.9% are not afraid of being manipulated in a virtual shop environment. For worldwide VR users, “rather not” was answered by 23.1%, “definitely not” by 22.3%, i.e., a total of 45.4% are not afraid of being manipulated. It is also worth noting the differences of undecided users who answered “I don’t know”. In the case of Polish users, this was only 5.4%, while among worldwide VR users it was 20%. As in the previous question, the percentage of undecided users in the global population is much higher than in the Polish population. VR users concerned that manipulation using AI techniques in a virtual commerce environment will be more effective were 26.8% in the Polish population, of which only 6.3% answered “definitely yes”, while 34.7% in the global population, of which only 8.5% answered “definitely yes”.

Summarising the results of this question, it can be concluded that a considerable proportion of respondents are aware of the potential risks



**Fig. 4.39** Answers of Polish VR users to the question. Are you concerned that you would be more susceptible to manipulation by software using artificial intelligence techniques, used in e-commerce, when shopping in Virtual Reality?



**Fig. 4.40** Answers of worldwide VR users—Are you concerned that you would be more susceptible to manipulation by software using artificial intelligence techniques, used in e-commerce, when shopping in Virtual Reality?

of immersing themselves in a virtual shopping environment, where intelligent algorithms will be able to take control of customer behaviour to some extent.

## Conclusions of the Research

In conclusion, the survey research conducted among Polish Virtual Reality headset users and the worldwide VR user population provided valuable insights. A summary of the results with the most important conclusions is presented below.

Analysing the population structure of the two groups of respondents, it is clear that the Polish population was much younger, but this does not seem to have had a significant impact on most of the results. Despite this age difference, respondents from both Poland and the global population shared similar perspectives on many aspects of Virtual Reality, as indicated by the calculated Pearson's correlation coefficient.

The surveys revealed a notable gender disparity among VR users, with a predominance of men. In Poland, women comprised only a small fraction of respondents, while in the global population, the proportion of women was slightly higher but still significantly outnumbered by men. This gender imbalance may be attributed to the prevalence of male-dominated gaming communities among VR users, as supported by statistics on video gamers.

The analysis of respondents' place of residence showed a relatively even distribution. In the global population, a slightly smaller percentage lived in rural areas and small towns compared to urban areas.

The surveys indicated that the majority of VR users were employed, which aligns with the high cost of VR equipment. Notably, Poland had a higher proportion of students among respondents, possibly due to the younger age profile of its VR users. In contrast, the global population had a significant percentage of pensioners, consistent with the broader age distribution observed.

The addition of a non-compulsory question on respondents' countries revealed that VR users were diverse and represented a wide range of countries. The United States, the United Kingdom, and Canada had the highest percentages of respondents, but a total of 26 countries were represented.

Both the Polish and global populations of VR users showed a minority with primary and vocational education. The majority of respondents in both populations had secondary education, with a higher proportion in

Poland. Tertiary education was prevalent in both populations, with a dominance of technical education, which is expected given the technical nature of VR. The global population had a slightly higher percentage of individuals with tertiary education, likely influenced by the younger age of VR users in Poland.

Both Polish and global VR users demonstrated a high frequency of online shopping, with the majority shopping several times a month. This high frequency of online shopping suggests that VR users are active participants in e-commerce, making them a suitable target audience for VR-based shopping experiences.

Oculus emerged as the dominant brand of VR goggles among both Polish and global respondents, with Meta Quest 2 being the most popular model. The prevalence of Oculus may be influenced by Facebook's ownership of the Oculus brand and its efforts to make VR more accessible through competitive pricing.

Users from both populations rated the immersion of VR goggles positively, with an average weighted rating exceeding 7.4 out of 10. This prominent level of immersion is a promising indicator for the potential use of VR headsets in e-commerce, as it suggests that users can feel fully engaged in virtual shopping environments.

VR users provided incredibly positive ratings for the quality of VR controllers, with an average weighted rating above 8 out of 10. VR controllers play a critical role in enabling users to interact with virtual environments, making them suitable for navigating and shopping in VR stores.

Users generally rated the image quality in VR goggles positively, although these ratings were slightly lower than those for immersion and controllers. The slight variation in ratings between Polish and global users may be due to differences in the availability of VR headset brands with varying image quality.

While VR controllers were the most common additional device, less than 5% of users in both populations owned more specialised VR devices, such as VR gloves, VR outfits, or cybershoes. These additional devices have the potential to enhance the shopping experience in VR environments by allowing users to interact with virtual products in a more tactile manner.

The diversity of VR headset brands and additional devices among global users reflects the broader range of options available in the global market. This diversity highlights the potential for various VR hardware configurations and e-commerce implementations to cater to a wide range of user needs.

The overwhelming majority of respondents, both Polish (99.1%) and worldwide (95.4%), primarily use VR goggles for gaming. This highlights that gaming is the dominant and most common use of VR headsets. While gaming is the primary use, a notable percentage of users also engage in other types of applications, such as educational, sports/fitness, and social applications. This demonstrates that VR headsets have the potential to serve various functional purposes beyond gaming. Surprisingly, none of the surveyed users indicated using VR goggles for shopping, which is consistent with the current lack of widespread adoption of virtual commerce (V-commerce). However, this is expected to change in the future as V-commerce solutions become more prevalent.

Users identified several advantages of using VR headsets, the most important of which is immersive gameplay that allows users to feel like they are in a game world. This reinforces the notion that games are the main driver of VR goggle adoption. A significant percentage of users also appreciate the ability of VR goggles to virtually transport them to places and situations that would otherwise be difficult to access, such as distant countries or outer space. This suggests that VR is also popular for immersive video experiences. VR headsets are viewed positively for their potential in sports and fitness applications, as well as in professional training and work-related activities.

Users reported several disadvantages associated with VR headset usage. The most common concern among worldwide users was the perception that VR could lead to the problem of not being able to control the passing of time, with 31.5% expressing this fear. In Poland, 26.8% shared the same concern. A significant portion of both Polish (50%) and worldwide (16.2%) users highlighted the risk of injury from hitting objects in the environment while using VR goggles. This discrepancy may be related to differences in living spaces, with smaller average living spaces in Poland potentially leading to a higher risk of collision.

Other concerns included motion sickness (26.2% worldwide, 16.1% Poland), fear of privacy invasion and data collection (18.5% worldwide, 17.9% Poland), and eye discomfort (13.8% worldwide, 13.4% Poland). Some users also noted concerns about children's safety in VR environments and the potential for VR to lead to addictive behaviours.

While the surveys did not reveal any current use of VR goggles for e-commerce, it is important to consider the potential barriers to adoption. Users expressed a need for convenience and a compelling advantage to overcome the effort required to use VR headsets for shopping. The relatively high level of discomfort, eye strain, and potential motion sickness associated with prolonged VR use may limit its suitability for extended shopping experiences.

The majority of VR users, both in Poland and worldwide, expressed an interest in shopping in virtual environments. However, most users indicated that they would use Virtual Reality shopping only occasionally. Approximately one in four respondents from both populations expressed a strong intention to use VR shopping frequently. A proportion of VR users remained sceptical about this new form of commerce, but the number of outright naysayers was relatively low.

VR users recognised the advantages of shopping in Virtual Reality, with the most prominent being the ability to view products in three dimensions and see them in their original environment. Seeing products in 3D and within their intended surroundings can enhance the shopping experience, especially for items like clothing and home decor. Despite the potential for immersive experiences, the ability to interact with a virtual assistant and touch products using VR gloves received lower enthusiasm, possibly due to limited user experience with these technologies. Notably, some users highlighted the potential for VR shopping to provide a more realistic demonstration of product usage and eliminate the inconvenience of browsing long lists of items in traditional online stores.

The majority of VR users did not perceive celebrity avatars (actors, sportsmen, musicians) in virtual stores as influential in their purchasing decisions. A significant portion of respondents even believed that celebrity avatars would negatively impact their purchasing decisions. This suggests that the use of celebrity avatars may not be a significant factor for most VR shoppers, though it remains a topic for future exploration.

VR users generally showed positive attitudes towards the effectiveness of recommendation systems using artificial intelligence techniques in Virtual Reality environments. While a slight majority believed these systems would be more effective, a considerable number remained undecided, particularly among worldwide users. This indicates that VR users see potential in AI-powered recommendation systems, but also have some reservations or uncertainties about their actual performance.

A substantial proportion of VR users expressed concerns about being more susceptible to manipulation by AI-powered software when shopping in Virtual Reality. Polish VR users were relatively less concerned about manipulation compared to their global counterparts, with fewer expressing strong concerns. Many worldwide VR users remained undecided, suggesting a need for further education and awareness regarding the potential risks of immersive virtual shopping experiences.

In summary, the survey results indicate that VR users are active online shoppers with a high level of immersion and satisfaction with their VR hardware. These findings suggest that Virtual Reality has enormous potential for enhancing the e-commerce experience, offering immersive virtual shopping environments where users can interact with products and make informed purchase decisions. However, ongoing advancements in VR technology and the availability of additional devices may further improve the suitability of VR for e-commerce applications, creating opportunities for retailers and consumers alike. The survey results indicate that VR users are generally open to the idea of shopping in Virtual Reality environments, recognising potential benefits such as viewing 3D products and immersive experiences. However, some respondents are sceptical about V-commerce, fearing, among other things, vulnerability to manipulation. The future of VR in e-commerce will certainly depend on the quality of VR shopping solutions as well as user education.

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# 5

## Augmented Reality in E-Commerce

The idea of Augmented Reality (AR) was first applied in mid-1980 by Jaron Lanier, who was the planner of VPL Research (Faisal, 2017). Many years have passed since then, but it is fair to say that the real technological development of Virtual Reality came with the spread of smartphones.

### 5.1 Augmented Reality Definition

Augmented Reality is a technology that overlays digital information onto the physical world, allowing users to interact with virtual objects or environments. In recent years, there has been increased interest in the use of AR in e-commerce to enhance the shopping experience for customers.

In Augmented Reality, virtual elements are seamlessly blended into a user's real-world experience (Rauschnabel et al., 2022). Augmented Reality can be defined as the dynamic, real-time view of a physical environment, either through a direct or indirect perspective, which is enriched through the overlay of digitally generated virtual data and information (Carmigniani & Furht, 2011). It can therefore be said that the

core of Augmented Reality is the combination of two types of view of the environment, real and digital.

Laghari et al. (2021) claim that in the future, companies will add AR features into mobile apps on their websites. In retail, this will result in applications that enable to dress or cover a user in various items of clothing, jewellery as well as sunglasses or makeup via the camera in the person's smartphone. Promoting AR will be found in interactions with different items, through gaming applications, and signs placed in environmental objects. The capacity of mobile phones to illuminate users regarding various environmental factors has been extremely enhanced over the last few years (Laghari et al., 2021). It can be concluded that Laghari et al. were right—it is already happening now.

## **5.2 Selected Areas Analysed in the Literature Regarding AR in E-Commerce**

Many studies about Augmented Reality in the e-commerce area can be found in the scientific literature. To check the popularity of research on AR, the author typed the search term “Augmented Reality” into Google Scholar and came up with around 2,560,000 publications. After refining to “Augmented Reality e-commerce”, the number of results dwindled to 40,900, indicating that e-commerce is not the primary application area for AR. The last thesis is confirmed by entering the keyword “Augmented Reality” in the Scopus search engine. The first five research fields with the highest number of AR-related publications are Computer Science (34,758), Engineering (20,037), Mathematics (8366), Computer Sciences (6655), and Medicine (4873). When refined to the keywords “Augmented Reality e-commerce”, the number of publications indexed in the Scopus search engine as of 11.11.2023 was just 259, of which only 74 were journal articles. It is noteworthy that more than 67% of these publications are from the last three years, demonstrating the rapidly growing interest in this field. Examples of studies

(the author has selected those with many quotations specifically related to e-commerce) with conclusions are presented below.

Yim et al. (2017) evaluated the effectiveness of Augmented Reality as an e-commerce tool using two solutions—sunglasses and watches. Results of this study indicated that AR-based product presentations are greater than traditional web-based presentations in the effect on media novelty, immersion, media enjoyment, usefulness, attitude towards medium as well as purchase intention. The model presented in this research confirmed that both interactivity and vividness generate diverse positive consumer evaluations through increased immersion. However, the part of immersion generated in new media, such as Augmented Reality, is associated with the novelty effects.

The overall perception and acceptance towards AR in marketing and retailing are discussed in Rese et al. (2017). Users' perceptions and experiences were measured by applying a modified technology acceptance model (TAM). To briefly summarise the results obtained in this publication, they are ambiguous and the relative importance of hedonic (pleasure, enjoyment, fun) and utilitarian (information) aspects changes for different types of AR applications (Rese et al., 2017).

Kowalczyk et al. (2021) developed a consumer response model and compared consumers' reactions in IKEA shop with AR and without AR. The results of this research revealed that AR outperforms web-based product presentations by generating greater immersion and enjoyment, whereas the opposite is true for media usefulness. The interesting results present those behavioural responses (such as reuse and purchase intention) are formed by affective (immersion, enjoyment, and product liking) as well as cognitive (media usefulness and choice confidence) responses to the Augmented Reality characteristics (interactivity, system quality, product informativeness, and reality congruence). Because the reuse intentions of AR apps result from enjoyment and usefulness, retailers are obliged to expand product informativeness as well as reality congruence to augment media usefulness and interactivity to increase enjoyment (Kowalczyk et al., 2021).

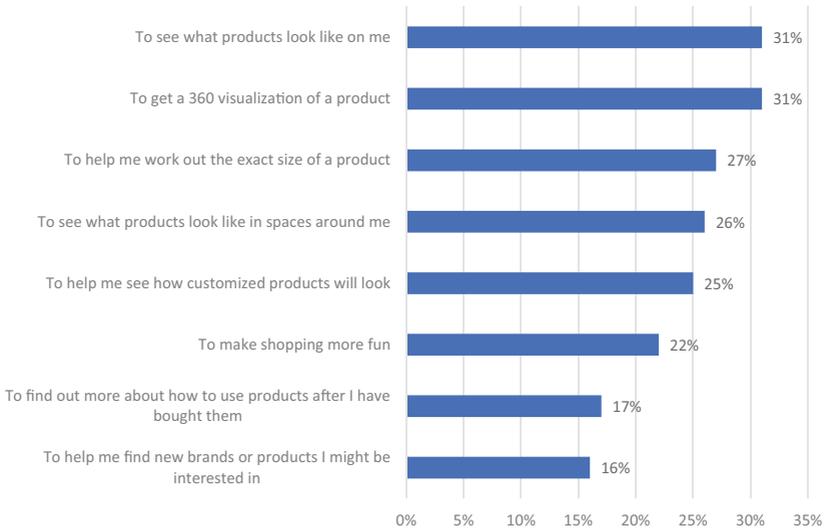
Riar et al. (2023) present a comprehensive review and synthesis of the applications and locales of Augmented Reality in retail settings, examining prevalent theories and technical aspects of AR, along with

its psychological and behavioural impacts. They discovered that AR's technological capabilities, such as interactivity, vividness, and informativeness, contribute to improved utilitarian and hedonic shopping experiences. These enhancements, in turn, increase the propensity of consumers to purchase products, re-engage with AR applications, and endorse these applications to others (Riar et al., 2023).

### 5.3 Advantages of Applying AR in E-Commerce

AR technology has become an essential tool in e-commerce, changing the way consumers interact with products. By combining digital elements with the real world, AR can improve the shopping experience, offering benefits for both businesses and consumers. However, the primary question to be asked in the context of implementation of AR in e-commerce is—what specific benefits can customers gain from a retailer offering AR. Figure 5.1 presents the results of a survey research in which customers were asked to answer the question: for which of the following reasons would you be interested in using AR while shopping online? The largest percentage of respondents (although it is less than one-third) answered that the benefit is to be able to see a 360 visualisation of a product and to see what products look like on me (<https://www.statista.com/statistics/1257605/reasons-global-online-shoppers-would-try-ar/>). Summarising these results, it can be concluded that a significant percentage of respondents perceive the benefits of richer visualisation of products through the use of Augmented Reality. Fu'Adi et al. (2021) claim that the advantages of AR implementation can be divided into two reasons: (1) the AR application in serving a better performance to customers, (2) the AR implementation to have a better relationship with customers. The more extended list of advantages of applying AR in e-commerce is presented below.

**Enhanced Product Visualisation:** One of the primary advantages of AR in e-commerce is its ability to provide customers with a realistic and three-dimensional view of products. AR applications allow users to superimpose virtual products into their physical environment,



**Fig. 5.1** Answers of respondents to the question: For which of the following reasons would you be interested in using AR (Augmented Reality) while shopping online? (Source <https://www.statista.com/statistics/1257605/reasons-global-online-shoppers-would-try-ar/>)

enabling them to visualise how the product would look and fit in a real surrounding. This enhanced visualisation reduces uncertainty and buyer hesitation, making it easier for customers to make more considered purchasing decisions (Alves & Luís Reis, 2020). This is confirmed by studies conducted by Dethe and Joy (2023) that many customers wish to see the product in their environment and also get a full 360-degree perspective of it.

**Virtual Try-On and Fitting:** In some industries such as fashion, beauty, and eyewear, AR offers an advantage through virtual try-on and fitting experiences. Customers can virtually “try on” clothing, accessories, and makeup, enabling them to judge how the products would look on their bodies or faces. This feature enhances convenience for shoppers and minimises the likelihood of returns, leading to increased customer satisfaction and reduced operational costs for e-commerce businesses (Kowalczyk et al., 2021). The implementation of AR shopping helps online retailers in offering their customers a more immersive

and convenient shopping experience through their devices (Garg et al., 2021).

**Improved Customer Engagement:** AR technology provides an interactive and engaging shopping experience that captures the attention of consumers. Interactive AR elements such as various games, quizzes, and virtual tours create a sense of excitement and interactivity, making the shopping process more enjoyable and memorable. Engaging customers through interesting AR features may lead to longer time spent browsing an e-shop, while interacting with products (Chandra & Kumar, 2018). This increased engagement fosters a stronger connection between the brand and the customer, enhancing brand loyalty.

**Reduced Purchase Uncertainty:** AR applications offer customers the opportunity to explore products in depth, decreasing the number of potential mismatches between online images and real-life products. With AR, consumers can evaluate product details, textures, and sizes, leading to increased confidence in their purchase decisions. This reduced uncertainty results in a more positive shopping experience and enhances trust in the brand (Kowalczyk et al., 2021). Specifically, AR can enhance the clarity of diagnosis and diminish the sense of distance, making distant objects seem nearer. Additionally, compared to traditional web-based e-commerce, it can decrease product ambiguity by augmenting the presentation of items through virtual showcases (Uhm et al., 2022).

**Innovative Marketing and Branding Opportunities:** AR in e-commerce presents innovative marketing opportunities for businesses to increase competitiveness. Retailers can create AR-powered campaigns, interactive advertisements, and branded AR filters to engage customers and increase brand visibility. AR-driven marketing initiatives offer a unique and memorable experience, helping businesses differentiate themselves and leave an impression on their target audience (Li et al., 2021). AR is employed in marketing communication to enhance brand experiences and efficiently boost engagement with digital campaigns (Kannaiah & Shanthi, 2015). Moreover, data derived from the use of AR techniques in marketing can provide valuable insights, potentially guiding also manufacturing strategies based on anticipated future customer requirements (Garg et al., 2021).

**Novelty Effect:** The advantages of AR are partially derived from how consumers view its novelty and distinctiveness, leading to a pronounced novelty effect. Considering that the novelty effect eventually fades, the long-term efficiency of AR-based product displays is thought to have limited impact in eliciting positive reviews from consumers (Yim et al., 2017).

Summing up, AR is able to improve the e-commerce, offering various advantages that may improve the shopping experience for both consumers and businesses. From enhanced product visualisation and virtual try-on to increased customer engagement and reduced purchase uncertainty, AR enables more immersive shopping. However, we need to be aware that the strongest effect is achieved among consumers for whom AR is a novelty, and thereafter this excitement effect is likely to wane. Also, positive consumer attitudes towards advertising using AR are fading over time (Hopp & Gangadharbatla, 2016) Therefore, AR needs to offer very tangible benefits to consumers so that it does not become just a technological gadget.

## 5.4 Disadvantages and Threats of Applying AR in E-Commerce

While Augmented Reality technology may improve the e-commerce with its immersive and interactive capabilities, it also presents certain disadvantages and challenges for businesses as well as consumers. As the adoption of AR in e-commerce continues to grow, it is essential to understand the potential drawbacks to make informed decisions about its implementation. The key disadvantages and threats of applying Augmented Reality in e-commerce are shown below.

**Implementing Cost:** Implementing AR in e-commerce often requires significant investment in software development. The cost of creating high-quality AR content, maintaining AR applications, and supporting compatible devices can be too high for some, especially smaller businesses. Additionally, AR technology requires skilled resources to design, develop, and integrate AR experiences, making it challenging for companies with limited technical know-how and lack of expertise in this area.

As this is a fairly new field, the number of off-the-shelf solutions available in this area is still small. An entrepreneur considering the adoption of AR for their online business should thoroughly evaluate the cost-benefit analysis of designing, executing, and providing AR solutions to their target consumers (Kannaiah & Shanthi, 2015).

**Adoption Barriers:** The novelty of AR in e-commerce may present a learning curve for some users, particularly those less technologically savvy or unfamiliar with AR technology. There are many theories in the literature regarding the acceptance of technology, including Technology-Organization-Environment (TOE) framework (DePietro et al., 1990), Technology Acceptance Model (Davis, 1989), or Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) which can be used to analyse AR adoption (Schuir & Teuteberg, 2021). The complexity of navigating AR interfaces and understanding how to interact with virtual products could discourage consumers from engaging with AR-enhanced shopping experiences. Convincing users to download AR applications or opt for AR features within the online store interface also may constitute a barrier, as some customers may be unwilling to accept the novelty.

**Quality Problems:** The image quality generated by AR applications often falls behind consumer expectations. The studies carried out in Indonesia indicate that the virtual try-on feature in Indonesian e-commerce, as it stands, does not align well with the desired standards of product informativeness, vividness, and system quality. Consequently, these three factors have yet to enhance performance (Gabriel et al., 2023). Also, according to the author, the quality of visualisation achieved in AR is significantly inferior to that achieved in Virtual Reality using a VR headset.

**Compatibility Issues and Device Limitations:** AR experiences depend on the capabilities of user devices, such as smartphones, smartwatches, and tablets. Older generation devices may not support AR functionality or may only be able to access part of the function. Moreover, the lack of standardised development tools can lead to compatibility problems.

**Privacy Concerns:** AR in e-commerce raises ethical considerations regarding the consumer's data privacy. AR applications often collect

extensive user data, such as location and photos of customer environment, to deliver personalised experiences. Ensuring an elevated level of security of consumer data as well as obtaining explicit user consent for data collection is essential to protect consumer privacy.

In summary, AR undoubtedly offers potential in transforming the e-commerce, but it is essential to consider its limitations and threats. The cost of implementation, technical constraints, user adoption barriers, privacy considerations, are among the primary disadvantages of AR in e-commerce. Addressing these challenges through well-considered development decisions, customer education, technological advancements, and privacy assurance is critical to enable the real potential of AR while providing a secure and attractive shopping experience for consumers.

## 5.5 Examples of AR Application in E-Commerce

One way that AR can be used in e-commerce is by allowing customers to visualise products in their own environment before the checkout process. An example can be a furniture retailer, which on applying AR creates a 3D model of a couch that customers can place in their living room using their smartphone or tablet. This allows customers to gauge the appearance of the couch in their space before finalising an order. AR can also be applied to provide enhanced product information to customers. For example, a clothing retailer can use AR to present customers how a particular outfit would look on them. Another method that Augmented Reality can be applied in e-commerce is the creation of interactive experiences that engage customers and build brand loyalty. An example can be a beauty retailer which uses AR to allow customers to virtually try on makeup and share their looks or photos on social media such as Facebook, Instagram, or Snapchat. An essential advantage of AR is that the augmented image can be created using a smartphone and dedicated software. Therefore, AR does not require from customer additional investment in hardware.

Tamer (2023) presents many examples of the use of AR in e-commerce. Based on this list, the classification of ten AR applications and examples of such uses are presented below.

### 1. Virtual Try-Ons with AR

With virtual try-on technology, customers can experience trying on clothes, glasses, makeup, and accessories in a virtual environment. This feature enhances the fitting process, leading to improved sizing accuracy and ultimately lowering return rates. Three examples of virtual try-ons with AR are presented below.

Example:

The renowned fashion brand, Michael Kors, became one of the pioneers in utilising Facebook's AR ads within the news feed. They were the first to explore this innovative feature, enabling Facebook users to easily try on a pair of Michael Kors sunglasses by clicking the "tap to try it on" button in the ads. This AR experience allowed users to superimpose the sunglasses on their faces virtually. Furthermore, the convenience did not end there, as users could directly purchase the sunglasses through the Facebook app, streamlining the shopping process (Williams, 2018).

The second example concerns M·A·C Cosmetics and virtual makeup within YouTube videos. YouTube's users who are followers of their beloved cosmetics brands had an opportunity to virtually try on the latest makeup offerings directly within the video platform. Leading the way in testing this novel AR functionality on YouTube was M·A·C Cosmetics. Viewers could experiment with various shades of M·A·C lipstick showcased in the videos, virtually trying them on. Once they found a shade they liked, they could conveniently click the SHOP button, redirecting them to M·A·C's website to make a purchase (Kwiecień, 2019).

ASOS, a prominent global online fashion retailer, introduced the trial of "See My Fit", an AR tool developed in collaboration with Israeli AR company Zeekit. This innovative tool provides customers with a simulated view of a product in various sizes and on different body types, aiming to enhance the online shopping experience. ASOS also launched

Fit Assistant, a feature that utilises machine learning to provide personalised sizing recommendations for its customers (<https://www.asosplc.com/news/asos-trials-see-my-fit-augmented-reality-tool/>).

## 2. 3D Product Previews with AR

With AR technology, customers gain the ability to examine products in 3D, rotate them, and zoom in to get a closer and more detailed view, empowering them to make well-informed and confident purchasing decisions. They can see what the products look like in their environment, such as their home.

Example:

The IKEA Place app offers users the capability to virtually position furniture items within their living space. This application includes an array of 3D products, such as sofas, lamps, rugs, and tables, all presented to scale, enabling customers to assess their suitability, design, and functionality within their room before making a purchase (<https://www.ikea.com/au/en/customer-service/mobile-apps/say-hej-to-ikea-place-pub1f8af050>).

WayFair, through the use of AR, provides customers with the opportunity to view virtual 3D representations of products within their real-life environment, presented at an accurate-to-life scale, utilising the technology readily available in their smartphones. Wayfair offers an extensive catalogue of over 18 million home-related items, catering to various customer needs. As a decision-making tool, AR is utilised by shoppers to make more informed choices and find the most suitable items for their homes. By employing AR, shoppers can visualise how a product will fit within their physical space and align with their personal style, ensuring they have all the necessary information to make confident and appropriate selections (Brewton, 2020).

## 3. In-Store Navigation with AR

Brick-and-mortar stores integrate Augmented Reality to assist customers in navigating through aisles and locating desired products

effortlessly. Through the use of AR technology, users can find products more easily using an app installed on their smartphone.

Example:

Lowe's In-Store Navigation app is a retail application that employs Augmented Reality technology for indoor mapping. Developed in collaboration with Google's Tango, this app aims to streamline the home improvement shopping process. Customers visiting Lowe's stores can utilise Tango-enabled smartphones to effortlessly search for products, compile a shopping list, and employ Augmented Reality to pinpoint the exact location of the desired products within the store (<https://corporate.lowes.com/newsroom/press-releases/lowes-introduces-store-navigation-using-augmented-reality-03-23-17>).

#### 4. Gamification of Shopping

AR has the capacity to generate captivating games and interactive encounters, elevating the shopping experience with an element of enjoyment and fostering customer loyalty. Adding gamified elements to the purchasing process, on the one hand, results in greater customer engagement, but also has the potential to increase the number of customers who will recommend a shop through WOM, pulling their friends into the game.

Example:

Alibaba's Tmall introduced a game called "Catch the Cat", reminiscent of the popular Pokemon GO, enabling consumers to earn exclusive promotions and prizes as they shop in the store. This gamification strategy not only increases brand loyalty and brand adherence, but also stimulates in-store traffic and encourages purchases in a fun and engaging way (Iskender, 2020).

#### 5. Virtual Showrooms and Product Customisation

Virtual showrooms allow customers to explore a wide array of products in a digital space, replicating the traditional in-store experience without the need for physical presence. Through AR technology, users can virtually place furniture, clothing, or other items within their living

spaces, enabling them to visualise how products would look and fit before making a purchase. Moreover, AR facilitates product customisation, allowing customers to personalise items according to their preferences and needs. From selecting colours and patterns to adding unique features, consumers can tailor products to align with their tastes. This level of interactivity and personalisation not only enhances the shopping experience but also fosters a stronger emotional connection between consumers and brands, ultimately driving customer satisfaction.

Example:

NIKELAND serves as a virtual shopping destination that empowers users to express their creativity and fashion sense by engaging in apparel design. Users have the opportunity to create personalised avatars and dress them in a wide range of Nike shoes, clothing, and accessories from the digital showroom. In cases where the selected products are not physically available in-store, they remain accessible through the online platform (<https://www.iqiglobal.com/blog/nikes-metaverse-shop/>).

## 6. Remote Assistance

By using their smartphones or tablets, customers can interact with the application and collaborate with the support team, visually identifying and resolving issues in a seamless and efficient manner. This AR-enabled remote support not only streamlines problem-solving but also enhances customer satisfaction by providing personalised and immediate assistance, ultimately improving the overall e-commerce experience.

Example:

Vuforia Chalk is an innovative app that leverages AR to enhance remote support in e-commerce. This innovative application empowers customer service representatives to deliver real-time, visual assistance to customers, regardless of their physical location (<https://www.inneo.co.uk/en/digital-reality/ar-vr/vuforia-chalk.html>).

## 7. Marketing Campaigns Enhanced with AR

AR technology offers marketers the opportunity to create highly interactive marketing campaigns. By integrating Augmented Reality into

e-commerce campaigns, marketers can present products and services captivatingly, drawing audiences in with unique visuals. Customers can virtually try on clothes, experience how furniture fits into their living space or interact with products in ways that were previously unfeasible. This combination of real and digital experiences not only captures consumers' attention, but also fosters deeper brand engagement and emotional connection, making AR a helpful marketing tool (Sing, 2023).

Example:

Pepsi developed AR software that allowed customers to engage with a virtual vending machine, offering an interactive opportunity to win prizes.

BMW introduced AR experience that enabled customers to virtually explore their iNEXT electric vehicle concept (Sing, 2023).

## 8. Social Media Integration

AR can be integrated into a variety of social media platforms, allowing customers to share immersive virtual fitting rooms and product experiences with their network of friends and followers. This interactive sharing not only increases brand visibility, but also boosts engagement among users, creating an increase in interest and curiosity around the products on display. As AR-based content goes viral, this opens up new opportunities for companies to connect with a wider audience and increase brand advocacy through the power of social media.

Example:

On Instagram, renowned brands like Ray-Ban and Gucci effectively utilise AR filters, providing customers with an exciting opportunity to virtually try on their products and share their delightful experiences directly on the platform (Tamer, 2023). By incorporating these interactive AR filters, brands can engage their target audiences more, encouraging user-generated content that increases brand exposure. This approach increases the interest and desirability of featured products in the vast Instagram community.

## 9. Interactive Product Labels

Augmented Reality labels are stickers affixed to various products, offering additional value propositions to consumers. By utilising a smartphone camera to scan these visuals, users can access a comprehensive representation of the brand or item being sold. The AR label can redirect users to images, animations, videos, and even interactive games.

What sets AR labels apart is their variety of applications. These labels can be triggered by different elements, such as full images, objects, or QR codes. This flexibility allows companies to use creativity in incorporating AR elements. By innovatively designing unusual labels, brands can increase customer engagement in a variety of ways.

In a competitive market, brands are increasingly focusing on ways to attract and convert potential customers. While visually appealing websites are essential, the ability to attract immediate attention is equally important. Augmented Reality labelling provides an excellent method of achieving this. Fedko (2022) delves into the various uses and benefits of Augmented Reality labelling for businesses looking to improve their marketing strategies and increase customer engagement. The use of AR labelling technology offers many opportunities to differentiate any brand. From traditional brand storytelling to location-based labelling, AR is a powerful tool that businesses can use to stay ahead of the market.

Example:

Pure Origin Coffee: Pure Origin recently launched an Augmented Reality campaign to share grower testimonials. Through innovative packaging, the company is able to incorporate video testimonials from partners, allowing them to tell the story of their lives and working conditions. This AR experience aims to provide customers with a deeper understanding of the impact of purchasing Pure Origin coffee on the lives of these growers. Using a smartphone camera, customers can easily access the AR content by scanning a provided QR code. From there, a pop-up will direct to the relevant webpage or app, enabling to follow the instructions to fully immerse in the AR experience. At Pure Origin, the utilisation of AR has facilitated meaningful communication with coffee growers worldwide, providing a platform for their voices to be heard across continents. Applying AR in Pure Origin has allowed for greater publicity of the mission to create a positive impact on communities and support vital causes across the globe (Zytveld, 2022).

## 10. Inventory Management with AR

AR is also becoming a tool to aid inventory management, offering retailers support in maintaining optimal stock levels and streamlining the replenishment process. Using AR technology, retailers can access real-time information on stock levels, facilitating accurate and timely stock tracking. This real-time visibility ensures that retailers can quickly identify low stock levels and potential shortages, enabling timely replenishment and preventing out-of-stock situations. What's more, AR enables shop staff to efficiently navigate inventory, locating products with ease and reducing the time it takes to replenish stock. Integrating AR with inventory management not only improves operational efficiency, but also enhances customer satisfaction by increasing the availability of desired products.

Example:

Utilising an advanced Scandit AR Scanner, the implementation of smart data capture technology in retail settings empowers both retail workers and consumers to benefit from enhanced stock management within the store environment. With the AR Scanner, retail workers gain real-time access to comprehensive stock information, enabling them to efficiently review and manage inventory levels with improved accuracy. This sophisticated integration of AR and smart data capture in retail showcases the potential for data-driven insights to optimise stock control and elevate customer satisfaction (<https://www.scandit.com/products/augmented-reality/>).

## 5.6 New Trends in AR

The following section presents five selected areas of AR application that the author believes will develop dynamically in the coming years.

**Extended Reality (XR) Integration:** The integration of AR and VR may become an important new trend in e-commerce. XR encompasses not only Augmented Reality but also Virtual Reality (Xi et al., 2023). As multisensory technologies and methods evolve, along with a deeper understanding of AR and VR, there is a shared belief that any sensory

experience can be digitally enhanced (Harley et al., 2018). By combining these technologies, e-commerce platforms can offer immersive experiences to their customers, enabling them to visualise products in their real environments with AR and even engage in a fully simulated multisensory environment with VR.

**AR-Powered Social Shopping:** Customers will be able to shop with friends and family members in real time using AR. The use of AR functionalities in social commerce offers an opportunity to enhance the shopping experience. Particularly in live-streaming shopping (Sun et al., 2019), there is the potential to use, some of the AR facilities, such as the streamer giving QR codes allowing the user to try on recommended clothes or cosmetics. Currently, companies in some sectors, mainly beauty and clothing, are offering AR filters, effects, and games on social media platforms to offer customers immersive experiences, enabling them to virtually try on products and share their experiences with friends and followers. This trend is expected to spread to other industries and will not only drive engagement but also facilitates word-of-mouth marketing, increasing the reach of e-commerce brands.

**AR for Other Devices such as Smart Glasses or Smartwatches:** The application of AR is not limited only to smartphones or tablets. Recent advancements in wearable technology, such as smart glasses (Koutromanos & Kazakou, 2023), and smartwatches, seem to be the next step in AR application in e-commerce. These devices, owing to their inherent wearability and constant proximity to the user, offer opportunities for instantaneous and hands-free shopping interactions. For instance, smart glasses can overlay virtual information about a product directly onto a user's field of vision, enhancing real-world environments with additional digital data. Similarly, smartwatches, with their tactile interfaces or voice interfaces, can potentially facilitate seamless AR-enhanced browsing. Such integrations can possibly enhance the way consumers communicate with e-commerce platforms. As research in this domain intensifies, it is necessary for e-commerce businesses to recognise the potential of these wearable devices and adapt their AR strategies accordingly.

**AR for Enhanced Product Personalisation Integrated with the Production Process:** To provide tailor-made experiences, AR is emerging as a powerful tool for product personalisation. Through AR-based

product customisation, customers can modify product attributes, such as colour, size, or design, in real time, allowing them to create personalised items that align perfectly with their preferences. The next step seems to be able to communicate the details of a personalised product for production through the sales platform. Of course, solutions such as the integration of the sales platform into the production process have already existed for many years, popularised by Dell for example (Bakos, 2001), but the use of AR in this process seems to be a solution that will become increasingly popular in the near future.

**AR for Education and Corporate Social Responsibility (SCR):** E-commerce platforms are increasingly utilising AR to enhance product education and showcase the intricate details of complex products. With AR-powered visualisations, customers can explore products in depth, rotate them, and access interactive information overlays, enriching their understanding of the products' features and functionalities. However, it is not only practical information on the functionality of products that can be conveyed using AR. AR can facilitate informed consumer choices by overlaying products with data on ethical sourcing, sustainability, or social impact, directly aligning with CSR goals.

AR will evolve in the coming years, and it is difficult to determine exactly what new e-commerce applications will emerge for this technology. The areas identified above have great potential for development, but whether they will actually gain ground will be shown in the coming years.

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# 6

## Social Commerce

Social commerce refers to the integration of social media and e-commerce, creating a synergistic platform that changes the way consumers and businesses interact and transact. Social commerce has gained popularity in recent years due to the ever-growing global presence of social media platforms and changing consumer behaviour.

### 6.1 Social Commerce Definition

Social commerce generally means social media initiated, or -mediated e-commerce (Han & Kim, 2016). In the literature we can meet some similar terms as social e-commerce, social commerce, social media commerce, F-commerce. In this book, the author uses social e-commerce and social commerce as synonyms. Social media commerce has also similar meaning, but usually, it refers only to e-commerce fully accomplished on social media platforms (Han & Kim, 2016). In a study conducted by Suraworachet et al. (2012), the term “F-commerce” (Facebook commerce) or “social media commerce” was employed to describe an e-commerce practice that enables users to make purchases of goods

directly on Facebook or other social media platforms. The origins of the spread of the concept of social e-commerce go back to the time when traditional e-commerce platforms such as Amazon incorporated social media elements, such as word-of-mouth and networking features, into their websites (Liang & Turban, 2011). Bürklin et al. (2019) identified two points in time: 2005 when Yahoo introduced social commerce and 2009 when Groupon initiated the social commerce business model as key milestones in the development of social commerce.

While the potential to enhance the efficiency and effectiveness of marketing-related processes through digital media is evident (Krings et al., 2021), there remains a crucial need for a comprehensive framework that guides the selection, utilisation, and integration of social media within marketing strategies.

## 6.2 User-Generated Content Drives Purchasing Decisions

One of the key drivers behind the success of social commerce is the power of social proof (Talib & Saat, 2017) and peer influence (Yan et al., 2023). Users on social media platforms such as: Meta/Facebook, Instagram, Twitter, YouTube, or TikTok often share their shopping experiences, product reviews, and recommendations, which can significantly impact the purchasing decisions of others. As people tend to trust recommendations from people they know or follow, social commerce leverages this social influence to create a sense of authenticity and credibility, enhancing the overall shopping experience.

User-generated content (UGC) has emerged as a potent force in shaping modern purchasing behaviour, and its impact has been significantly amplified by the rise of social media platforms. The advent of social media has changed the way consumers interact with brands and make purchasing decisions, going beyond traditional marketing strategies and directly engaging potential buyers through UGC. UGC encompasses various forms, including user ratings, product reviews (Lopez-Nicolas & Molina-Castillo, 2008), testimonials, images, videos, and social media posts, all generated by everyday consumers sharing

their authentic experiences and opinions. E-WOM (Electronic Word of Mouth), which is an element of UGC, has the positive influence of customers' participation for generating loyalty and finally leading into changing of e-shopping behaviour of consumers (Yoo et al., 2013).

In the field of e-commerce, social media has become a dynamic channel for the dissemination of UGC, as users freely share their thoughts, recommendations, and product-related content with a wide online audience. This shift in consumer behaviour has led to a notable change in the purchasing process, with potential buyers now placing significant trust in their friends' experiences and recommendations, rather than relying solely on a brand's marketing efforts.

The impact of UGC on purchasing decisions is multifaceted. Firstly, social media provides an accessible platform for consumers to express their opinions, enabling real-time feedback and reviews that others can access instantly. This transparency increases consumer trust and fosters a sense of credibility.

Secondly, the interactive nature of social media allows users to directly contact UGC creators for additional information or personalised recommendations. This two-way communication fosters a deeper connection between brands and consumers, enabling companies to quickly address concerns and establish stronger relationships with their audiences.

What's more, UGC humanises the shopping experience because it comes from authentic individuals rather than faceless corporate entities. This human touch resonates with consumers on an emotional level, influencing their purchasing behaviour.

User-generated content provides an important source of data to aid in understanding customer needs. Different text mining techniques, such as semantic and sentiment analysis, enable to extract significant information embedded in UGC (Li et al., 2022). With the development of Natural Language Processing (NLP), UGC analysis has step by step replaced consumer surveys as the main method to understand consumer needs, influencing the improvement of products and services (Qi et al., 2016).

For e-commerce businesses, effective use of UGC can bring significant benefits. By encouraging the use of UGC, brands can build a loyal community of engaged customers who become brand advocates,

extending their reach to new potential buyers by sharing interesting content. Social media platforms act as an ecosystem for the proliferation of UGC, enabling companies to reach a wider audience and effectively reach niche markets.

From a business perspective, it is crucial how to get customers to generate brand-friendly content. There are some motivating factors distinguished in literature as expression of personal identity, need for interaction with other consumers, intentions to share brand or company related information, and entertaining oneself (Daugherty et al., 2008).

The use of UGC also presents challenges for e-commerce businesses, such as managing negative reviews and comments, it is also extremely important to maintain authenticity. Brands need to strike a delicate balance between promoting positive UGC and responding constructively to any negative reviews and comments, thereby demonstrating transparency and a commitment to honest communication with customers.

In summary, the popularity of social media has transformed customer purchasing behaviour through the influential role of UGC. Consumers now rely heavily on authentic experiences and opinions shared by their peers on social media platforms, making UGC a driving force in shaping purchasing decisions. Strategically integrating UGC into marketing efforts has great potential to build brand trust, loyalty and ultimately drive e-commerce success.

### **6.3 The Role of Social Media Influencers in E-Commerce**

Social media influencers (SMIs) play a significant role in e-commerce, complementing the influence of user-generated content on purchasing decisions. Social media influencers can be defined as individuals who have amassed a considerable number of followers on platforms such as Instagram, YouTube, TikTok, and others and have the ability to influence the opinions and behaviour of their followers. Their authenticity, relatability, and experience in niche areas make them highly influential in promoting products and services to an engaged audience.

SIMs create a mix of sponsored content, i.e., commercial content, and non-commercial content on social media platforms. Both types of content have the potential to influence the behaviour of social media audiences. Sponsored content from SIMs often takes the form of product reviews, wherein the influencer creates and shares posts endorsing the product through their channels such as Instagram, YouTube, TikTok, blogs, or Twitter, in return for compensation from the brand sponsor (Stubb & Colliander, 2019).

In the e-commerce sphere, social media influencers bridge the gap between brands and consumers by serving as trusted intermediaries. Their partnerships with brands and authentic promotion of products through sponsored posts, reviews, and recommendations create a powerful form of UGC that impacts followers. As influencers showcase products in real-life scenarios or offer personal recommendations, they humanise the shopping experience, making it more appealing to potential buyers. Another reason to use influencers in e-commerce marketing is the lower cost of advertising on an influencer on social media than on media in conventional marketing channels, which makes e-shops interested in advertising in such a way (Halim, & Karami, 2020).

There are many SIMs rankings on the internet. An example will be quoted here, more to show the scale of their popularity than their exact reach, which changes dynamically. An example of an influencer with quite spectacular popularity is Jimmy Donaldson, known as MrBeast, with over 138 million subscribers on YouTube, and over 78 million followers on TikTok (Mitchell, 2023). The top three social media influencers overall (by total followers on Instagram, Facebook, and Twitter) are the following: (1) Cristiano Ronaldo, Portuguese football player, 787 million followers; (2) Leo Messi, Argentinian football player, 530 million followers; (3) Selena Gomez, American actor/musician, 499 million followers (Frederick, 2023). What is interesting that Cristiano Ronaldo, the leader of the mentioned ranking has “only” four million subscribers on YouTube on his official channel (<https://www.youtube.com/@CristianoRonaldoYouTube>). It can therefore be seen that influencers sometimes focus on selected social media channels, treating others as less important. In any case, the given follower numbers testifying to the reach of influencers are very impressive and show that their role in

shaping consumer behaviour is huge. It is worth noting that it is not only global celebrities with a reach of hundreds of millions of users, but also hundreds of thousands of influencers with slightly less global popularity, often specialising in niche industries, who have a significant impact on consumer purchasing decisions. SMIs can reach highly targeted audiences, often aligning with specific demographics or interests. This level of precision targeting allows brands to access niche markets that can be difficult to reach through traditional advertising methods. By leveraging influencers' established relationships with their followers, brands can leverage pre-existing trust and credibility, giving their products a competitive advantage.

## Selection of Influencers

As the internet is now saturated with an enormous number of influencers, including celebrities, athletes, musicians, and more, it becomes imperative to identify the right group of influencers. In this crowded world of social media, identifying the most relevant influencers becomes essential to effectively reach and engage target audiences (Gillin, 2008). Nevertheless, calculating the influencer impact index is a complex undertaking, necessitating the evaluation of numerous data points sourced from diverse channels. Furthermore, social media data lacks a structured format, adding to the complexity of the process. Traditional statistical measures, commonly employed by researchers, may not adequately capture the complexities of the system. As a result, researchers resort to employing various machine learning regression models, such as Ordinary Least Squares (OLS), K-Nearest Neighbours (KNN), Support Vector Machines (SVM), and Lasso Regression, to assess the impact of different celebrities on various social media platforms. These various techniques offer more robust and flexible approaches to analyse the influence of celebrities in the dynamic and multifaceted world of social media applications (Arora et al., 2019).

Therefore, it is crucial for brands to carefully select influencers whose values align with their own and whose followers represent their target audience. It is important to remember that authenticity is paramount in

influencer marketing, and any perceived lack of authenticity can negatively impact both the influencer's reputation and brand image. The originality and unique personality of the influencer, attracting users, is also extremely important. With a well-planned and well-considered scenario, the quality of the content presented can be enhanced. Users greatly appreciate a brilliant sense of humour and acting skills, as well as expert knowledge, in the case of expert influencers.

Influencer marketing enhances brand visibility and awareness, especially among younger consumers (Dehghani et al., 2016). As social media users spend considerable time engaging with influencer content, they become familiar with brands and products endorsed by these influencers. This heightened exposure can lead to increased brand recognition and customer recall, influencing purchasing behaviour when the time comes to make buying decisions.

## Virtual Influencers

Several brands have begun to experiment with virtual influencers. With advancements in computing capabilities and AI algorithms expected in the near future, it is anticipated a surge in the prominence of virtual influencers on social media platforms. These digital personalities will consistently embody and promote brand values, interacting with followers at any given time (Appel et al., 2020).

One spectacular example of a virtual influencer is the Aitana—25 years old AI-generated model created by Spanish agency. This virtual influencer, whose popularity is growing all the time, generates monthly revenues of \$11,000 (Hogg, 2023). As of 30 November 2023, this AI-model had 176,000 followers on Instagram. This figure seems to confirm the marketing effectiveness of AI influencers. However, it is important to note that as the number of such AI-posters increases, the element of initial novelty delight will fade and the same values as for human influencers will start to count, i.e., originality, an interesting and unique message, and a brilliant sense of humour. What will definitely be missing, however, is authenticity, which is still an exclusively human attribute.

Summing up, SMIs wield a substantial impact on e-commerce. Their ability to connect with niche audiences, offer recommendations, and humanise the shopping experience makes influencer marketing a valuable and increasingly prevalent strategy for companies. When executed thoughtfully and in alignment with brand values and in accordance with ethics, influencer marketing holds significant potential for driving sales, increasing brand loyalty, and further propelling the digital transformation of the e-commerce industry.

## 6.4 E-Commerce on Social Media Platforms

E-commerce on social media platforms is changing the way people buy products, transforming traditional online shopping, which was previously an individual activity (with few exceptions such as group buying), into a more social activity, with more interaction with other social media users. Social media platforms, such as Facebook, Instagram, Pinterest, and TikTok have evolved beyond their original roles as communication tools to become robust e-commerce marketplaces, where users can discover, explore, and purchase products in some cases without leaving the platform. Brands and businesses can set up their online stores directly on social media pages, showcasing products with high-quality images and engaging content.

Examples of shopping on social media platforms abound. Instagram, for instance, offers the “Shoppable Posts” feature, enabling businesses to tag their products in posts and stories, allowing users to tap on the tags and be redirected to a product page for easy purchasing. Facebook also facilitates e-commerce through the Facebook Shops (<https://www.facebook.com/business/shops>), enabling businesses to create an online store within their Facebook page. Users can browse products, make purchases, and even contact sellers directly through Messenger. Considering Facebook shops, the full checkout feature on the Meta platform is only available for users in the United States of America. Thus, it is not yet accessible for use in other countries, but it will probably be available in the future. Now the user can browse through product catalogues, read reviews, and access relevant information without the need to navigate

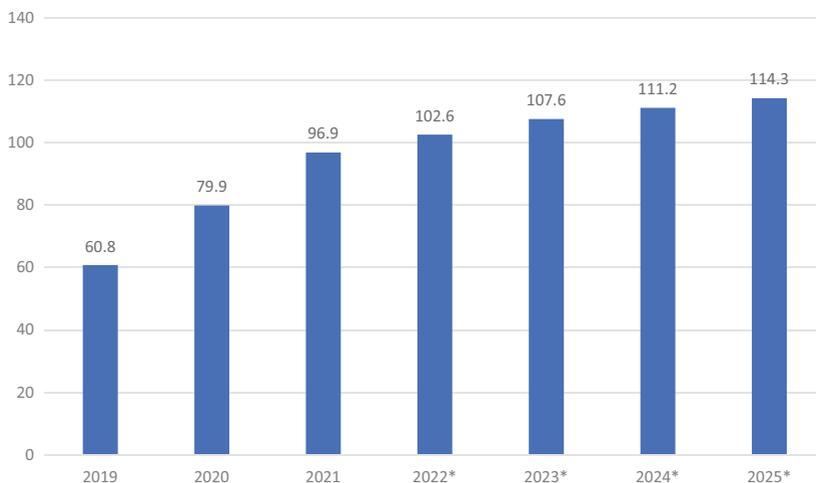
away from their preferred social media app. After choosing the product, the customer should click on the link that leads to the e-commerce platform to complete the transaction. This situation is likely to change, as Facebook, like any commercial enterprise, will aim to keep users on its platforms by additionally charging a commission on transactions made on its platform.

TikTok Shop allows brands to exhibit and sell products directly to the TikTok community for discovery and purchase. The entire shopping experience takes place within the app, eliminating the need for redirection to external shopping apps or websites, thereby resulting in increased conversion rates and sales (<https://shop.tiktok.com/business/en>).

Pinterest also allows presenting a shopping offer to customers. Product Pins showcase items that can be purchased from the merchants mentioned in the Pins. Clicking on them takes users to the retailer's website. The primary purpose of Product Pins is to connect shoppers on Pinterest with products they may be interested in buying. These pins are enhanced with relevant metadata and formatting, making it clear to Pinterest users that they are clickable and available for purchase. They include essential information such as pricing details, product availability, as well as the product title and description (<https://help.pinterest.com/en/business/article/shopping-on-pinterest>).

Figure 6.1 presents the number of social commerce buyers in the United States. Social buyers are defined as social network users, who have made at least one purchase via any social channel, including links and transactions on the platform itself, during the calendar year, including online, mobile as well as tablet purchases. As it can be seen, the greatest growth was observed during Covid-19 time. The forecasts (from 2022 to 2025) presented for the coming years assume less growth in the number of buyers.

Shopping on social platforms has many advantages for users, who can view and engage with user-generated content, product recommendations, and reviews from other customers. One of the significant benefits of shopping on social media platforms is the power of social proof (Talib & Saat, 2017). Roethke et al. (2020) claim that while social proof diminishes the effect of monetary-based reciprocity, it intensifies the effect of utility-based reciprocity. This social influence can significantly



**Fig. 6.1** Number of social commerce buyers in the United States from 2019 to 2025 in millions (Source <https://www.insiderintelligence.com/chart/257842/us-social-commerce-buyers-2019-2025-millions-change-of-us-social-network-users>)

impact purchasing decisions, as individuals tend to trust the opinions and experiences of people they know or follow-on social media.

The integration of personalised advertising with social media platforms is an immensely powerful marketing tool for companies (Wirtz et al., 2017). Businesses can deliver tailor-made advertisements, product recommendations, and promotional offers, ensuring that users are presented with products that precisely align with their interests and preferences. These dedicated customer ads appear in an environment that inspires trust, among social media messages from friends and family. Such an environment can subconsciously increase trust in the brands and products presented.

It is also worth mentioning that social commerce has opened new opportunities for small and medium-sized businesses to reach a broader audience and compete with global brands. Social media platforms offer affordable advertising options, allowing businesses of all sizes to promote their products and connect with potential customers worldwide. This leads to a more diverse and dynamic marketplace, which is always beneficial to consumers.

However, shopping on social media platforms also comes with certain disadvantages. One major concern is the potential lack of security and privacy in handling personal information and payment details. Low barriers to entry and an extremely high number of retailers can be an incentive for potential fraudsters. Therefore, consumers should be cautious while providing sensitive data and ensure that they are dealing with reputable and secure sellers.

Moreover, the ease of impulse buying on social media platforms can lead to overspending and hasty purchasing decisions. The constant exposure to visually appealing products and seamless checkout processes may encourage impulsive buying behaviours, which could result in regrets or dissatisfaction with the purchased items. As aforementioned, elements such as social proof and the appearance of adverts surrounded by posts from friends and family can induce buying impulses.

In summary, e-commerce on social media platforms is transforming the way people shop. Convenience, social influence, and personalised shopping experiences make it an attractive opportunity for both customers and businesses. However, customers need to be cautious about privacy and security, and be mindful of impulsive buying tendencies. As social media platforms begin to extend their functionality to include e-commerce elements, the future of trade on these platforms offers promising opportunities to further enhance the online shopping experience.

## 6.5 The Future of Social Commerce

Social commerce has huge potential for growth as customers spend a considerable amount of time on social media. Various innovative developments in social commerce are expected to emerge. The following areas containing potential developments, but also threats can, in the author's opinion, significantly influence the shape and development of social commerce.

**Enhanced personalisation.** Social commerce is likely to focus on delivering even more personalised products advertisements. In each

subsequent year, the amount of information held by social media platforms on users, especially the highly active ones, will increase. Advanced machine learning algorithms will be trained on more data, so their effectiveness will increase, resulting in gaining more in-depth insights into individual preferences, behaviour, and purchase history. Xue et al. (2020) have shown that live interactions in social media, which include among others personalisation, responsiveness, and entertainment, positively affect perceived usefulness as well as negatively impact perceived risk and psychological distance, increasing social commerce engagement. This higher level of personalisation will not only improve user engagement but also will help in increasing conversion rates.

**Social VR and AR experiences.** As Virtual Reality and Augmented Reality technologies advance, social commerce is anticipated to incorporate immersive shopping experiences. Of particular importance may be the development of Virtual Reality functionality on the Meta platform. Mark Zuckerberg's huge investment in Oculus has resulted in a clear revival of the VR industry. Then Meta spent a total of \$10.2 billion in 2021 on Reality Labs (Bezmalinovic, 2022) so further efforts driving social media platforms towards Virtual Reality can be expected. Virtual storefronts, virtual try-on features, and AR product visualisation will allow consumers to interact with products in a more lifelike manner, bridging the gap between online and in-store shopping.

**Social commerce in livestreaming.** The integration of live commerce into social media platforms is becoming more popular, especially live-stream shopping have been adopted by many small sellers as a direct selling tool (Wongkitrungrueng & Assarut, 2020). Live-streaming shopping events, where influencers or brands showcase products in real-time and interact with viewers, have gained popularity in recent years. The future will see further innovations in this area, enabling additional functionalities such as trying on products using AR technology or live interaction with avatars of other users participating in the livestream using VR headsets. Doubtless some of the livestreaming will be done by avatars in the future due to the lower cost and the lack of time constraints—a virtual influencer can stream 24 hours a day.

**Social commerce on niche platforms.** While major social media platforms as Facebook, Instagram, TikTok, Pinterest dominate the

current social commerce landscape, according to the author, niche and specialised platforms are expected to emerge. Examples include social networks for specific interest groups, such as the portal for art lovers, sector-specific thematic portals, e.g., the portal for doctors or scientists. These platforms will cater to specific interests, demographics, or industries, providing companies with opportunities to reach highly targeted audiences.

**Social commerce and social responsibility.** Consumers are increasingly conscious of social and environmental issues. Future social commerce businesses are likely to emphasise ethical and sustainable practices. Brands that will integrate social responsibility into their strategies may gain a competitive advantage, appealing to socially conscious consumers. Puwirat and Tripopsakul (2019) in their research have shown the positive impact of the digital social responsibility activities on the customer trust as well as brand equity concerning social commerce environment.

**Instant messaging integration.** One of the prospective directions for the evolution of social commerce lies in merging instant messaging and social media platforms with robust shopping functionalities. This strategic fusion, as exemplified by the Chinese platform, WeChat, represents a promising opportunity for e-commerce development. Cao et al. (2021) have shown that instant messaging enables a more reachable, cost-reducing, and immersive user shopping experience. It also influences the decision-making process of shoppers based on established social connections, mutual confidence, common identity, and community standards. Additionally, it fosters unique social engagements that can lead to the development of new connections while preserving existing social bonds (Cao et al., 2021). By affording users a holistic environment that merges social communication and transactional capabilities, instant messaging integration creates a more interactive marketplace.

**Resentment due to excessive advertising on social media platforms:** the increasing number of advertisements on social media sites, the constant tracking of consumer behaviour can lead to reluctance to use social media platforms, or the use of ad-blocking tools (such as the AdBlock software). It is important to remember that the primary purpose of using social networks is to connect and interact with friends.

Therefore, intrusive advertising soliciting the purchase of products and services may cause customers of these sites, who are particularly sensitive to excessive commercialism, to stop using them.

**The risk of incapacitating users through the use of sophisticated persuasion algorithms.** Increasing knowledge of user behaviour and mechanisms for influencing user behaviour pose the threat of taking control of the user using several types of persuasive mechanisms (McNamee, 2020). This threat is particularly relevant in the context of social commerce, where the user can lose not only time but also money. Companies which advertise on social media platforms often exploit the psychological fear of missing out (Abel et al., 2016) by creating a sense of scarcity around certain products or time-limited offers. Marketers use urgency and time-limited promotions to induce a fear of regret and drive immediate purchases (Hmurovic et al., 2023). Consequently, users may be inclined to buy products impulsively, fearing they might lose out on a perceived opportunity, even if the product does not fulfil a genuine requirement. There is also the problem of peer influence and social comparison (Hu et al., 2019). Social media brings an environment of constant comparison, where users are exposed to versions of others' lives and possessions presented in pictures and videos. This constant exposure to idealised lifestyles can lead to feelings of inadequacy and a desire to keep up with peers, leading individuals to make unnecessary purchases (impulse buying) in an attempt to attain a similar lifestyle (Van Tran et al., 2022). Social media users need to be aware of these tactics and exercise mindfulness when making purchasing decisions. Responsible advertising practices and consumer education are essential to mitigate the threats posed by persuasion mechanisms, ensuring that customers make informed choices and prioritise genuine needs over impulsive desires. As social media continues to shape consumer behaviour, striking a balance between efficient marketing and protecting consumers from being incapacitated by persuasion techniques remains a critical challenge for both platforms and advertisers alike.

Social commerce is an interesting combination of social media and e-commerce. With its ability to harness the power of social influence, delivering personalised experiences, social commerce continues to transform retail as well as digital marketing. Despite the aforementioned risks,

it is the author's opinion that social commerce will grow rapidly in the coming years. Companies that can skilfully implement social commerce into their distribution channels will have the chance to achieve a competitive advantage in the market. However, in the development of social commerce, it is important that companies act ethically and do not abuse methods of persuasion for economic gain.

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# 7

## Artificial Intelligence in E-Commerce

Interest in artificial intelligence (AI) has become overwhelming in recent years, thanks to large language models including ChatGPT. Investment in artificial intelligence applications has skyrocketed. It is predicted that by 2030, around 70% of companies will be using AI (Bughin et al., 2018). The exponential growth of interest in AI in e-commerce can also be seen in academic research—for example, Bawack et al. (2022) analysed bibliometric data from 4335 papers on AI in e-commerce issues. The rapid development of AI solutions in recent years has led to even greater interest in this field among both researchers and business practitioners. A detailed discussion of all areas of AI use in e-commerce would require a paper the size of the Encyclopaedia Britannica, so only a few areas have been selected for this book, indicating their particular relevance to the development of e-commerce. Before going on to analyse the areas of application of artificial intelligence, it will be presented how AI is defined.

## 7.1 Artificial Intelligence Definition

The term artificial intelligence was initially used in the context of human intelligence being supported by machines (Isaacson, 2014). In the second approach, often found in science fiction literature, artificial intelligence is an entity independent of humans, making decisions on its own. It is still debated whether currently existing language models, such as ChatGPT (<https://chat.openai.com/>) or Bard (<https://bard.google.com/>) can already be considered as thinking, decision-making, and human-independent beings. In the author's opinion, these are still only really incredibly good language models that can support humans in their actions. The beginnings of work on the development of artificial intelligence can be traced back to the middle of the twentieth century with the publication of an article by Alan Turing *Computing Machinery and Intelligence* (Turing, 2012) although it should be remembered that the first ideas of intelligent machines date back to ancient times (Truitt, 2021). The term "Artificial Intelligence" was formally introduced approximately six years after its conceptualisation. In 1956, Marvin Minsky and John McCarthy, the latter being a computer scientist affiliated with Stanford University, convened the Dartmouth Summer Research Project on Artificial Intelligence (DSRPAI), a research initiative spanning roughly eight weeks, held at Dartmouth College in New Hampshire (Haenlein et al., 2019). Nowadays, after many years of development of artificial intelligence theory, there are many definitions of the concept in the literature and many different approaches to defining artificial intelligence. Before defining artificial intelligence, it would be necessary to define what intelligence is. Again, this raises the problem of multiple approaches and perspectives created by diverse groups of people (computer scientists, programmers, philosophers, lawyers, etc.) in defining the concept (Martinez, 2019; Wang, 2019). The author favoured the definition (especially in context of e-commerce) given in the publication (Wang, 1995) where intelligence was defined as: the ability of an information processing system to adapt to its environment while working with insufficient knowledge as well as resources.

Artificial intelligence can be defined as computers (or other electronic devices) ability to engage in human-like thought processes such

reasoning, learning as well as self-correction (Kok et al., 2009). The author asked ChatGPT, which is an AI representative if it can define artificial intelligence. The answer given by ChatGPT was the following:

Artificial Intelligence (AI) is a branch of computer science and technology that focuses on creating and developing systems, algorithms, and machines capable of performing tasks and making decisions typically requiring human intelligence. These AI systems leverage data, learning, reasoning, and problem-solving to adapt to changing conditions, solve complex problems, and achieve specific objectives.

Obviously, the definition given by ChatGPT is a creation of a generative model learnt from the content available on the internet, so it can be said that it is an intelligent compilation of the knowledge available on the internet about AI definitions. The use of the word intelligent is seemingly most justified, since, reading the above definition, it is difficult to accuse it of being incorrect or not logical. Since the definition given by ChatGPT fits the context of the use of AI in e-commerce, so let us consider that for the purposes of this book this definition is adopted by the author.

## 7.2 Application Areas for Artificial Intelligence in E-Commerce

Artificial intelligence is now being used in many areas of e-commerce. It is therefore worth having a closer look at these areas and the role of AI in various e-commerce processes. Singh (2021) proposed classification of AI application implications in e-commerce that are oriented towards the customer. The author selected the following areas:

- a. Automated purchase handling systems,
- b. Automated product recommendation systems,
- c. Artificial assistant,
- d. High degree of personalisation,
- e. Effective visual immersiveness.

Figure 7.1 presents a more detailed classification of AI applications in e-commerce, which was presented in Chodak and Chawla (2022). Three primary areas: logistics, facilitation for the customer and marketing were distinguished, however, for the purposes of this book, the detailed classification has been slightly modified.

The innovative methods of deliveries were discussed in the second chapter. The other areas will be presented in the following part of this chapter. The author is aware that each of these issues could be the subject of a separate book, so he has tried to gather only the most important, cross-sectional information on these issues.

### 7.3 AI in E-Commerce Fulfilment

In e-commerce, efficiency and accuracy of order fulfilment play a key role in meeting customer expectations. Automated picking processes have become a solution for optimising e-commerce warehouse operations. The important technologies in this domain are Automated Mobile Robots (AMRs) and Automated Storage and Retrieval Systems (AS/RS) (Yildirim et al., 2023).

AMRs have changed the way order picking is conducted in e-commerce fulfilment centres. AMRs are newer and much more advanced version of AGVs (Automated Guided Vehicles) (Dhaliwal, 2020). The intelligent robots navigate through the warehouse, guided by advanced mapping and localisation systems. Equipped with sensors and cameras, they can detect and avoid obstacles, ensuring safe and efficient movement. AMRs work collaboratively with human workers, receiving instructions from a central control system. This cooperative approach allows for seamless integration between humans and robots, enhancing picking efficiency as well as reducing the number of errors.

AS/RS, on the other hand, is a sophisticated system designed for the automated storage and retrieval of products. It consists of high-density racking structures and robotic cranes capable of swiftly and accurately retrieving items from their designated storage locations. AS/RS systems can handle large volumes of inventory, optimising space utilisation within the warehouse (Li et al., 2022). By eliminating the need for

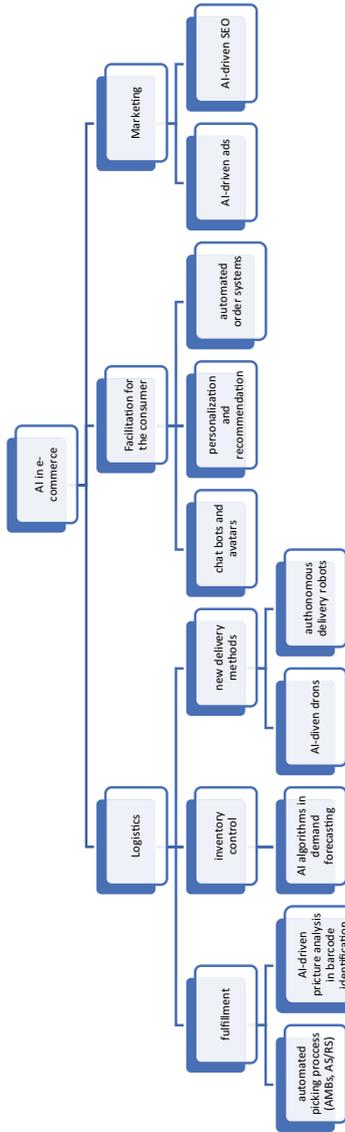


Fig. 7.1 Artificial intelligence areas in e-commerce (Source Own elaboration based on [Chodak & Chawla, 2022])

manual searching and retrieval, these systems significantly reduce picking time and errors, improving overall efficiency of these processes in the company.

Mobile Robot Fulfilment Systems (MRFS) combines mobile shelves, picking stations, and mobile robots, which is different from traditional automated storage systems (Li et al., 2022). MRFS utilises autonomous mobile robots to navigate through warehouses, picking and transporting items to fulfil customer orders. These robots are equipped with advanced sensors, cameras, and mapping technologies that enable them to navigate complex environments, avoid obstacles, and interact safely with human workers. MRFS leverages intelligent algorithms and real-time data to optimise picking routes, minimise travel time, and maximise productivity. By integrating with existing warehouse management systems, MRFS streamlines order fulfilment operations, reduces labour costs, and improves order fulfilment accuracy.

The integration of AMR and AS/RS in e-commerce warehouses offers numerous benefits. Firstly, these automated systems enable continuous picking operations, as they can work around the clock without the need for breaks or rest periods (compared to human labour). This results in faster order processing and shorter lead times, potentially improving customer service levels. Secondly, automated picking processes minimise human errors that can occur during manual picking and result in the wrong products being shipped. The precision and reliability of AMRs and AS/RS or other robotic pick-and-place systems significantly reduce the likelihood of such errors, improving order accuracy (Liang et al., 2015).

Additionally, automated picking processes contribute to cost savings in the long run. While the initial investment in these systems can be significant, the reduction in labour costs, increased operational efficiency, and minimised error rates justify the return on investment. Of course, the profitability of such investments depends on many factors, including the scale of the business. An accurate assessment of the profitability of the investment requires careful calculations, considering the detailed data of each company.

The implementation of automated picking processes, such as AMR and AS/RS, in e-commerce fulfilment centres has transformed order

fulfilment processes. These technologies increase picking efficiency, reduce errors, optimise space utilisation, and improve overall customer satisfaction. In the future, as e-commerce continues to evolve, automated picking processes will play an increasingly important role in streamlining operations and ensuring seamless order fulfilment.

## 7.4 AI in Inventory Control

Artificial intelligence has become an important tool in optimising e-commerce inventory levels. Leveraging the power of machine learning and predictive analytics, artificial intelligence enables e-commerce shops to optimise their inventory management processes.

The key area where AI is applied in inventory control is demand forecasting. Traditional forecasting methods often rely on historical data and statistical models, which may not fully capture the complex and dynamic nature of e-commerce demand. AI algorithms, on the other hand, can analyse large volumes of diverse data, including customer behaviour or emotions (Khrais, 2020), market trends, information from social media channels, and other external factors, to generate more accurate demand forecasts. AI-driven models enable to identify the demand depending on previous customer feedback and then predict the future sales volume of the item (Biswas et al., 2023). By leveraging these insights, e-commerce businesses can better anticipate customer demand (Suchacka & Stemplewski, 2017), optimise inventory levels, and reduce the risk of overstocking or stockouts, leading to improved customer satisfaction as well as reducing the cost of frozen capital in stocks.

Furthermore, AI-powered inventory control systems can automate replenishment processes (Lu & Fang, 2019). These systems continuously monitor inventory levels, sales patterns, and lead times to determine optimal reorder points and quantities. With machine learning algorithms, AI can dynamically adjust reorder parameters based on changing patterns and trends, ensuring timely replenishment while minimising excess inventory. By automating these tasks, businesses can streamline

their procurement processes, reduce manual errors, and free up valuable human resources to focus on more strategic aspects of inventory management.

AI also plays a crucial role in optimising inventory allocation and warehouse management (Dash et al., 2019). Through advanced algorithms and optimisation techniques, AI can analyse several factors such as order frequency, product characteristics, and geographical demand patterns to determine the most efficient allocation of inventory across multiple warehouses or distribution centres. This helps minimise shipping costs, reduce order fulfilment time, and improve inventory turnover rates.

In summary, artificial intelligence provides increasingly sophisticated demand forecasting capabilities, automates replenishment processes, and optimises inventory allocation. By leveraging AI, e-commerce companies can achieve more accurate demand forecasts, reduce inventory costs, improve order fulfilment performance, and increase customer satisfaction. It can be predicted that in the future, artificial intelligence will be used in every warehouse of companies wishing to remain competitive in the e-commerce market.

## 7.5 Chatbots and Avatars

Another interesting area of application of AI in e-commerce concerns customer communication in online shops. Chatbots and avatars have automated the way customers are served, reducing the cost of shops by replacing humans with specialised software. Powered by artificial intelligence, these virtual assistants offer real-time help and handle conversations with users. Chatbots, typically text-based, and avatars, which can be visual representations, use Natural Language Processing (NLP) based on machine learning algorithms to understand and respond to customer queries and requests. By simulating human-like interactions, chatbots and avatars enhance customer engagement, improve conversion rates, and streamline the purchasing process (Song & Shin, 2022). The conducted research, concerning chatbot commerce, confirmed the

significant positive impact of perceived enjoyment as well as perceived social presence in customers' purchase intentions (Han, 2021).

AI-driven chatbots and avatars play a crucial role in e-commerce by effectively addressing customer needs, providing product recommendations, and assisting with order tracking and troubleshooting (Antonio et al., 2022). Through advanced algorithms, they analyse vast amounts of customer data, including purchase history and browsing behaviour and other meta data, to offer tailored suggestions and personalised recommendations. By understanding customer preferences, chatbots can guide users towards products that align with their interests, increasing the likelihood of making a purchase. Moreover, these AI-powered assistants are fully available 24/7, ensuring round-the-clock customer support and reducing response times.

The integration of chatbots in e-commerce platforms brings several benefits to both businesses and customers. For e-commerce companies, AI-powered virtual assistants enable cost savings by reducing the need for human customer support agents. Chatbots can handle multiple customer interactions simultaneously, providing quick and usually accurate responses. From a customer perspective, these AI-driven assistants offer convenience and speed of service. Users can engage in conversations, ask questions, and seek assistance without the need to navigate menus or wait for human agents, what can be frustrating if the waiting time increases.

The future of chatbots and avatars in e-commerce holds immense potential. As AI technology advances, these virtual assistants will be able to understand even complex customer requirements. Natural language understanding and generation will improve, enabling chatbots to engage in more nuanced and context-aware conversations. Additionally, the use of sentiment analysis and emotion recognition (Kocoń et al., 2022) could enable chatbots and avatars to respond empathetically, providing better customer support. It is also worth mentioning that the style of communication undertaken by the avatar or chatbot is important (Li & Wang, 2023)—the user's engagement and enjoyment of communication can be increased by including a sense of humour in the language model (Cortes et al., 2023).

In addition to the many advantages of chatbots, their basic weakness must also be mentioned. The main disadvantage of AI-driven chatbots and avatars is the lack of “human touch”. While AI-driven chatbots provide automated assistance, they may lack emotional intelligence that human customer support agents possess (Meshram et al., 2021). Customers may sometimes prefer interacting with a human representative who can empathise with their concerns and address issues that may go beyond the capabilities of an AI-driven chatbot. The absence of human interaction may lead to decreasing of customer satisfaction, particularly in situations that require a nuanced understanding of emotions or delicate matters.

The last decade has brought huge progress when it comes to Natural Language Processing by robots. Especially the last few years and the use of transformer neural networks have revolutionised the field of NLP (Vaswani et al., 2017). A question of the near future will be the use of chatbots so advanced that humans will not be able to distinguish whether they are talking to a human or a bot. The famous Turing test has already been passed by two systems, ChatGPT and Google’s LaMDA (Jajalow, 2022).

Chatbots powered by AI have changed the e-commerce communication methods. Through their ability to understand natural language, offer recommendations, and provide 24-hour support, these virtual assistants have become valuable tools in e-commerce. As AI technology, especially NLP progresses, chatbots, as well as avatars, will continue to evolve, delivering even more immersive support for customers.

## 7.6 Personalisation and Recommendation with AI

In a digital age where online shopping is becoming increasingly commonplace, providing customised recommendations has become a key strategy for increasing user satisfaction and boosting sales. Personalisation is one of the key success factors in e-commerce (Zumstein & Kotowski, 2020).

Personalisation and recommendation systems utilise AI algorithms to analyse vast amounts of user data, including browsing behaviour, purchase history, demographic information, and other meta data as geolocation (Viana & Soares, 2017). By leveraging this data, these systems generate personalised recommendations, product suggestions, and customised experiences for individual users. Using advanced AI techniques, e-commerce platforms try to understand user preferences, anticipate their needs (Karn et al., 2023), and deliver a tailored experience that promotes customer loyalty and boosts conversion rates.

AI-powered personalisation systems employ a range of techniques to enhance user experiences. Collaborative filtering, a widely used approach, utilises the collective behaviour of similar users to make personalised recommendations (Bobadilla et al., 2011; Schafer et al., 2007). Content-based filtering, which is also an immensely popular approach, analyses user preferences based on their interaction with specific items or content, allowing for more precise recommendations (Lops et al., 2011). Hybrid methods, which combine collaborative and content-based filtering, leverage the advantages of both approaches to offer more accurate and diverse suggestions (De Campos et al., 2010). Additionally, AI techniques such as Natural Language Processing and sentiment analysis enable e-commerce platforms to understand user reviews and feedback, further refining the personalisation process (Preethi et al., 2017).

Recommendation systems play a crucial role in driving user engagement, what should lead to increase in sales. By providing personalised product recommendations, these systems guide users through vast product catalogues, helping them discover relevant items they may have otherwise missed. The use of AI algorithms enables recommender systems to continuously learn and adapt to user preferences, ensuring the relevance and timeliness of suggestions. In addition to personalised product recommendations, these systems can also offer recommendations for related content, such as articles, videos (Deldjoo et al., 2016), or user-generated content. This allows customers to learn more about products, such as learning about reviews carried out on YouTube channels or specialised blogs, or reading reviews and comments posted on social media.

The integration of AI-powered personalisation and recommender systems in e-commerce yields numerous benefits (Alamdari et al., 2020). Firstly, these systems increase user satisfaction by reducing the cognitive load associated with information overload, presenting users with targeted choices that match their preferences. Secondly, recommender systems contribute to increased sales by directing users towards products they are more likely to purchase. Furthermore, by continuously learning from user data, these systems enable companies to gain valuable insights into consumer behaviour, facilitating more effective marketing strategies.

However, deploying and maintaining effective recommender systems also comes with challenges. Privacy concerns and the ethical use of user data are paramount, requiring robust privacy policies and compliance with relevant regulations (Himeur et al., 2022). In addition, it remains a challenge to address the problem of cold starts, where recommendations for new users or subjects are limited due to insufficient data (Lika et al., 2014). Ensuring that the AI algorithms used are transparent and understandable is also essential to build trust and mitigate potential bias or discrimination.

Micropersonalisation more widely known as microtargeting, a relatively novel approach to personalisation in the realm of e-commerce, has gained significant attention in recent years. Unlike traditional personalisation techniques that operate at a segment or cohort level, micropersonalisation focuses on tailoring user experiences at an individual level by leveraging fine-grained data and advanced algorithms.

Micropersonalisation employs a range of techniques to fine-tune user experiences in e-commerce. Machine learning algorithms play a significant role in analysing vast datasets and extracting valuable insights about individual users (Kashyap et al., 2022). Additionally, sequential pattern mining techniques enable platforms to consider the order of user actions and personalise recommendations based on temporal behaviour (Pitman & Zanker, 2010). Advanced machine learning algorithms analyse user data, learn individual preferences, and then make accurate predictions for personalised recommendations. Natural Language Processing enables platforms to extract meaning and sentiment from textual data such as product reviews and customer feedback, allowing for a deeper understanding of user preferences (Lin, 2020). Deep learning

techniques, such as deep neural networks, empower e-commerce platforms to uncover complex patterns and deliver personalised content across various channels, such as websites, email, and mobile applications.

It should also be noted that implementing micropersonalisation in e-commerce comes with challenges. The collection, storage, and analysis of fine-grained user data require robust data infrastructure and advanced analytics capabilities. Ensuring data privacy and complying with regulations such as General Data Protection Regulation (GDPR) is crucial (Haddara et al., 2023), as micropersonalisation relies on sensitive user information. The ethical use of AI algorithms and the responsible handling of user data requires transparency, fairness, and adherence to privacy regulations. Furthermore, managing the computational complexity and scalability of micropersonalisation algorithms requires a huge amount of computing power.

By applying machine learning, e-commerce platforms can unlock the power of data, analyse user preferences, and provide highly tailored recommendations as well as personalised content. Despite challenges surrounding ethics, privacy, and explainability, the integration of AI in micropersonalisation holds great promise for the future of e-commerce.

## 7.7 Automated Order Systems

Automated order placement with AI has emerged as a solution to optimise the e-commerce workflow. By applying AI technologies, the software is able to automate the order placement process, minimising human effort and maximising operational efficiency. The automation of ordering processes is widely used in business-to-business relations (Allal-Chérif et al., 2021), however, it is a less popular area in the business-to-consumer sector.

Automated order placement systems with AI offer advanced functionalities that simplify the order placement process. AI algorithms analyse customer data, including browsing history, purchase behaviour, preferences, and data from various sensors, to generate personalised orders. Machine learning algorithms continuously learn from data to improve order accuracy and predict demand patterns. However, in order to make

full use of automatic order generation in addition to AI algorithms, sensors which are elements of Internet of Things (IoT) environment are needed to collect information and transmit potential demand data to the ordering system (Zhongmin & Yanan, 2018).

Depending on the nature of the products, there are three categories of fully automatic or semi-automatic orders:

- recurring, cyclical orders, concerning regularly ordered goods (e.g., dog food, milk, hygiene products, etc.). Most of this type of product falls into the fast-moving consumer goods class, but in this case, it is more important to emphasise the cyclical nature of the orders, which is why a different nomenclature has been proposed. In the case of cyclically ordered products in fixed quantities, it is simple to automate the order by specifying a standing order. Much more interesting is the problem when the system itself has to determine the moment and size of the order. For B2B and industrial systems, this is an area that is very well recognised, and processes are often fully automated. In this text, however, we will focus on the B2C area, i.e., serving individual consumers. Determining the timing of an order can be automated by sensors that generate information about the absence of a particular product. The sensors, which are part of an IoT smart home system, can be installed in various appliances (fridges, cupboards, etc.). When a sensor in the fridge identifies a shortage of a particular commodity (e.g., milk or butter), it sends a signal generating an order to the relevant online shop (Baier et al., 2016). In addition, the intelligent software can analyse the market and select the shop with the most suitable product for the user, considering additional criteria such as price and delivery time. Also, the size of the order can be determined on the basis of a demand forecast, resulting from the analysis of available data, such as historical demand and other factors such as seasonality, the calendar, including information on trips or holidays, or dietitian recommendations.
- orders for goods with an unspecified but limited lifetime. Examples of these types of goods could be underwear or consumer electronics. Nowadays, the customer usually makes the decision himself that the product should be replaced by a newer one because the old one

has already worn out physically or technologically. However, there will increasingly be automation of these processes as well, in which an intelligent system, on the basis of available information from various sensors and video analysis, analyses the wear and tear of the product itself and suggests a replacement, and once approved, makes an automatic order in an optimised online shop.

- one-time orders. In the case of one-time orders, the possibility of demand prediction is low, and the automation of the ordering process would consist rather in supporting the ordering process itself, e.g., by recognising a voice order or an order presented in the form of a photo, video. In the case of voice ordering, this type of solution already exists in the market, where the customer is able to communicate with the online shop via a voice interface. Here we have a combination of voice recognition and NLP technology. Another approach is image analysis, when the customer shows a picture of an object and intelligent software analyses the graphic object and then searches for offers in the online shops that match the customer's requirements.

The development of automated ordering systems powered by artificial intelligence brings significant benefits to e-commerce companies and customers alike. For companies, these systems increase operational efficiency by reducing the effort of online shopping assistants. AI algorithms enable orders to be placed faster and more accurately, taking into account optimisation criteria specified by the customer or proposed by the system. Customers benefit from an automated ordering process, resulting in time and money savings.

An essential element, although more difficult from an implementation point of view, is the algorithm's selection of the optimal supplier selected according to specific criteria. The list of criteria can be long, e.g., price, speed of order fulfilment, supplier brand, reliability of delivery, quality of products, available specific forms of payment or shipping, etc. The user of an automatic ordering system will have to determine which criteria are most important to him. However, most often the supplier will be selected on the basis of price. It is also possible to consider the situation that the intelligent agent will be on both the ordering and selling side. In

this case, two intelligent agents will negotiate the terms of the transaction (Huang et al., 2010).

Implementing automated ordering systems with artificial intelligence in e-commerce comes with challenges and issues to be solved. Data security and privacy are critical aspects that must be carefully considered to ensure that customer information is protected during the ordering process. Connecting a smart home with various sensors to the internet makes it vulnerable to malicious attacks. Once the system has been hacked, the attacker can steal various sensitive data such as contact info, medical information, shopping preferences, lifestyle habits, or credit card data (Pishva, 2017). Constant monitoring and improvement of artificial intelligence algorithms is essential to maintain security and optimisation in the context of the criteria chosen by the consumer. Furthermore, ensuring transparency and clear communication that takes into account the explainability of AI decisions in the ordering process is essential to build customer trust.

It is very probable that automated ordering systems will become more popular in the future. Using artificial intelligence technology, these systems simplify the ordering process, saving customers time and money (if the system is able to select a supplier). However, in order to effectively use automated ordering systems in e-commerce, the challenges of sensor integration and data security must be addressed.

## 7.8 AI-Driven Ads

AI-driven ads use advanced algorithms to analyse vast amounts of data, including user preferences, behaviours, and contextual information, enabling e-commerce platforms to optimise advertising strategies and enhance customer engagement.

In the competitive world of e-commerce, the delivery of effective advertising is key to attracting customers and optimising marketing costs. Artificial intelligence-based advertising has become a powerful tool to achieve these goals. By using artificial intelligence technologies such as deep learning, marketing platforms provided by Google or Facebook/

Meta and other corporations can analyse complex data sets, gain insights into consumer behaviour and deliver personalised ads.

AI-driven ads have been addressed in literature since the 1990s. However, the last few years have increased the scientific interest in this area (Ford et al., 2023), as well as real business implementations have become more popular.

Artificial intelligence techniques play a key role in driving targeted advertising in e-commerce. Machine learning algorithms enable platforms to analyse user data, learn from past ad performance and optimise targeting and rate-setting strategies. Natural Language Processing techniques make it possible to understand and interpret textual data, facilitating the creation of attractive advertising texts that are in line with user preferences (Hartmann & Netzer, 2023). Computer vision algorithms enable the analysis of visual content, enabling personalised and contextually relevant ads based on image or video data (Philp et al., 2022). These AI techniques work together to deliver dynamic, data-driven ad campaigns that maximise relevance and engagement of customers. The example of such a system is Google Max Performance Ads ([https://www.google.com/intl/pl\\_pl/retail/solutions/performance-max/](https://www.google.com/intl/pl_pl/retail/solutions/performance-max/)), which generates ads automatically, optimises CPC (cost per click) or CPA (cost per action) rates, automatically selects where advertisements are to be displayed.

AI-driven ads offer numerous benefits for e-commerce. By applying AI algorithms, companies can optimise advertising campaigns, ensuring that ads are delivered to the most relevant audience segments. This targeting precision leads to increased conversion rates, improved return on ad spends (ROAS), and enhanced overall marketing effectiveness. AI-powered optimisation also enables businesses to automate the ad creation process, saving time and resources while maintaining ad quality. Furthermore, personalised, and contextually relevant ads increase customer engagement and brand loyalty, strengthening the customer-business relationship.

While AI-driven ads offer significant advantages, their implementation is not without challenges. The collection and analysis of vast amounts of data require robust data infrastructure and advanced analytics capabilities. Therefore, it is mainly domain of corporations such as

Google, Microsoft, Amazon, or Meta. Privacy concerns and compliance with data protection regulations must be carefully addressed to protect user information and build trust (Palos-Sanchez et al., 2019). Maintaining transparency and explainability of AI algorithms is essential for addressing potential biases. Moreover, striking the right balance between personalisation and privacy is crucial to respect user preferences and mitigate concerns related to data usage.

There is also a problem with proper semantic relatedness, which is defined as the conceptual distance between words in the human mind (Cai et al., 2009). We can imagine visiting an information portal website where a beer advertisement is located next to the tragic text about drunk driving. While humans can see at once the error in this example of ads location, the AI algorithms that manage advertisements online may have problems with this type of contextual nuance (Watts & Adriano, 2021).

While challenges related to data management, privacy, algorithmic transparency, and proper semantic relatedness exist, the benefits of AI-driven ads make them a valuable strategy for businesses looking to optimise their advertising strategies.

## 7.9 Search Engine Optimisation with AI

Search Engine Optimisation (SEO) is one of the important digital marketing areas. SEO is one of the widely used techniques that provides websites more reachable in search engine results (Yalçın et al., 2010). One key area of SEO is the generation of original and unique content. For online shops, this unique and rich content can be a detailed description of the product on offer in the shop.

One interesting innovation that is becoming increasingly popular in online shops is the use of artificial intelligence to generate product descriptions. Until as recently as 2021, this was the domain of humans alone, possibly with the assistance of proofreading or translation software, but now the SEO copywriting profession may be a thing of the past and replaced by Large Language Models (LLMs).

This concept is already present in the literature. For example, (Zhang et al., 2022) analysed Automatic Product Copywriting Generation (APCG), which consisted of two components: (1) The natural language generation component is constructed using a transformer-pointer network and a pre-trained sequence-to-sequence model. This model has been trained on a vast amount of data from our proprietary platform to ensure high-quality output. (2) The copywriting quality control process incorporates both automated evaluation and human screening. This means that authors assess the quality of the generated content using automated methods, as well as involving human experts to carefully review and verify the copy. This combination of automated and manual evaluation ensures that the copy meets high standards for quality and effectiveness.

In addition to generating product descriptions, LLM as ChatGPT can suggest metatags and tags to describe the product: title, description, keywords. It can also suggest changes to the HTML code of a page to improve its ranking in search results or even generate the entire HTML code.

However, there are several problems to be solved associated with the automated creation of texts to effectively position an online shop in search engine results.

Firstly, these texts should encourage customers to buy, and therefore contain a clear marketing message. This is a task that AI is unlikely to have much of a problem with, as it is able to learn the language, the syntax, the wording that prompts consumers to make purchasing decisions. It could even be argued that if the learning took place on databases of numerous shops with access to server log analysis, together with databases containing transactions and product descriptions, the algorithm could learn which texts/formulations/phrases found in product descriptions are more effective from the point of view of shoppers' purchasing decisions. Machine learning algorithms are able to extract such knowledge and use it to create texts.

Secondly, texts should be unique because search engines, including Google in particular, promote unique content, giving sites with such content a higher ranking than sites with duplicate content. The texts generated by LLMs are based on the texts on which the models have been taught, so for niche products, it may be the case that the LLM generates text very similar to existing texts on the Internet.

Thirdly, texts should be correct in terms of content. This seems fairly straightforward in the case of popular goods, intended for a wide audience. However, the task of creating texts for niche products, or specialised products requiring deep subject-matter knowledge, would be difficult for such software, especially if there is no adequate base of specialised texts to train the model. In the author's opinion, in the case of specialised goods requiring deep subject knowledge, expert proofreading of AI-created texts will still be required for a long time to come.

The dangers that the author sees in the phenomenon of AI SEO copywriting is the proliferation of misinformation that will appear on websites, including in product descriptions. One can imagine a situation where a model learning how to write texts for paramedic products will notice that the phrase "lowers cholesterol" increases product sales, so will include this phrase in product descriptions regardless of whether it is true or not.

Another risk that can be considered is the situation when the provider of the best automatic text generator on the market (the best LLM) is at the same time the owner of a search engine, which will in its results give preference to texts generated by its own software. It is possible to imagine a situation where, for example, Google or Microsoft make minor modifications to their page ranking algorithms to reward pages with text generated by their own tools.

One of the commercially available IT tools that uses artificial intelligence techniques to generate texts is ChatGPT (<https://chat.openai.com/chat>). The capabilities of this tool are truly immense.

## Interview with ChatGPT

In order to test ChatGPT, the author interviewed him. The original content of the interview is reproduced below.

Can you tell me more about ChatGPT?

ChatGPT is a conversational AI language model developed by OpenAI. It uses the transformer architecture and was trained on a large corpus of text data to generate human-like responses to text-based prompts. ChatGPT can respond to a wide range of topics, including but not limited to questions about common knowledge, definitions, and personal opinions.

Can ChatGPT be used as SEO copywriter in internet shop?

Yes, ChatGPT can be used to generate product descriptions and other SEO-friendly content for an e-commerce website. However, it's important to keep in mind that while ChatGPT can generate coherent and coherent text, it may not always produce high-quality content that effectively communicates the value of a product or service, or that accurately reflects the brand voice and tone of the e-commerce website. Additionally, search engines may penalize websites that use AI-generated content that is duplicated across multiple sites or that lacks originality.

Do you think that search engines can distinguish between human and AI generated content?

Yes, search engines have the ability to distinguish between human-written and AI-generated content. This is because AI-generated content often lacks the nuances and characteristics of natural language that are present in human-written content. Additionally, AI-generated content

may contain repetitive phrases or lack coherence, both of which are red flags for search engines. As a result, websites that use AI-generated content for their SEO may not rank as well as websites with high-quality, human-written content. To ensure that a website ranks well in search results, it's best to use human-written content that is well-researched, well-written, and original.

Do you think that in the future, AI generated texts can replace SEO copywriter?

It is possible that in the future, AI generated texts could play a larger role in SEO and online content creation, but it's unlikely that AI will completely replace human SEO copywriters. While AI language models like ChatGPT can generate text that is grammatically correct and can be optimized for search engines, they may lack the creative flair, nuance, and brand voice that is essential for effective SEO copywriting. Additionally, AI-generated content may not always align with the goals and brand identity of a business, which human copywriters can ensure through their understanding of the brand and its target audience. In the end, it's likely that AI will continue to play a role in the SEO industry, but it will likely complement the work of human copywriters, rather than replace them entirely.

I can see now that the quality of texts that you generate is very high.

Thank you! I have been trained on a large corpus of text data, which allows me to generate human-like responses to a wide range of topics. However, it's important to remember that I am an AI language model and there may be limitations to my responses. I do my best to provide accurate and helpful information, but it's always a good idea to fact-check my responses and to consult multiple sources for a more comprehensive understanding of a topic.

Thank you for this interview. I am going to use it in my book about the future of e-commerce.

You're welcome! I'm glad I could help. If you have any other questions, feel free to ask. Good luck with your book!

## Advantages of Using LLMs for Content Creation

The use of generative large language models appears to be the future of SEO copywriting. The use of LLMs to generate content, particularly product descriptions in online shops, offers many advantages, which will be described below.

### Savings

Firstly, the use of LLMs for content generation represents a significant saving for the company. Typically, content generation staff, i.e., SEO copywriters, are billed per page (usually A4) of content generated or, less frequently, per hour/day/month of work. Using LLM provides the opportunity to generate content at a much lower cost, resulting from the fees charged by LLMs providers and the cost of preparing the prompts for the system and copying the responses. In the case of ChatGPT version 3.5, fees are not charged, and in version 4.0 they are significantly lower than the cost of an SEO copywriter.

### Speed

Secondly, these models can significantly enhance the efficiency and scale of content creation. The time it takes for the generative model to generate content is considerably shorter than the possibility of human content creation. Also, relevant is the fact that Google and other

providers of search engines take into account who first inserted information on a topic and prefer original content creators in their search results. The speed of content creation will give a competitive advantage to those businesses that use AI generative models skilfully. This acceleration in content production also enables e-commerce businesses to rapidly expand their product catalogues and keep pace with the market demands.

### **Quality, Consistency, Persuasiveness**

For e-commerce platforms, compelling, trustworthy, persuasive, and detailed product descriptions have the power to draw in consumers and increase sales. Although not every seller is able to create captivating descriptions. LLM offers a solution by producing these descriptions on a large scale, aiding sellers in enhancing their product narratives (Koto et al., 2022). Additionally, the consistency of AI-generated content ensures that product descriptions maintain a uniform tone and quality across the entire inventory, supporting the brand's identity.

### **Better Personalisation, Real-Time Personalisation**

What's more, generative AI models are perfect for personalisation. By analysing huge datasets and patterns of user behaviour, these models can tailor product descriptions to specific customer segments or individual preferences. Generative models, combined with customer behaviour analysis and a database of customer information, are able to generate personalised product descriptions in real time. This level of personalisation promotes a deeper connection between customers and products, increasing the likelihood of conversion. Furthermore, AI-based content generation can adapt to trends and market dynamics in real time, ensuring that product descriptions remain relevant and up to date. AI-driven generative model is able to introduce hyper-personalisation of the content by connecting the prospective customer's browsing history and past orders with all other available data and metadata (Ooi et al., 2023). This agility in content creation empowers e-commerce businesses to respond swiftly to changing consumer preferences and market shifts,

giving them a competitive edge in a fast-paced industry. Knowledge enhanced pre-trained language model can be successfully used to product summarisation what may give great economic value, as they can help generate text that matches the product information and inspires users to buy (Yin et al., 2022). The broad knowledge base used by AI-driven generative models allows rich and varied content to be obtained.

In summary, the advantages of using generative AI models to create e-commerce content include efficiency, consistency, personalisation, and adaptability, all of which contribute to a more compelling online shopping experience.

## **Disadvantages and Threats of Using LLMs for Content Creation**

While generative large language models offer significant advantages for content generation in e-commerce, they are not without their share of disadvantages.

### **Originality and Uniqueness**

Firstly, there is the issue of content originality and uniqueness. AI-driven language generative models often draw from vast datasets, which can lead to the generation of product descriptions that are eerily similar to existing content elsewhere on the Internet. This is more likely to be the case for niche products whose descriptions are only available in a few or even one place, or where there is homogeneity of descriptions across multiple sites. This lack of originality not only hampers search engine optimisation but can also result in a bland and unremarkable online presence, potentially undermining a brand's competitiveness. Furthermore, an over-reliance on creating content with the same LLM can contribute to the homogenisation of product descriptions across different e-commerce platforms, making it difficult for companies to stand out and showcase their unique

value propositions. It is also worth mentioning the risks of hidden plagiarism as well as infringements of intellectual property rights (Brühl, 2023) because the currently available LLMs do not specify the sources on which the models were learned.

### **Errors, Inaccuracies, and Hallucination**

Another critical drawback is the potential for errors and inaccuracies in AI-generated content. These models are not infallible and can produce descriptions that are factually incorrect or misleading. This is particularly problematic when dealing with complex or technical products where precision and accuracy are paramount. Furthermore, AI may struggle with understanding context, or the subtle nuances of human language, leading to content that lacks the human touch and emotional resonance necessary for effective marketing. To mitigate these issues, human oversight and editing are often necessary, which can offset some of the time-saving benefits of AI-generated content.

The important drawback of LLMs is their tendency to hallucinate, i.e., to produce content that is not true (Gupta et al., 2023). For example, ChatGPT, when asked to write a few paragraphs about a book with a title specified in the query, is even able to generate subsection titles with a description of the content. However, the description of the book produced by this tool is false, the titles of the subsections and their contents made up (generated from keywords occurring in the query). In order for generative models to create true content, it is necessary to pin them down with the current knowledge base and skilfully prompt them will be based on the knowledge base at hand. However, according to the author, for many years to come, LLM-generated content will still require human verification and removal of false or inaccurate information, especially in specialised fields.

## **Risks Relating to the Full Automation of Text Creation Processes**

Automating the process of generating the content of product descriptions and storing this content in databases requires the creation of an additional IT interface. “Manual” operation of LLMs as ChatGPT requires giving a prompt, copying the answer, and then pasting the answer into the e-shop interface. This is a fairly straightforward, low time-consuming activity, but in the case of a large database of rankings, this process would require manpower to handle the process. Unfortunately, due to the aforementioned problem in the earlier paragraph, full automation of the content generation process by generative models would be a risky undertaking for the e-shop. This process may be fully automated using an API which connects LLM with online shop software, but currently the hallucinogenic nature of this type of tool, requires additional human control.

## **Risk of Overuse of AI-Driven Generative Language Models for Content Generation**

The temptation to generate substantial amounts of text at an exceptionally low cost can lead to overuse of this tool. If users realise that, for example, in-store reviews are automatically generated, which is obviously an unethical action, they may turn away from the shop brand under consideration. The author encountered such a situation in one of the Polish largest electronics shops (the name will not be given so as not to discourage the brand, which may well repent and rectify its mistake), where one of the TVs had 453 reviews, the vast majority of which were written by the generative model. This was evidenced by the remarkably similar style, almost identical length of entries (around 2500 characters!—usually reviews are much shorter). Customers in the shop reacted to these product reviews with an unequivocal negative reaction (they have the option to indicate whether the review is useful or unhelpful by

ticking the handle up or down). This example shows that the thoughtless overuse of generative models can bring more losses than benefits to a company.

There may be many more risks associated with the use of AI-driven generative models (see e.g., [Gupta et al., 2023]), some of which we probably still do not know. Using such tools requires common sense and human intelligence, which is still far superior to artificial intelligence. Mention should also be made of the problem of job losses among the numerous copywriters. The process of redundancies in this type of profession has already started and is likely to intensify in the coming years.

### **Example of a Dedicated Tool for SEO Using NLP (Nature Language Processing) and AI**

SEO support systems will probably increasingly turn to tools using generative models in the future. An interesting proposal has been put forward by SE Ranking (<https://online.seranking.com/>), which provides the possibility for the system to generate content, but it has some additional tools to make the generated content even more customised.

In the first step, the user is asked to provide a list of keywords to be covered by the article. The system also asks about the Google Interface language and the country and region. The user can also use content from an existing page and add direct competitors to analyse. The system then searches for articles on the Internet with links and allows the user to select which web publications the system is from which to create content. The system also determines the recommended content parameters based on the competitors selected for analysis as number of words, paragraphs, headings.

Then the system shows the box next to the terms that the user wants to use in the article. Selected terms, which are shown in the respective table, will be added to the brief, and should be used in the created text because they have a direct impact on the brief progress score. Terms are extracted with the use of Natural Language Processing. The system suggests that NLP terms are the most relevant terms collected from competitors' pages.

Then the user can choose the tone of voice that best matches the company brand voice. The tone of voice makes the text appear less artificial and more human. The user can choose a professional, formal, friendly, positive, calm, or polite tone of voice.

Next, the user can choose the structure of the article or specify his/her own in the panel.

In the panel, user can select the topic of the article (header H1) or specify his/her own. The article's topic is used to generate headings.

In the next steps, the user can choose the structure of the article, specify headings and other text parameters. The final output of this tool is a text generated from all the previous arrangements.

In conclusion, SE Ranking is an interesting example of an SEO support tool using generative language models. It improves content generation by allowing users to enter keywords, customise language settings, and incorporate competitive analysis. The tool's integration with natural language processing to extract relevant terms makes it a useful tool for SEO specialists. It can be assumed that such innovative solutions will become a standard SEO tool in the future.

## **The Future of AI-Driven Content Creation Tools**

The forementioned type of AI-driven tool is already becoming standard in SEO support software. In the future, we should expect even more automation of the content creation process for online shops.

It can also be assumed that in the future there will be more emphasis on the marketing quality of texts rather than just the quantity of texts. Systems will analyse the marketing effectiveness of texts based on sales performance and possibly other metadata such as time spent on the product page, number of clicks on product images, etc. It can also be expected that product descriptions and images will be generated in real time based on user data. Such a solution would require a lot of computing power, assuming the simultaneous creation of many thousands of texts for many thousands of users browsing the shop's content. However, it can be expected that e-commerce giants such as Amazon or Alibaba will be able to afford such solutions.

We can also expect the integration of generated content with the entire dynamically customisable interface (Kopel et al., 2013). This would result in e-commerce systems that are completely tailored to the individual user, both in terms of the content presented and the entire interface and all functionalities. For example, based on knowledge about the user, the system would suggest not only the products in which the user is interested, but such forms of product filtering that the user uses and those forms of payment and shipping that the user chooses most often or even the whole front-end interface (Wasilewski et al., 2023). In this way, each user would have online shops fully adapted to his or her preferences. Of course, the ultimate goal of this type of full personalisation would be to increase customer satisfaction, translating into increased shop turnover. Only then would the costs incurred for full personalisation, including expensive computing power, become economically justifiable.

## **The Future of Search Engines in an Era of Almost Free Content**

The ability to generate substantial amounts of content using LLMs will probably be used by the most website owners, including e-commerce sites. However, this begs the question of what happens if all website owners start generating enormous amounts of text in order to improve their ranking in search engine results. A Search Engine Results Page (SERP) is a ranking, so there is only one first, one second, and one third position there. This situation is unlikely to change in the future. So, how will the flood of free content created by generative models affect search results? Will search engines like Google or Bing still take the amount of unique content into account when ranking?

Another interesting question, which the author does not know the answer to, concerns the recognition of whether content has been generated by a human or by LLM. If search engines can recognise whether content has been generated by a generative model, they may give preference (or not) to human-generated content. Whether search engines will recognise text created by generative models may depend on the models

themselves, which may leave a trace in the text—e.g., a characteristic statistical distribution of words that will not be recognisable by humans (or will be a very time-consuming process) but will be recognisable by AI tools. Given the competition in the search engine market, for example between Google and Bing, content generated by ChatGPT (Microsoft is a strategic investor in OpenAI, which created ChatGPT) may be discriminated against by Google's search engine, if it can recognise which AI tool is the author of the content.

Another solution, which may happen in the long term, will be a radical change in the algorithms used by search engines to evaluate pages, in order to prevent the Internet from being flooded with a huge amount of content generated by generative models just to better position websites. The change in the page rating algorithm used by search engines, will probably consist of not taking into account the amount of content, or even a lower rating for pages with too much content. Since it has become so easy and inexpensive to create content via generative models, the amount of content may not be particularly important in the search engine's evaluation of a website in future.

## **Methodology of Research Concerning Applying LLM in SEO**

To test the feasibility of using the ChatGPT tool for copywriting, an experiment was carried out in a real online shop. The shop has been operating for more than 10 years, offering a wide range of more than 8000 products, mainly books. According to the information obtained from the person managing the shop, it appears that currently product descriptions are usually taken from publishers/producers. Unfortunately, this negatively affects rankings in search results and causes the store to have to invest a significant amount of money in ads, mainly Google Ads, to attract customers. Only in the case of strategic, selected products do the employees modify the descriptions to improve their positioning in Google search. Due to the enormous range of products, the cost of an SEO copywriter for the entire product base would be huge. In this case,

the use of a tool such as ChatGPT, capable of performing rapid and automatic rephrasing of texts, seems to be the ideal solution for the shop.

For the experiment, thirty products were selected for which their current ranking in Google search results was checked. In order to obtain a reasonably objective result, the incognito mode of the search engine and the SE Ranking software (<https://online.seranking.com/>) for the SEO ranking analysis of websites were used. The products selected for the experiment were those that had a description copied from the manufacturer/publisher.

Three experiments were conducted to confirm the hypothesis of whether the use of a ChatGPT class tool can improve the ranking of an online shop's product in Google search results.

## The First Experiment

In the first experiment for the first group of ten products (Table 7.1), product descriptions were rephrased using ChatGPT. The following text formula was used as a prompt:

“Can you rephrase the following text: (...)” and the text to be rephrased is given in brackets.

The text rephrased by ChatGPT was then copied into the product description database, replacing the pre-existing description. This resulted in a product description that should be unique, unlike the earlier product description taken from the manufacturer. In theory, such a change should have a positive impact on the Google SERP ranking.

In order to assess changes in Google's SERP position, successive measurements were made using incognito mode and SE Ranking software. The first two measurements were made using a “manual” check of each position in incognito mode, but due to the labour-intensive nature of this method, it was decided to use SE Ranking's specialised software for reading the objective position in Google. The results from incognito mode were compared with the position indicated by the SE Ranking software and the results were consistent, so for the remainder of the experiment it was decided to use the SE Ranking software.

**Table 7.1** The results in Google SERP after rephrasing text by ChatGPT

No	Title of product (acronym)	Ranking in Google SERP 04.04.2023	Ranking in Google SERP 08.04.2023	Ranking in Google SERP 28.04.2023	Ranking in Google SERP 06.05.2023	Ranking in Google SERP 20.05.2023	Ranking in Google SERP 05.06.2023	Ranking in Google SERP 09.06.2023
1	DKRHS	15	19	21	20	20	18	17
2	AKVMWP	18	15	12	22	22	13	15
3	OSDMWKNWDW	7	8	8	8	8	8	9
4	CWBSWZN	29	27	21	26	18	18	17
5	BANROWKRSND	-	-	12	14	18	15	13
6	CDINDBWWS	18	18	22	22	17	18	19
7	PGDBML	6	29	9	9	9	8	9
8	SRMDUMRKT5	10	10	10	12	13	12	10
9	RSZBCAPD55	7	6	-	6	7	5	7
10	MD55	22	27	96	-	-	-	29
Ranking in Google SERP 28.06.2023	Ranking in Google SERP 30.06.2023	Ranking in Google SERP 04.07.2023	Ranking in Google SERP 25.07.2023	Ranking in Google SERP 03.08.2023	Ranking in Google SERP 04.09.2023	Ranking in Google SERP 13.09.2023	Ranking in Google SERP 14.10.2023	
16	14	12	8	10	7	9	8	
19	17	15	17	16	16	16	11	
10	12	8	10	7	9	9	9	
81	15	33	25	25	20	12	10	
10	11	10	10	8	8	7	8	
8	8	8	5	4	4	4	5	
8	9	8	7	7	7	6	7	
9	10	8	7	9	7	5	6	
6	6	5	6	7	7	4	3	
32	-	35	-	55	27	41	30	

## The Second Experiment

For the second group of 10 products (Table 7.2), ChatGPT was asked to write 5 paragraphs about the products, giving the following text as a prompt:

“Can you write five paragraphs about the following book: (...)” the title of the product is given in brackets, as it appears in the e-shop’s database.

The texts created by ChatGPT were then copied into the product description. Unfortunately, in this case, it was necessary to verify the texts and remove the parts that were false. In this way, additional product description texts were obtained, which should influence the ranking in the Google SERP results. It should be noted that the previous product descriptions were not altered, only additional texts were added.

Then, as in the previous experiment, Google SERP rankings were measured for individual products.

## The Third Experiment

The third experiment was launched almost three months after the launch of the first experiment, when the positive effects of the first experiment on Google search results were already visible.

For the third experiment, ten products were again selected, this time guided by the shop manager’s suggestion and sales data, in order to consider products relevant to the e-store’s turnover.

For these products, comprehensive SEO improvements have been made, including:

- rephrasing of existing product description text by ChatGPT.
- generation of additional product description text by ChatGPT.
- possible amendments to <description> , <keywords> , <title> meta tags.

**Table 7.2** The results in Google SERP after adding new text created by ChatGPT

No	Title of product (acronym)	Ranking in Google SERP 18.04.2023	Ranking in Google SERP 25.04.2023	Ranking in Google SERP 06.05.2023	Ranking in Google SERP 20.05.2023	Ranking in Google SERP 05.06.2023	Ranking in Google SERP 09.06.2023	Ranking in Google SERP 28.06.2023
1	DSSFKFDOT	5	4	4	2	1	1	1
2	WPWB	10	9	24	12	12	13	23
3	SRMNKD	19	18	15	28	15	21	21
4	NMDCOBA	16	15	17	13	14	15	12
5	SJBNMKPP	18	20	27	30	33	20	21
6	NWRNOKRS	8	10	93	9	11	9	9
7	SSSNUJICA	10	11	10	14	14	14	13
8	DDRZAFJS	-	-	-	-	-	-	-
9	QWPIOS	19	11	8	10	11	10	-
10	MMLF	14	14	13	9	12	11	11
Ranking in Google SERP 30.06.2023	Ranking in Google SERP 04.07.2023	Ranking in Google SERP 25.07.2023	Ranking in Google SERP 03.08.2023	Ranking in Google SERP 04.09.2023	Ranking in Google SERP 13.09.2023	Ranking in Google SERP 14.10.2023		
1	1	4	3	5	2	4		
19	17	13	14	11	9	12		
19	12	13	10	13	15	9		
11	13	14	14	14	14	13		
25	24	20	20	20	19	18		
-	-	-	-	-	-	-		
12	12	9	10	11	13	10		
-	-	-	-	-	-	-		
-	-	-	-	-	-	-		
10	8	11	8	7	2	5		

## Results of the Experiment Concerning Applying LLM in SEO

Table 7.1 displays the results of an experiment where product descriptions were rephrased by ChatGPT, and their rankings in Google’s Search Engine Results Page (SERP) were monitored over time.

As it can be seen, rephrasing product descriptions with ChatGPT generally resulted in improved rankings in Google SERP. Across most products, there was a noticeable upward trend in positions over time. Products, including “DKRHS”, “AKVMWP”, and “CWBSWZN” improved their positions considerably, showcasing the stability of the improvement. Products like “CDNDBWWS”, “SRMDUMRKTs”, and “RSZBCAPDSS” witnessed significant improvements in their SERP rankings, achieving positions within the top six. “BANROWKRSND” initially did not appear in the SERP, but gradually gained visibility, reaching position eight by the end of the experiment.

The detailed ranking results in the Google SERP for the “CDNDBWWS” product are shown in Fig. 7.2. It can be seen an initial fluctuation in ranking, then a spike, followed by a smaller fluctuation again, but at much higher positions. Achieving such a marked improvement in ranking, should result in increased sales of this product in the future (but of course, actual sales are a function of many variables, e.g., product price, not just Google ranking position).

The average SERP position presented in Fig. 7.3 is improved for most products over the course of the experiment. This suggests that

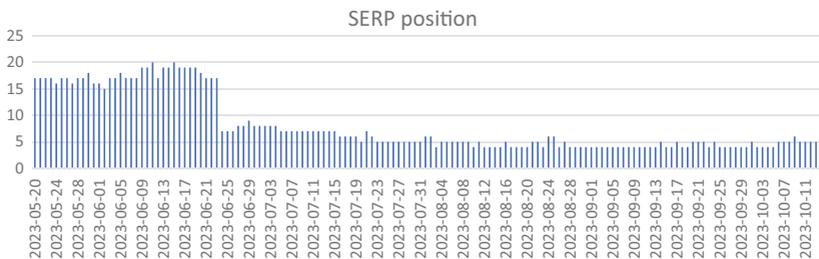
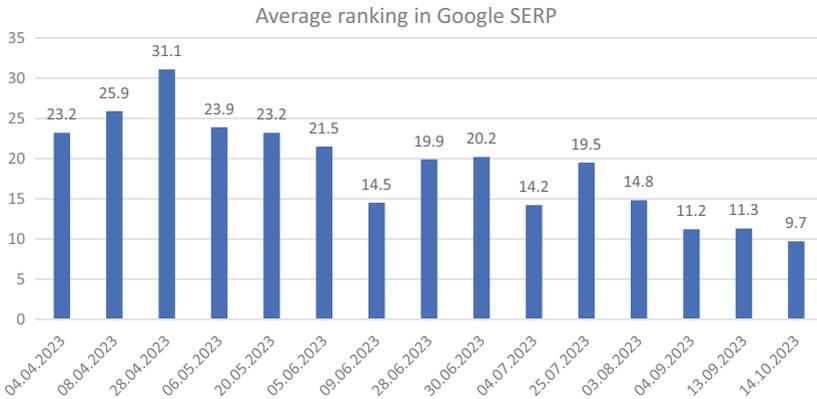


Fig. 7.2 Rating in Google SERP of product CDNDBWWS



**Fig. 7.3** Average ranking in Google SERP after rephrasing text by ChatGPT

rephrasing product descriptions with ChatGPT had a positive impact on their online visibility.

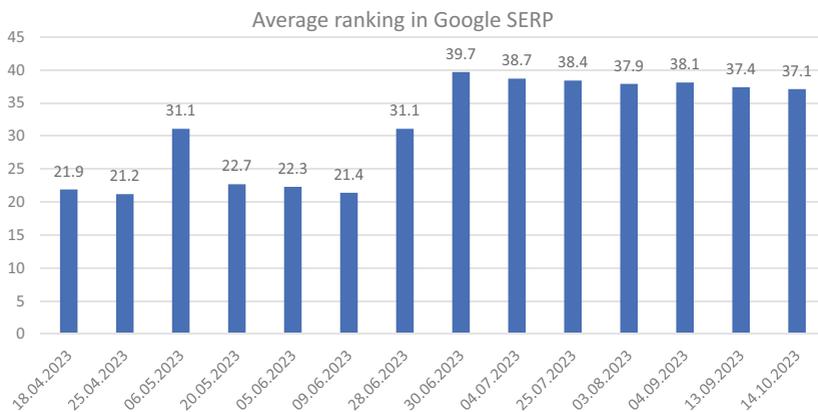
Table 7.2 represents the results of a second experiment, where product descriptions were enhanced with additional content created by ChatGPT, and their rankings in Google’s SERP were tracked over time. In contrast to the previous experiment, it can be seen that despite adding extra descriptions to the products, there is no consistent improvement in their rankings in Google SERP. In fact, some products, like “SSSNUICA”, “SJBNMKPP”, maintained relatively stable rankings over time, with occasional fluctuations. Product “WPWB”, witnessed fluctuations and declines in their rankings, indicating that the additional descriptions did not consistently boost their visibility.

Products “QWPIOS” and “NWRNOKRS” showed inconsistent visibility, and disappeared from Google SERP during the experiment, suggesting that the enhancements might even decline the ranking.

Some products have improved their ranking, but this is only 40%. Only two products (“SRMNKD” and “MMLF”) have improved their ranking enough to be reflected more in sales levels. Given that two products also disappeared from the SERPs, it is difficult to consider the result of this experiment satisfactory.

The average position in the SERP for these products (Fig. 7.4) not only did not demonstrate an improvement trend, but show deterioration of results, indicating that adding extra descriptions did not lead to higher rankings on average. This result of this experiment can be explained by the fact that a significant part of the product description was not changed, only an additional description was added. The existing part of the description negatively influenced the results because, as aforementioned, products whose descriptions were copied from manufacturers were selected for the experiment, so they were identical to the existing descriptions on other shops' websites on the Internet. The duplicate content was dragging the results down, and adding new parts did not give positive results.

Table 7.3 represents the results of a third experiment where SEO complex improvements, including rephrasing product descriptions, and new paragraphs in product descriptions were implemented by ChatGPT as well as some metatags improvements were done. As in the two previous experiments, the rankings of these products in Google's SERP were tracked over time. It can be seen consistent improvement in Google rating for some products, such as "SPALFMOT" (significant improvement from non-existence in SERP into fourth position), "BID-DKPP" (good improvement from non-existence in SERP into ninth



**Fig. 7.4** Average ranking in Google SERP after adding new text created by ChatGPT

position), “E1BJWC” (significant improvement into second position). This clearly suggests that the SEO complex improvements, resulted in higher positions in Google SERP.

Product “RBZSWZPRZKCSR” was consistently holding the highest position of the SERP. In this case, improvement was not possible, but the experiment indicated that the actions taken did not worsen the ranking position.

While most products showed improvement, a few, like “OBORKPGJP”, “KOJNSIWWSPKDCS” did not demonstrate changes in rankings, indicating that provided SEO improvements may not have been as effective for these products.

The average position in SERP for these products (Fig. 7.5) demonstrated a strong improvement trend, underscoring the effectiveness of the SEO complex improvements in enhancing their visibility on Google SERP.

## 7.10 Summary of Experimental Results

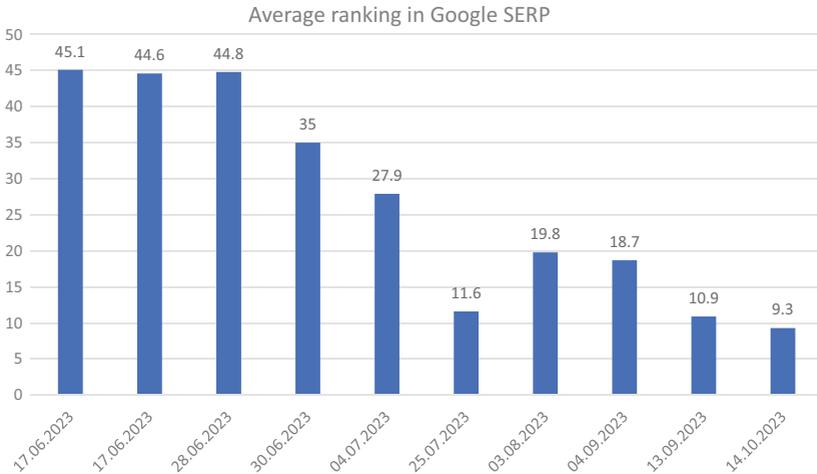
In summary, the first experiment demonstrated that rephrasing product descriptions using ChatGPT contributed to higher positions in Google SERP for the majority of the products, with average rankings showing a noticeable improvement. This highlights the potential of AI-powered rephrasing to enhance online visibility and SEO performance.

The second experiment reveals that simply adding supplementary descriptions to the products, without rephrasing existing content, did not consistently result in higher positions in Google SERP. The rankings remained relatively stable, with occasional fluctuations, and in some cases, products even lost visibility. This highlights the importance of complex improvements of content quality and optimisation techniques in improving SERP rankings, as merely increasing the amount of content may not yield the desired results.

The third experiment highlights that implementing SEO complex improvements, which included rephrasing product descriptions, adding new paragraphs of descriptions, and improving products metatags led to consistent and notable improvements in SERP rankings. Products

**Table 7.3** The results in Google SERP after complex changes with ChatGPT

No	Title of product (acronym)	Ranking in Google SERP																			
		17.06.2023	17.06.2023	28.06.2023	28.06.2023	30.06.2023	30.06.2023	04.07.2023	04.07.2023	25.07.2023	25.07.2023	03.08.2023	03.08.2023	04.09.2023	04.09.2023	13.09.2023	13.09.2023	14.10.2023	14.10.2023		
1	MMBCZMBMZA	7	7	8	8	6	6	6	6	8	8	8	8	5	5	8	8	20	20	6	6
2	RPIASO	-	-	-	-	-	-	29	29	21	21	20	20	21	21	20	20	21	21	18	18
3	RBZSWZPRZNIKCSR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	SPALFOT	-	-	-	-	5	5	7	7	6	6	6	6	5	5	6	6	6	6	4	4
5	KOJNSIWWWSPKDCS	7	6	6	6	6	6	6	6	11	11	9	9	8	8	7	7	7	7	7	7
6	CMDDDWJJP	-	-	-	-	-	-	-	-	23	23	-	-	-	-	23	23	26	26	19	19
7	OBORKPGJP	21	19	20	20	19	19	16	16	23	23	33	33	27	27	26	26	27	27	21	21
8	BIDDKPP	-	-	-	-	-	-	-	-	10	10	9	9	9	9	9	9	9	9	9	9
9	KCFH	9	9	9	9	9	9	8	8	8	8	8	8	7	7	6	6	6	6	6	6
10	E1BJWC	6	4	4	4	4	4	6	6	5	5	4	4	4	4	3	3	4	4	2	2



**Fig. 7.5** Average ranking in Google SERP after complex changes with ChatGPT

showed increased visibility and maintained stable or improved positions over time, emphasising the significance of comprehensive SEO strategies in optimising online content for better search engine rankings.

The third experiment, as expected, produced the greatest improvement in Google's SERP ranking results. It can therefore be hypothesised that the use of artificial intelligence tools such as ChatGPT for SEO will improve search engine rankings, however, changes made to the structure of a page should be comprehensive, covering not only the content but also the metatags. In fact, full verification of such a hypothesis would require a much larger research sample, for different classes of online shops and products.

It should also be noted that if all online shops performed similar SEO activities using LLMs, the ranking would not change significantly. In addition, it should be noted that the actions taken affected the current version of Google's ranking algorithms, and if the algorithms are modified, the results may be different.

Summing up, artificial intelligence will undeniably play an increasingly important role in all online shop processes. Companies that are

able to implement and effectively use these innovative tools will achieve a competitive advantage over those that delay their implementation. As shown in this chapter, these tools have many advantages, but they should not be used in an unreflective manner, but in a well-considered way in order to obtain concrete economic benefits.

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# 8

## The Future: Directions E-Commerce Is Heading

The previous chapters have discussed selected e-commerce issues that the author believes will be crucial in the coming years. This chapter, summarising the previous considerations, will present a comprehensive analysis indicating what the future of e-commerce is expected to look like. Of course, the author is aware that predicting the future always involves the risk of incorrect forecasts. At any time, technologies may emerge that will entirely change the face of e-commerce that we do not currently know. There is a whole host of factors that could powerfully change e-commerce and the whole functioning of economies in the future in unexpected ways. Unexpected wars, pandemics, catastrophes such as volcanic eruptions, meteor strikes, or unforeseen phenomena on the sun and a whole host of other phenomena that are difficult to predict can change the world as we know it instantly. This does not mean, however, that we should not try to predict the future, but we should remain humble and aware that our predictions will not necessarily come true.

## 8.1 Interviews with Experts—Methodology Description

There is a wealth of formal forecasting methods, quantitative and qualitative. In this case, it is not a question of trying to determine exactly what will happen in the coming months, but rather to map out a broader vision for the coming years, so the Delphi method (Grime & Wright, 2016) is the valuable research tool for such a purpose. In this case, the author used a deliberately modified Delphi method with the following modifications: the experts came from different fields in order to get a broader perspective. The author did not seek consensus among the experts, but only wanted to know their opinion on the future of selected aspects of e-commerce.

The interviews with the experts took the form of a structured extended interview with the following questions:

1. Do you think the impact of e-commerce on economies will grow in the coming years?
2. What logistics solutions will gain popularity in the coming years for e-commerce?
3. What forms of payment will gain popularity in the coming years in e-commerce?
4. Do you think Virtual Reality shops will become more popular in the coming years?
5. Do you think Augmented Reality solutions will gain popularity? If so, which ones?
6. Will social commerce continue to develop rapidly? In which direction?
7. In which areas will artificial intelligence in e-commerce play a key role?

As can be seen, the above questions correspond to the structure of the earlier seven chapters of the book. The author conducted many hours of interviews to obtain as much information as possible—the length of each interview lasted between 1 and 5 hours (most over 2 hours). The interviewees were experts in the following fields: business, economics,

management, computer science, investment, marketing, physics, mechatronics, national security, and the arts. Such diverse areas allowed the author to learn about different viewpoints and ways of looking at the future of e-commerce. The variety of issues raised as key to e-commerce was fascinating. In order not to bore the reader by presenting the content of the lengthy interviews in detail, the author has compiled the most valuable information obtained from the experts.

## 8.2 Conclusions from Interviews

In answering the first question, experts agreed that the impact of e-commerce on economies will grow. This was an answer in line with expectations, while when asked which areas of the economy e-commerce will have a particular impact on, the experts highlighted the following aspects:

- One of the reasons indicated by the expert that the impact of e-commerce on the economy will grow is the suggestion that the share of e-commerce in total trade will increase. This is due, among other things, to the fact that there is an ongoing replacement of a generation that only partially uses e-commerce by a generation for whom e-commerce and especially mobile commerce is the primary method of shopping. The expert also noted that the increasing proportion of people working remotely (which spiked during the Covid-19 pandemic) will encourage the growth of e-commerce. People not driving to work will have less opportunity to shop when returning from work. In addition, by spending time in front of a computer while working remotely, they will have more opportunities to shop online on their lunch break, for example.
- The experts agreed that the impact of e-commerce on economies will grow and cover numerous areas, from the labour market to the impact on supply chains, the development of many sectors of the economy, including logistics. E-commerce may also affect the spatial economy, through the development of large logistics centres, as well as numerous

parcel pick-up points, which will be available on virtually every street corner.

- Some experts have pointed out that e-commerce, encompassing all related domains, will gradually take on more and more of the workforce. Industries involved in servicing the e-commerce sector, including logistics, which includes transport, packaging production, hardware and software development adapted to e-commerce, will experience an increase in employment. Another expert suggested that the growth of e-commerce will lead to an increase in employment in legal services dedicated to e-commerce. The increasing number of online transactions will have a significant impact on the legal services industry. With the proliferation of digital platforms and the increasing transfer of transactions to the online sphere, there will be an increased need for specialised legal services provided to both consumers and e-commerce businesses. This growth will require expertise in areas such as data protection, intellectual property rights, contract law, consumer rights protection, and others. Law firms and lawyers will need to adapt to the complexities of e-commerce, including the issue of innovative technologies using artificial intelligence, developing new legal frameworks to resolve disputes and ensure compliance. As a result, the expert foresees a significant increase in employment opportunities in the legal sector, specifically tailored to the complexity of the e-commerce environment.
- One expert suggested that, in the near future, niche products may be available only in e-commerce. Online platforms offer a multitude of advantages, facilitating accessibility and reach for niche products that might otherwise struggle for visibility in traditional brick-and-mortar shops. This means that e-commerce plays in not only the distribution but also the survival and growth of niche markets. With the global reach of the internet, niche product manufacturers and retailers can tap into a vast and diverse consumer base, breaking geographical constraints. In addition, the convenience offered by e-commerce platforms serves to increase the appeal of niche products, satisfying demanding consumer preferences. Another expert pointed out that

e-commerce will continue to have a positive impact on the development of entrepreneurship and the SME sector, which is primarily responsible for the distribution of niche products.

- One expert said that the role of e-commerce will undeniably increase, but traditional commerce will continue to be popular due to the need for social interaction. Particularly in some cultures (e.g., the Middle East), where buying is intrinsically linked to human interaction, conversation, and bargaining, e-commerce will not completely replace traditional trade.
- One expert said that he believes that shops and marketplaces will begin to expand overseas. On a global scale, this will lead to greater internationalisation of e-commerce and greater availability of products from around the world to customers in particular countries.
- An interesting trend that is starting to become more popular among the big e-commerce players is the shift from an online shop model to a marketplace was mentioned by another expert. The incentive for other businesses to start selling on such newly established marketplaces is lower sales commissions than with market leaders such as Amazon.
- One expert pointed out that the effect of traditional trade being replaced by e-commerce will be associated with economic growth due to a better allocation of resources in the economy.

In answering the second question concerning logistics, the experts highlighted the following aspects:

- The first issue that came up in some experts' responses was the question of ecology. They pointed out that it will become increasingly important to calculate the carbon footprint of supply and packaging. The experts pointed out that the enormous amounts of cardboard, foil, paper currently consumed in order packaging processes are unacceptable in the long term. One solution to potentially reduce the carbon footprint of e-commerce is the use of reusable packaging. However, implementing such solutions requires modifications to existing logistics systems, which involves investment. Nevertheless, the growing emphasis on using green solutions may force courier companies and

online retail platforms and shops to implement reusable multipurpose packaging.

- One expert pointed out that the globalisation of e-commerce and the requirement for even faster delivery of products from various parts of the world will force faster development of air transport. Another issue raised by experts was the reduction of delivery times and the popularisation of same-day delivery. However, experts pointed out that one-day delivery will still only be possible in and around urban agglomerations because the development of same-day delivery services will require retailers to expand their network of logistics centres near major cities.
- One expert said that the acceleration of automated deliveries by autonomous vehicles will occur if labour costs rise. Automation in logistics centres and load centres will also accelerate if labour becomes more expensive. Another expert suggested that deliveries by autonomous robots driving on pavements, according to the expert, will be popular, but only in specific areas such as university campuses, gated housing estates, etc. Another expert pointed out that transport in the form of small autonomous vehicles moving on pavements is unlikely to take off, due to the low possible speed for crowded pavements and pedestrian safety issues.
- The majority of experts stated that drone deliveries will not become commonplace for safety reasons. Drones are also now increasingly associated with their use in war, so public acceptance of flying drones carrying parcels is declining. One expert pointed out that flying drones with cameras, which are standard equipment on almost every drone, could raise concerns for those concerned about their privacy. One expert pointed out that there are already areas with a ban on drone flights, which could hinder parcel deliveries. Another expert was very sceptical about the widespread use of drones for parcel delivery. He stated that there are too many obstructions in urban areas in the form of poles, trees, cables, and other infrastructure for drones to fly without problems. Additionally, he highlighted places with limited internet access due to specific infrastructure elements such as high-voltage power lines, which can hinder drone communication. According to another expert, the delivery of goods by drone will only be carried out

in specific hard-to-reach terrain (mountains, jungle, etc.). The expert stated that he finds it difficult to imagine that people will accept, for example, clouds of flying drones in urban areas.

- Experts agreed that point-of-use delivery will become increasingly popular, not least for environmental reasons. Experts predict that, thanks to the densification of the network of parcel collection points, this form will become increasingly convenient and accessible. Both deliveries to parcel lockers and collection points such as retail chains or petrol stations will become increasingly popular. One expert discussed whether consolidation of the parcel collection points market, which seems reasonable from the point of view of economies of scale, or rather competition between companies offering their parcel lockers, is more likely in the future. It is difficult to determine clearly in which direction the parcel locker supplier markets will evolve, whether monopoly or oligopoly. This will depend on the size and structure of the e-commerce market, as well as the legal regulations on space policy in each country.
- One expert suggested that urban areas with high population densities and problems with surface transport may opt for an underground pipe system. Such a system, although costly to implement, can be very efficient given the speed of delivery. The pipe transport system can be linked to a network of delivery lockers. Another expert stated that such solutions would be possible, but only in newly built modern housing estates, allowing for the design of an underground transport network.
- One expert pointed out that the future of logistics centres will be fully automated warehouses. The next step in automation will be automated transport in autonomous cars and the automation of the transfer of parcels from these cars to parcel lockers. Another expert said he believes that in the future, androids will sit in autonomous cars delivering parcels instead of human couriers.
- Two experts pointed out as a potential threat, especially for small online shops, the increasing waste management requirements, requiring e-stores to comply with many bureaucratic procedures. For small operators, the lack of resources and qualifications needed to complete the numerous submissions and forms can be a problem in the future.

Speaking on the future of e-commerce payments, experts emphasised the following areas:

- Experts emphasised that when paying electronically, convenience is important, but security is crucial. One expert pointed out the desirability of eliminating third parties (intermediaries) when making payments. However, such a solution would require full trust between the two parties to the transaction (buyer and seller).
- Experts were sceptical about the widespread use of cryptocurrency in e-commerce in the future, but one expert predicted an increase in the impact of blockchain technology on electronic payment systems. One expert noted that he is sceptical about the widespread use of cryptocurrencies in e-commerce in the current situation, but in the event of a global crisis and a sharp increase in inflation, cryptocurrencies may gain popularity again.
- One expert pointed out that current electronic payment systems available in Europe or America require a bank account or credit card to be linked to the payment system. It is therefore impossible to make electronic payments anonymously (those wishing to remain anonymous therefore use cryptocurrencies). In some Asian countries, payment systems are available where the account is linked only to a mobile phone, which can be an anonymous device with a pre-paid card. Perhaps these types of payment systems could gain popularity in other parts of the world, especially among customers who want to remain anonymous during transactions.
- Experts also highlighted the potential development of barter services, where instead of paying, the customer provides certain marketing services, such as recommending a product on social media. One expert said that in the future, it may be possible to account for the purchase of goods by the energy produced. Such a possibility would apply to prosumers with their own energy sources, such as photovoltaics or wind farms.
- One expert said that he does not expect big innovations in the e-payments market, as they are already so easy to use and convenient that it will be difficult to improve them yet.

- One expert said that a payment model based on billing for product recommendations on social media can resemble multi-level marketing, where profits are also accrued from sharing by people, related to the recommender.
- The expert said that there will be constant competition in the electronic payments market between global players such as PayPal, Visa, Mastercard, and local payment systems such as BLIK or M-Pesa. The competition will be at the level of commissions and functionality. Another expert noted that, in his opinion, convenient payment systems are being developed in various parts of the world, such as aforementioned M-Pesa or BLIK, and perhaps the direction in which global payment systems should develop would be to take the best functionalities and features from such local solutions and adding them to existing global solutions.
- One expert noted that with the potential move away from cash in many countries, it will become impossible to pay cash on delivery. This is a trend that has already forced couriers delivering parcels to have payment acceptance terminals for several years.
- One expert pointed out that retailers will be interested in simplifying and speeding up payments, due to the fact that faster payment means less time for the consumer to hesitate about the purchase. Therefore, the future of payments is one-click acceptance, without codes, authorisation, and other procedures that delay payment.
- One expert noted that an interesting trend would be consumer-to-consumer exchanges within a social media platform. C2C trade, which currently takes place on auction sites such as eBay or Allegro, could appear on social media platforms because customer networks would enable a quick flow of information about “released” products. Particularly ardent supporters of reducing the carbon footprint by reducing production would be interested in this form of trade in used items.
- Experts predict the likely development of “buy now, pay later” systems, which may be similar to the widespread adoption of credit cards in bygone eras. These deferred payment mechanisms are predicted to have an enormous impact on the growth of online retail. Inevitably, this growth of online shopping with deferred payment raises a parallel concern: the escalation of consumer debt. One expert pointed out that

deferred payments will particularly gain in popularity during a period of high inflation.

When it came to Virtual Reality technology and its use in e-commerce, some experts were sceptical and others were confident of dynamic development in the coming years. The experts raised many interesting points:

- Experts pointed out the need to have the right equipment for VR, which entails additional costs. In addition, the need to configure the hardware, get it up and running, fine-tune the focus, etc., makes experts sceptical about whether this technology will be widespread in the future, as mobile commerce is much more convenient.
- One expert predicted that Virtual Reality cafés will soon start to emerge, allowing the use of VR equipment—not just goggles, but also gloves and other additional devices. Just as internet cafés were popular many years ago, until the majority of the population had access to the internet. For VR equipment, high purchase costs are currently a barrier, so such VR cafés could be a transitional phase until the prices of VR equipment come down enough to make it accessible to everyone. Another expert pointed out that the widespread availability of VR headset could be the tipping point when retail businesses start investing in V-commerce development. Due to the higher complexity of V-commerce software than traditional e-commerce, a certain critical mass of users is required to make the investment in V-commerce worthwhile.
- One expert said there may be a proliferation of a hybrid approach, where, in a traditional shop, users can use VR goggles to transport themselves to places and situations they cannot experience in-store.
- One expert said that the barrier to entry for V-commerce will decrease with the advent of off-the-shelf solutions for V-commerce implementation. If such solutions are available in an open-source model it will accelerate the development of V-commerce.
- One expert pointed out that one of the barriers to the development of virtual commerce is that purchasing decisions cannot be made collaboratively when only one of the users has a VR headset (of course, image

transmission from VR goggles to a monitor is possible but requires additional procedures).

- One expert pointed out the high start-up costs of V-commerce implementation. The expert stated, V-commerce, if it takes off, is more likely to be among strong global brands or expensive luxury goods.
- Another issue raised by one expert was that of reflecting the touch of products. If the quality of VR gloves and suits guarantees a realistic feeling of touching products, this could increase the attractiveness of virtual commerce. One expert pointed out that generally sensoriality should increase the popularity of VR in e-commerce. Currently, VR gloves are expensive (the cheapest version costs more than €40), but it can be expected that as VR becomes increasingly popular, unit production costs will decrease, and not only gloves, but sensory sweatshirts, trousers, etc., will be more available. The shoe market would probably be happy to see VR socks available that allow to try on shoes. Such socks would most likely reduce the number of order returns, which is very high in this industry.
- One expert said that google VR is not a natural environment for humans, so perhaps there will be some innovation that will allow Virtual Reality to be used in a more comfortable way. Perhaps there will also be opportunities to carry scent, which could increase immersiveness by engaging another sense.
- One expert pointed out that Virtual Reality will influence the growth of the gaming market, as evidenced by the research presented, which indicates that games are the most popular application area for VR goggles.
- The expert concluded that Virtual Reality is wonderfully suited to present simulations and training for more high-tech and complex products. He pointed to the automotive market or specialised industries such as electronics as examples.
- The expert pointed out that there are still problems during prolonged use of VR goggles regarding headaches and eye pain. As long as these problems are present in a significant percentage of the population using VR devices, it is difficult to expect them to be widely used in e-commerce.

- An important comment was made by one expert that virtual commerce involves increased costs, building models, the need for more network bandwidth, and more server processing power. All these costs will have to be included in the price of the products. Therefore, the industries where virtual commerce is most likely to emerge first will be for high-margin luxury products.
- Considering the avatars, which will act as customer advisors in virtual commerce, expert opinion was divided. Some experts were sceptical about the idea, not seeing it as adding much value for the customer, while others thought it was a great idea, especially if the avatars represented characters that were extremely popular. One expert said that what form the avatar takes is less important to them than the expertise of the product advice given.
- One expert noted that a breakthrough in the virtual commerce market could be the arrival of new headsets from Apple. Perhaps a new quality and a powerful brand will get virtual commerce off the ground. The expert also expressed the hope that with the advent of hardware, there will also be software to set up virtual shops. Another expert pointed out that Apple has always been detail-oriented and quality-oriented, and in the case of V-commerce software, it is these two elements that can be crucial for consumers to convert to this form of commerce.
- One expert pointed out that the reason for the low interest in Virtual Reality for business could be the memory of the misguided investment in the game and environment Second Life, which was supposed to conquer the market a few years ago and was a precursor to a widespread VR environment. Unfortunately, investments in Second Life have mostly failed, and it is now a platform that should rather be considered in the context of the history of IT development. This may be the reason for the scepticism of some businesses for VR, remembering first the media fuss around Second Life and then the failure of this platform.
- One expert pointed out that Virtual Reality commerce could become popular with older people, especially those with mobility issues. It is quite possible to imagine, the existence of local VR shops (the equivalent of local neighbourhood shops), where the local community meets, and social goals are pursued in addition to shopping.

Responding to a question on Augmented Reality:

- Experts agreed that this area will grow rapidly in e-commerce. Two key areas identified by the experts where AR will play a special role are the home furnishing industry and the clothing industry. Experts pointed out that wherever the positioning of a product in a space matters, AR technology can work well.
- Experts pointed out that AR technology is already in frequent use. Experts also pointed out that, unlike Virtual Reality commerce, AR does not require consumers to have additional equipment. It is a fairly intuitive technology and simple to implement. The experts pointed out that, like any solution, there must be added value for the customer, so, for example, to encourage consumers to use QR code labels, companies can organise competitions with prizes. Attractive prizes can in addition trigger a stream of information and referrals on social media.
- The expert pointed to the gardening as a potential interesting application area for AR. When planning a garden and ordering plants online, an application using AR and having a view of the garden acreage and the plants growing in it could suggest the selection of new plants, taking into account plant interdependencies, growth rates, etc. The app, while having a preview of the plants in the garden, could also suggest types of fertilisers or plant care products dedicated to particular species, but also for specific plant problems, with, of course, the possibility of ordering them in the e-shop.
- One expert pointed out that a key criterion for the widespread use of AR solutions will be whether they facilitate the purchasing process, i.e., their ancillary function. It is also important that they make the purchasing process more attractive.
- One expert said that the popularity of in-store solutions using Augmented Reality will grow as technology advances and image quality improves.
- One expert suggested that as a complement to Augmented Reality functionalities for trying on/seeing products, there will be an AI (or traditional) advisor advising which model of goods to choose after the shopper has tried them on. Another expert said that AI advisors will be

particularly useful in explaining new products or new functionalities of products entering the market to consumers.

- Considering the implementation of Augmented Reality in online shops, one expert said that, in line with the current trend of creating systems in a composable commerce model (composing the best-of-breed e-commerce components to develop a customised solution [<https://www.netscribes.com/composable-commerce/>]), AR implementations will be ready-made modules that can be plugged into existing e-shop software.
- One expert pointed out that there is considerable pressure to introduce various innovations, even if they have no practical justification. This is due to the mentality of people (especially young people) who expect more and more new experiences. Therefore, a variety of gadgets using AR may become popular among novelty enthusiasts.
- One expert pointed out that Augmented Reality still suffers from a number of implementation problems for more difficult tasks, such as showing the fit of a fabric to a customer's body. For AR glasses or watches, the software does an excellent job, but for materials with distinctive characteristics (some stretch, others do not), a good representation of how a customer would look in a given garment is still a task that the software does not adequately handle. Perhaps more investment in providing deep neural network models with more training data, containing information on how different types of material lay on different silhouettes, will allow progress in this area as well.
- One expert said that the future of Augmented Reality is a three-dimensional image of the product (perhaps holographic) displayed in front of the customer. Additionally, through the use of additional sensors such as gloves, it would be possible to touch these goods by feeling the texture of the material, etc. The expert expressed the opinion that such solutions seem more convenient to him than VR goggles.

Expert responses on the future of social commerce included the following aspects:

- One way forward for social commerce could be to combine instant messaging, social media with shopping capabilities, a solution that WeChat offers in Asia.
- An important observation by an expert highlights the significant importance of the authority of influencers in the sphere of social commerce. Influencers, with considerable credibility, play a key role in shaping consumer choices.
- Experts indicated that they believe social media platforms will have a significant impact on purchasing decisions. Most experts agreed that SM platforms will not become the shopping platform of first choice.
- One expert noted that social commerce will primarily target people who spend a lot of time on social media, and it is not just young people. Such people will be more likely to be manipulated and have their needs artificially created, due to the long-term impact of the information environment they are in. For such people, social commerce can become the shopping platform of first choice.
- One expert noted that social media platforms will develop their marketplaces to diversify their revenues. However, the key question is whether customers will want to use these platforms. As the expert noted, this can depend on many factors, including cultural ones; in different countries around the world, the popularity of such solutions can vary widely.
- The expert pointed out that social commerce has a great opportunity for dynamic growth because “there is life in social media”. People are spending more and more time on social media, so in time they will also use it as a shopping platform.
- One expert suggested a different social commerce model. Just as in the one described in the sixth chapter the commercial elements are transferred to the social media platform, a reverse situation can be proposed, where the social media elements are transferred to the commercial platform. Customers of such a platform are offered options such as influencer videos, live-streaming commerce, liking, and commenting on products and community building opportunities on the commerce platform. The solution seems conceptually interesting, but it is difficult to say whether it will be popular with customers.

- One of the experts noted that in the future, there will be a need for regulations regarding the impact of influencers on consumer decisions. Such regulations would force influencers to sign formal contracts with the companies whose products they advertise. The agreement would require a detailed review of the product before it is recommended to customers. The expert mentioned pathological cases when influencers recommended products without first familiarising themselves with them.
- One expert noted that social commerce may be the future of e-commerce, but the form in which this will develop may be entirely new, not yet recognised.

By far the longest speeches by experts concerned the question about the areas of e-commerce where artificial intelligence will be used:

- experts agreed that the role of artificial intelligence is to provide expert advice. However, they pointed out that this is advice based on hard criteria and not marketing gimmicks. Clients expect recommendation systems, chatbots, avatars, or any form of AI-based advice to be based on sound knowledge and measurable criteria. Only this form of advice will instil confidence in customers. Any form of manipulation using AI will, eventually, be met with a wave of criticism. Another expert pointed out that the quality of the shopping advice provided by such advisors will be crucial. High usability of such solutions will be key for users. Customers are not going to accept errors or manipulation.
- One expert said that more and more decisions will be made by artificial intelligence applications. Consumers will slowly get used to having an AI advisor make more and more decisions for them. At present, there is not yet public acceptance of moving decision-making to AI applications, but perhaps as AI tools become more popular, acceptance will be greater. In the expert's opinion, this is a very dangerous step towards giving decision-making power to machines. One of the effects could be the disappearance of people's critical thinking skills and uncritical acceptance of solutions that are suggested to them by, for example, large corporations or totalitarian governments. Another expert said he was afraid that excessive use of artificial

intelligence, also in purchasing processes, may lead consumers to stop thinking independently. The expert suggested that maybe there will be a segmentation of customers into those who will willingly and fully use AI consulting and cede decision-making to their AI shopping assistants, and those who will be sceptical about AI and retain full autonomy when making purchasing decisions.

- An additional important issue raised by experts is the explainability of AI decisions. This is an issue that is also widely discussed at the legislative level, as can be seen from the AI Act proposed by the Parliament of the European Union, based on the objectives of the European Commission, which proposed the first EU regulatory framework for AI [<https://www.europarl.europa.eu/news/en/headlines/society/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence>]. Experts highlighted the risks associated with the increasing decision-making power of artificial intelligence algorithms. Therefore, the expert said, a supervising system will be necessary to control the honesty and integrity of decisions made by AI. Here, of course, there is the question of who or what and in what form the supervision would take. If it is a human, it will always be subject to lobbying, if it is an AI algorithm, objectivity will depend on the evaluation mechanisms adopted, which can be influenced by the creator of the AI algorithm, and here again we come to the possibility of influencing the outcome through the use of lobbying.
- The experts pointed out that it is advisable for artificial intelligence algorithms not only to suggest products to the customer, but to be able to guide them through the entire purchase decision process. The guide process also includes the explainability of AI decisions. This form of augmented advice would build trust and increase loyalty to a shop offering this type of service.
- One expert pointed out that AI-powered shopping assistants will be used in the same way we use search engines today (perhaps search engines will take over the function of such assistants). Such tools will be used primarily by consumers who value convenience.
- Determining whether AI advisors will be popular among online shoppers, one expert noted that, like any novelty, it is likely that some customers who like to test innovative solutions will decide to test such

solutions. If the quality of recommendations of such an AI advisor is sufficient, customers will use them by recommending this innovation to each other. For this reason, it is extremely important that the solutions that reach the market for widespread use already guarantee sufficient quality. Clients are unlikely to accept a solution where the model will be trained in a human-in-the-loop model, and they will have to answer dozens of questions about whether the advisor's recommendation suits them.

- Another issue raised by experts was the increased use of various types of sensors (elements of the Internet of Things) as a source of data that AI can use in advisory processes, both on the customer side and on the online shop or the shop's business partners (logistics companies, suppliers, etc.). Examples include intelligent devices that inform about used components, automatically generating an order in the online shop (if the user has given such instructions when setting up such a device, of course). Other examples could be fridges or cupboards, equipped with sensors and cameras, generating an order if the stock of a particular product in the household falls below a set minimum.
- One expert remarked that the use of artificial intelligence for SEO will be developed, and will include not only text, but also images, videos, metatags, and any elements that will be relevant in the future to improve search engine ranking.
- One expert highlighted the rather significant problem of data access by the AI system. If AI algorithms are to take into account a customer's purchasing capabilities, the algorithm should have access to sensitive data, such as the customer's account balance. This is likely to be opposed by a significant percentage of customers.
- One expert noted that intelligent agents to support consumers in their purchases require large computing resources and a lot of data, which will have to be processed in the cloud on the part of corporations with computing infrastructure. It raises concerns not only about the security of this data, but also about the risk that corporations could influence consumers' decisions by hiding in secret algorithms certain mechanisms that benefit corporations or their business partners. The expert pointed out that the degree of complexity of machine learning algorithms is such that corporations can hide this type of activity

in computer code and no control bodies will be able to detect it. The expert also pointed out that the increasing number of sensors conveying information about the consumer's needs (smart fridges, hoovers, shelves, etc.) and putting purchasing decision-making in the hands of intelligent agents will benefit manufacturers, so there will be incentives from large manufacturers to implement such solutions.

- One expert noted that AI will be increasingly used to generate short product advertising videos. Videos, just like photos and product descriptions, can be generated in real time, taking into account customer preferences. The expert said that in his opinion, the future of e-commerce is a multisensory environment in which AI adjusts images (static and moving), texts, music, and scents to the customer's preferences.
- One expert noted that among the application areas for artificial intelligence in e-commerce, there will be entirely new ones that we are currently not even able to name and define.
- Summarising the consideration of the use of AI in e-commerce, experts stressed that what should characterise AI algorithms is reliability, transparency, and honesty.

The information from the experts shows various aspects of the future of e-commerce. The author does not wish to judge which of the experts' opinions about the future are more likely to come true. The coming years will verify if and on which issues the experts were right.

### **8.3 Likely Scenarios of Changes in E-Commerce in the Coming Years**

What will the future of e-commerce look like? Given the dynamics of the emergence of change and innovation over the past two decades, it is difficult to make accurate predictions. Arguably, some of the innovations that will emerge in the coming years will again surprise us. However, it is possible to try to identify some trends or technologies that are highly likely to be important in e-commerce in the coming years. This chapter aims to pull together and present the most important aspects that will

affect how we order, how we receive shipments, and how we pay for them.

## The Future of Customer Ordering Methods in E-Commerce

Figure 8.1 serves as a roadmap for understanding the technologies and innovations that will influence consumer behaviour in the future of e-commerce. The author has selected several elements that he believes will have a significant impact on the way customers order in the future:

**Ordering Through a Social Media Platform:** As social media platforms transform into marketplaces, consumers are likely to shift in part from traditional e-commerce sites to purchasing directly through their favourite social media platforms.

**Recommendations from Influencers:** Leveraging the trust and relationships that influencers share with their followers, influencer-based marketing is expected to become an important driver of online purchasing decisions.

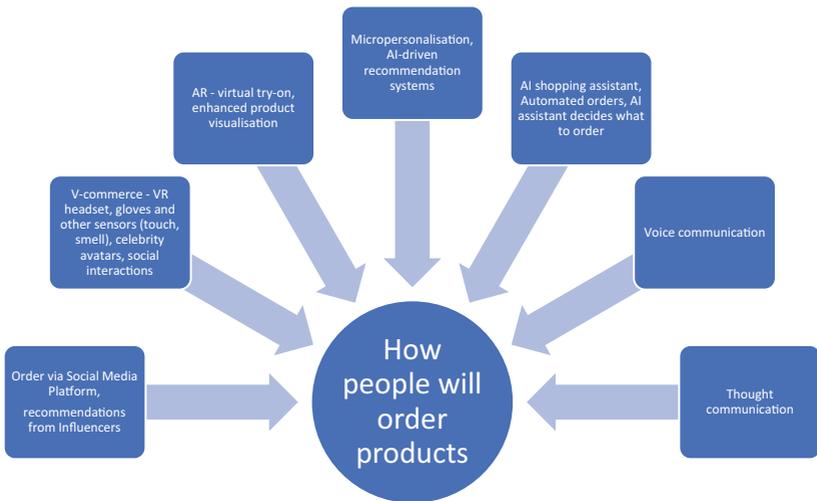


Fig. 8.1 Technologies and areas that will influence the way e-commerce orders are made in the future

**V-Commerce:** Virtual Reality is set to offer a whole new paradigm for e-commerce. Equipped with VR goggles, gloves, and other sensors that enable touch and smell, shoppers will be able to enjoy immersive shopping experiences served by celebrity avatars.

**Augmented Reality:** Augmented Reality will provide a solution, allowing consumers to virtually try out or place products in their real environment before making a purchase. Perhaps there will be integration of VR and AR in the form of XR solutions.

**Micropersonalisation, AI-Based Recommendation Systems:** Using machine learning algorithms, future e-commerce platforms will offer hyper-personalised shopping experiences, providing product suggestions based on a range of consumer data, metadata, and behaviour.

**AI Shopping Assistant, Automated Orders:** Advanced AI-based virtual assistants are expected to guide shoppers through the entire shopping process, offering personalised advice. As already mentioned, the AI shopping assistant in VR will be able to take the form of a celebrity avatar, including well-known experts in a particular shopping field. More and more orders will be placed fully automatically, including by smart appliances such as fridges, washing machines, etc. As AI capabilities develop, more and more purchasing decisions will be made by AI personal shopping assistants.

**Voice Communication:** As voice-activated assistants become ubiquitous, voice commands are set to become a convenient mode for browsing products and placing orders. Voice communication with online shops seems to be a solution that will grow in popularity in the near future, due to the lack of additional hardware requirements on the consumer side and the high added value. The consumer will be able to communicate with the e-shop by voice while doing other activities such as cooking, running, or watching TV. Also in virtual commerce, voice communication will play a key role in facilitating communication and replacing VR controllers in some areas.

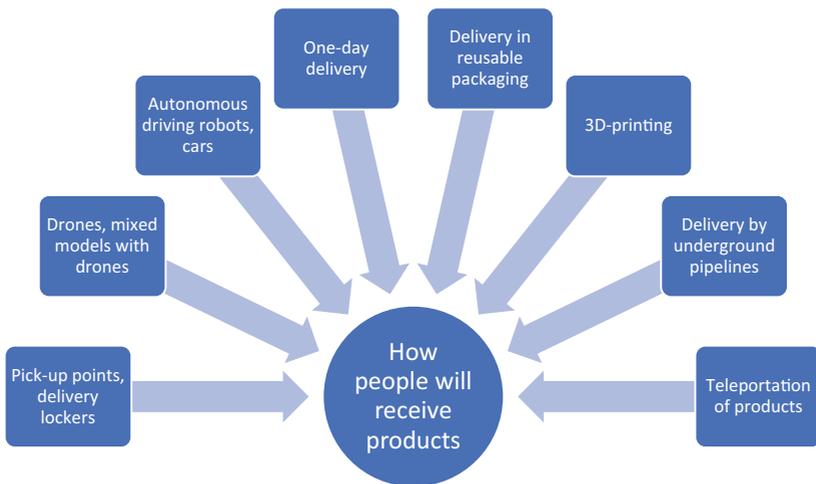
**Thought Communication:** The most futuristic aspect of the chart suggests a world where neural interfaces could allow for direct thought-based interactions with e-commerce platforms, making the entire shopping process instantaneous.

By presenting these key issues and technologies, Fig. 8.1 aims to provide a holistic view of innovations that could radically change the way consumers approach online shopping. From the impact of social media and innovative technologies to the rise of artificial intelligence-based personalisation, the chart depicts a future where e-commerce will become more seamless, intuitive, and deeply integrated into our daily lives.

## The Future Trends of Delivery in E-Commerce

An essential area for e-commerce is the delivery of goods. Many innovative technologies are expected to develop in this area in the coming years.

Figure 8.2 provides an overview of upcoming changes in e-commerce delivery methods. It outlines innovative approaches and technologies that are likely to affect the ways in which consumers receive online orders:



**Fig. 8.2** Technologies and areas that will influence the way e-commerce products are received in the future

**Pick-Up Points, Delivery Lockers:** The concept of a dense network of pick-up points, such as parcel machines (delivery lockers) or pick-up centres located in shops, petrol stations, etc., is becoming more and more popular every year. This form of parcel delivery is an efficient, low-cost alternative to individual home delivery. In the coming years, this form of delivery can be expected to continue to grow thanks to an increasing number of additional features, such as the handling of reusable packaging and much more.

**Drones, Mixed Drone Models:** Drone technology is being highlighted as a way to offer faster and more sustainable deliveries, especially for lightweight parcels. Drone delivery could reduce the need for larger, less efficient delivery vehicles. Perhaps delivery models involving a combination of drones and autonomous delivery vehicles will become popular once the legal issues surrounding drone and autonomous car delivery are resolved. Solutions combining drone and parcel machine deliveries are also possible.

**Autonomous Driving Robots, Cars:** Autonomous delivery robots seem to be the solution to the last mile problem. Small robotic vehicles could drive around neighbourhoods, delivering packages right to the door. Autonomous cars could be used to deliver products to pick-up points, such as delivery lockers, or from pick-up points to the customer.

**Same-Day Delivery:** The expectation for fast delivery is growing, so same-day delivery options may soon become the norm rather than the exception, especially in large urban areas.

**Delivery in Reusable Packaging:** Pressure to reduce carbon footprint will force changes in parcel packaging processes and a slow shift to reusable packaging.

**3D Printing:** With the advancement of 3D printing and materials engineering technology, a turnaround in e-commerce deliveries is expected, where products can be 3D printed at the customer's site or at a location near the consumer, reducing shipping and storage costs while enabling fast delivery.

**Underground Pipeline Delivery:** This futuristic option envisages a network of pipelines, perhaps similar to pneumatic pipes, through which

parcels could be sent directly to homes or, more cost-effectively, to collection points. However, such solutions are likely to appear in newly built areas.

**Teleportation of Products:** The most futuristic of the methods presented suggests a world where teleportation technology allows products to be transmitted instantly from the retailer directly to the consumer's location. Of course, as far as teleportation is concerned, the author does not foresee this being possible in the next decade, but further in the future we may gain an understanding of how to deal with quantum teleportation of objects.

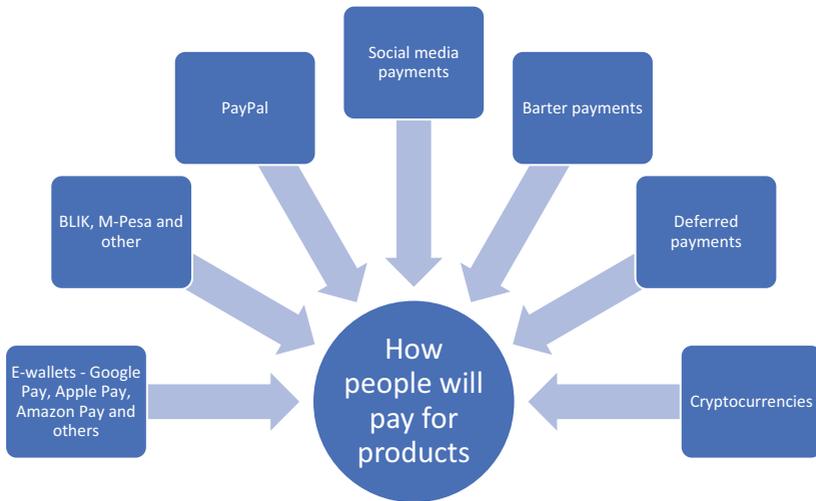
Summing up, Fig. 8.2 shows a set of possibilities that could shape the future of e-commerce delivery. From drones to teleportation, it highlights a future where receiving products ordered online becomes faster, more convenient, and even more surprising, meeting growing consumer expectations, and pushing the boundaries of technological possibilities. Of course, traditional delivery by courier or post to the end recipient will still occur, but in the author's opinion the share will decrease, which is why it is not included in Fig. 8.2.

## Future Trends in E-Commerce Payments

What will payments for goods bought online look like in the future? Will entirely new technologies or solutions emerge, or will currently existing ones maintain their popularity? Fig. 8.3 shows solutions indicating the future of payment options in the e-commerce sector:

**E-Wallets (Google Pay, Apple Pay, Amazon Pay, and others):** Digital wallets offer secure, fast, and simple payment options. It can be predicted that these forms of payment will continue to grow in popularity.

**BLIK, M-Pesa Payments:** As a mobile payment service mainly used in Poland, BLIK because of its simplicity, may gain popularity worldwide, serving as an alternative to more established forms of payment. Similarly, M-Pesa and other payments that are currently only popular in selected parts of the world may extend the boundaries of their popularity.



**Fig. 8.3** Future trends in payment methods in e-commerce

**PayPal:** Representing the old guard of online payments, PayPal continues to grow, offering features such as One Touch for quick payments and forming partnerships to expand its network.

**Social Media Payments:** Direct payments via social media platforms are becoming a convenient way for consumers to pay without leaving their favourite apps. An innovation in payments can be social payment when part or all of the value of a transaction can be realised through a user's activity on social media—sharing information about a product and recommending it to friends. The amount of the price reduction may depend on the marketing power of the user's account as calculated by an indicator taking into account, for example, the number of followers, the number of reactions to other users' posts, etc.

**Barter Payments:** An interesting throwback to the past, the barter system could make its presence felt in e-commerce. Barter exchanges could begin to gain popularity if a methodology is developed and implemented to settle transactions through convenient smartphone apps. As mentioned above, barter exchanges could include social media activity or other areas such as energy production by prosumers.

**Deferred Payments:** “Buy now, pay later” models are gaining popularity, giving consumers the option to defer payments or break them down into smaller, more manageable instalments. The rise in popularity of deferred payments in e-commerce may unfortunately lead to a dramatic increase in consumer debt.

**Cryptocurrencies:** Digital currencies such as Bitcoin and Ethereum are slowly becoming more widely accepted as payment options, but the high volatility of exchange rates still makes most online retailers wary of accepting cryptocurrencies.

Summing up, Fig. 8.3 provides a broad view of the future of e-commerce payments, presenting a combination of established methods and new technologies or possible solutions. The solutions presented are designed to capture the transformational opportunities facing the online payments sphere, making it a valuable addition to any discourse on the future of e-commerce.

## Reference

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# 9

## Summary

Due to the diverse nature of the individual chapters, the summary is divided into individual chapters. The book as a whole is summarised in the last chapter, which brings together the information contained in the book.

### 9.1 Summary of Chapter 1: Measuring the Impact of E-Commerce on the Economy

The development of e-commerce affects many areas of the economy and has significant implications for many sectors of the economy. The attractiveness of e-commerce stems from its efficiency, in particular, in reducing transaction costs, facilitating access to the global market, and enabling global branding. E-commerce has a significant impact on the labour market, creating jobs related to e-commerce and eliminating those of traditional trade. In addition, e-commerce is transforming a wide range of business operations, including product development and distribution.

Quantifying the impact of e-commerce on the economy requires an approach that includes both macroeconomic indicators, such as GDP growth, employment, and microeconomic elements, such as business costs and consumer behaviour. This dual approach allows the impact of e-commerce to be assessed across the economic spectrum.

The shift to e-commerce has been significantly accelerated by the pandemic, as evidenced by the impressive growth rates of major e-commerce players and forecasts predicting a significant CAGR of global e-commerce retail sales until 2025. The shift from traditional to e-commerce is evident in various sectors, including the spectacular growth of e-grocery sales in the United States.

The field of e-commerce is a dynamic catalyst in the labour market, changing employment trends, and generating new occupations. A reliable measure of the impact of e-commerce on the labour market is provided by the sector's employment figures, which have seen marked growth in recent years, as seen by companies such as Amazon and Alibaba Group. This expansion indicates a migration of the workforce from traditional retail to the digital market. Furthermore, e-commerce has spawned a number of new professions, including shopping influencers, SEO copywriters, and online shopping assistants, among others. However, some of these professions, such as SEO copywriting, may disappear as LLMs take over these roles.

Despite the significant impact of e-commerce on trade globalisation, global export growth has not been observed in recent years, which can be explained by the existence of a full range of factors that determine the value of global exports, such as business cycles, political decisions, and many others.

E-commerce is significantly lowering the barriers to entry for new businesses. The advent of user-friendly e-commerce platforms, such as WooCommerce and Wix Stores, has significantly reduced the need for advanced technical knowledge or significant capital.

E-commerce can significantly extend the life cycle of products, not least because they do not need to be presented in expensive display areas. This allows slow-moving products to be offered continuously, extending their time on the market.

Online shop software has evolved over the past quarter of a century, significantly improving the user experience from both the front-end and back-end. Front-end solutions are increasingly personalised and responsive, increasingly using artificial intelligence-based recommendation systems that tailor product offers to individual consumers. The back-end, which includes the management panel, has become extensive, integrating with payment and logistics partners and a variety of marketing tools.

In parallel to these advances, online marketing has become more complex and targeted, driven by growing e-commerce competition. Marketing platforms from corporations such as Google and Meta use huge databases of detailed user information to offer targeting accuracy. However, advances in targeting and marketing have resulted in a worrying by-product—the loss of user privacy.

One area that is less often discussed is the impact of e-commerce on tax avoidance practices. E-commerce businesses that are not tied to a physical location are more susceptible to tax avoidance than traditional retail businesses. Such practices not only introduce competitive inequalities, but also affect the government's tax revenue, pointing to the need to review regulation to address the challenges posed by e-commerce in the fiscal environment.

In conclusion, the first chapter showed the important role of e-commerce in the economy by analysing the impact of e-commerce on several specific areas selected for the book.

## **9.2 Summary of Chapter 2: The Development of Different Logistics Solutions in E-Commerce**

The e-commerce sector is having a major impact on the logistics sector. The growth of online shopping has led to an increase in parcel shipments, thereby increasing the sector's revenues and enabling investment in innovative delivery methods. This is evidenced by the upward trend in global parcel shipping volumes, which are expected to continue to grow.

The last mile problem—delivery to the end customer—remains a significant challenge, increasing the cost of delivery in e-commerce. In response to the last mile problem, innovative solutions such as collection delivery points have emerged. These are divided into staff-operated and self-service types, with the former possibly involving local agencies and the latter including automated parcel machines (delivery lockers). Self-service parcel machines have grown in popularity, especially during the pandemic—thanks to innovations such as lockers for multiple parcels and contactless collection via a smartphone app. The growth in popularity of this form of delivery is likely to be supported by the fact that delivery lockers generate a smaller carbon footprint than delivering parcels to the end recipient's door.

The increase in parcel volumes has driven the evolution of the logistics sector, favouring the emergence of new delivery methodologies. Existing innovations such as parcel machines are being complemented by emerging technologies such as drone and robotic delivery. Investment in autonomous delivery operators, including autonomous vehicles, robots, and drones, has exceeded \$8 billion over three years (2020–2022).

Delivery robots are evaluated on a variety of metrics, including their reach, payload, speed, energy efficiency, size, adaptability to terrain, and additional features. The search for optimal solutions aims to balance these parameters with cost-effectiveness. The most important aspect of autonomous delivery robots is their ability to navigate safely, as accidents may result in regulatory action blocking their deployment. E-commerce delivery robots require reliability, adaptability, durability, ease of use, and performance.

The prospects for implementing parcel delivery by drone have been comprehensively analysed. The advantages of drone deliveries are first and foremost speed and flexibility, enabling fast deliveries compared to traditional means, bypassing ground traffic, and providing direct routes, with speeds potentially exceeding 100 km per hour. From an economic point of view, drones promise up to a nine-fold reduction in delivery costs compared to van-based deliveries, due to the lack of a human operator. From an environmental perspective, electric-powered drones could make a positive contribution to reducing emissions and traffic jams on the roads, thus supporting sustainability efforts in urban environments.

However, the implementation of drone technology in e-commerce is not without its challenges. The limited carrying capacity of most drones, along with limited operational range due to battery life, currently limits their use to smaller parcels. Regulatory airspace restrictions also pose significant challenges, as well as security concerns, and invasion of privacy. Addressing these issues requires strategic development of routing protocols and dedicated air paths.

Innovative hybrid models that combine drones with other delivery methods appear promising. One such model involves drones operating from delivery trucks, maximising efficiency by making last mile deliveries while utilising the capacity of the truck for numerous loads. Drones can be dispatched from mobile landing platforms on delivery trucks to speed up delivery.

An unexplored model in the literature, proposed in the second chapter, involves the integration of drones with delivery lockers, which could offer a fast door-to-door service through drone deliveries directly from parcel machines to the customer, increasing convenience.

An important aspect resulting from increasing customer expectations is the reduction in delivery times. Online shops and sales platforms will increasingly try to structure their logistics in such a way as to enable same-day delivery. However, this will involve making investments in new logistics centres.

With the increase in the number of parcels shipped, return logistics is becoming increasingly important due to the high number of returns in online shopping. A well-thought-out returns logistics strategy, including clear communication about returns policy, flexible return options, and the use of reusable packaging, is essential for customer satisfaction and competitive advantage in e-commerce.

The digital dimension of e-commerce is growing with the incorporation of 3D printing technology, enabling the online transfer and local printing of an increasingly wide range of products. The explosive growth of the 3D printing market highlights its potential to change the way goods are produced and delivered. E-commerce platforms can increasingly integrate such technologies, where digital delivery using 3D printing can become more commonplace.

Innovations in reusable packaging in e-commerce reflect the desire to protect the environment. These advanced packs can have built-in GPS and, thanks to their robust design, ensure the safety of goods during transport.

In conclusion, Chapter 2 analyses the transformation of the logistics sector caused by the growth of the e-commerce sector. The chapter examines innovative last mile delivery solutions, including parcel collection boxes. It also analyses innovative delivery methods such as drones and autonomous robots. In addition, the need to reduce delivery times is highlighted and the essence of reverse logistics is briefly discussed. The chapter concludes with a discussion of the use of 3D printing as a method of shipping items online and the adoption of innovative reusable packaging solutions for e-commerce.

### **9.3 Summary of Chapter 3: Current and New Payment Methods in E-Commerce**

The development of electronic payment systems has been an integral part of the expansion of e-commerce. The beginnings of online shopping characterised by payment on delivery, quickly evolved towards the use of credit cards, in parallel with the development of electronic banking, and the introduction of electronic money transfers. PayPal, in particular, became a pioneer, facilitating international trade with its cross-border money transfer capabilities. Mobile commerce then brought smartphone-based payments, including Apple Pay and Google Pay, while payment integrators consolidated these diverse offerings. However, PayPal remains a hugely popular payment service provider, with 435 million active users by 2022. Despite its successes, PayPal faces declining growth rates and increasing competition from Amazon Pay, Apple Pay, and Google Pay, among others.

Stripe is emerging as a leading provider of payment software by providing, among other things, robust APIs that facilitate e-commerce transactions. The ease of integration of payment services with the most popular e-commerce software is driving the exponential growth of these solutions. The platform's security measures, such as advanced machine

learning for fraud detection, are a definite advantage for increasing transaction security.

BLIK payments have been presented as an innovative and convenient form of payment. Its creation in 2015 by the Polish Payments Standard and its subsequent growth to becoming the leader of the main mobile payment method in Poland was presented. However, despite more than one billion transactions in 2022, BLIK's global expansion is uncertain and requires strategic alliances with global payment entities to expand its international reach.

Cryptocurrency payments are being presented as a controversial, e-commerce payment segment, with benefits such as low transaction fees and fast processing times attractive to both merchants and consumers. Despite the projected growth of the cryptocurrency market and the integration of digital currencies by major financial service providers such as Visa and PayPal, the adoption rate among merchants is limited. This reluctance is attributed to the volatility of cryptocurrencies, a lack of widespread understanding of blockchain technology, and issues of mistrust by consumers for this form of payment.

E-wallets, functioning as digital equivalents to traditional wallets, consolidate financial and transactional information to provide a secure online payment system. The ubiquity of e-wallet applications, such as Google Pay, PayPal, Amazon Pay, and Apple Pay, underscores their growing importance, and one can foresee the potential decline of conventional cash and card transactions. E-wallets provide numerous benefits, including expedited transactions, enhanced security, and a simplified payment process, which solidifies their place as a pillar in the future of e-commerce.

The development of deferred payments marks a shift away from instant payment models, offering a paradigm in which consumers can delay their financial obligations until after they receive goods or services. Deferred payments increase consumers' financial flexibility. However, it raises critical concerns about growing consumer indebtedness, requiring regulatory oversight similar to that governing consumer credit.

Combining the areas of e-commerce and social media, the author proposes the concept of social media-linked payments, based on the premise of using user-generated promotions as a transaction currency.

The proposed model extends the influencer paradigm to the general public, in which discounts and rewards are dependent on promotional activities on high-profile platforms such as Facebook, Instagram, and TikTok. This system, while promising in terms of increasing customer engagement and vendor visibility, also poses transparency, privacy, and security challenges that require careful implementation.

In conclusion, Chapter 3 provides an overview of the dynamic changing field of e-commerce payment methods. It conducts an analysis of the market, covering established players such as PayPal and Stripe, as well as emerging trends such as BLIK payments, cryptocurrency payments, e-wallets, and deferred payment options. In addition, the author suggests integrating payment systems with social media promotion, suggesting interesting prospects for the future of online transactions.

## 9.4 Summary of Chapter 4: Virtual Commerce

The concept of virtual commerce is one of the potential directions for the development of e-commerce. However, certain conditions are needed for the proliferation of V-commerce. Considering the demand side (customers), the cost of VR equipment should be lower. Virtual commerce should offer convenience, providing an immersive experience, allowing customers to view products in 3D and touch and try products using VR peripherals.

Considering the supply side (online shops and platforms), the availability of V-commerce implementations is currently a key point. The emergence of standardised implementations can facilitate widespread adoption. Companies that pioneer V-commerce have the opportunity to become market leaders and initially gain windfall profits, but they also need to implement effective marketing strategies to convince consumers to use VR devices when shopping.

V-commerce, despite its many advantages, is fraught with unresolved problems and important risks. A fairly frequent problem associated with the use of VR goggles is Virtual Reality sickness. Despite technological

advances, this issue is still a problem for some users. Another issue relates to potential addiction. Prolonged use of Virtual Reality can lead to addiction due to the altered perception of time and the appeal of the virtual environment, potentially discouraging users from returning to the real world. The potential problem of shopping addiction in a V-commerce environment is also worth mentioning.

To address these issues, several safeguards have been proposed for virtual commerce. Preventing the use of lending mechanisms during V-commerce transactions can protect users from over-indebtedness, especially for impulsive purchases in the VR world. Allowing consumers to withdraw a transaction without giving a reason, as is practised in some countries for e-commerce, can provide a safeguard for impulsive purchases made in Virtual Reality. Displaying the time spent in Virtual Reality or implementing an automatic shut-off mechanism after a certain period of time can help users to remain aware of excessive VR use and encourage breaks, especially for children. Implementing laws prohibiting subliminal manipulation or other addictive elements in V-commerce shops can protect consumers from unethical practices.

A key element of the fourth chapter is the presentation of the results of a comprehensive survey conducted by the author among VR goggle users to explore the potential of VR technology, in e-commerce applications. The methodology of the study involved reaching out to VR users via social media and using VR-related interest groups on Facebook. Polish and global VR users from twenty-six countries participated in the survey. The survey consisted of twenty-one questions, including demographic information, VR usage patterns, equipment ratings, and opinions on VR's role in e-commerce. It is a valuable resource for understanding the perspectives and experiences of VR goggle users, shedding light on the potential role of VR in the future of e-commerce.

The first part of the analysis of the survey results provides insight into the demographics, age, gender, place of residence, labour market status, country of respondents, and educational level of the survey participants. The weighted average age was 30 years for the Polish population and 48.8 years for the global population. Despite the significant age difference, respondents from both groups had similar views on many aspects of Virtual Reality. The survey included an optional question about the

country of origin of respondents, revealing a diversity of countries among participants. The three countries with the highest proportion of respondents were the United States (35%), the United Kingdom (22.2%), and Canada (10%). The educational level of respondents varied. Both populations showed a minority with primary and vocational education, while the majority had secondary or tertiary education. It is worth noting that those with a technical education dominated in both populations, reflecting the technical nature of VR technology.

The analysis of the results of the core part of the survey begins with online shopping frequency. In Poland, the majority of respondents (66.1%) shopped online several times a month, while in the global population 46.9% also shopped with the same frequency. These results suggest that VR users are active online shoppers, which forms the basis for the study of e-commerce applications in VR.

Considering the brand and model of VR goggles used by respondents, Oculus was the dominant brand, with the most popular model being the Meta Quest 2. Respondents rated the immersion level of their VR goggles on a scale of 1 to 10, where 10 represents maximum immersion. Both Polish and global users gave high ratings, with a weighted average of 7.46 and 7.99, respectively. Users rated the quality of the VR controllers on a scale of 1 to 10, with ratings indicating positive reception. Polish users gave an average rating of 8.17, while global users rated the controllers slightly higher, at 8.20. Respondents were also asked to rate the image quality of their VR goggles on a scale of 1 to 10. The results showed slightly lower ratings compared to the immersion and quality of the controllers, with Polish users averaging 7.08 and global users 7.68. This suggests that some VR goggles may need further improvement in image quality, particularly for e-commerce applications.

Considering the ownership of additional VR devices, only VR controllers were common, and ownership of other VR devices such as VR gloves, VR outfits, or cyber boots was less common, with less than 5% of users owning them.

The main use of VR goggles indicated by respondents was gaming, with 99.1% of Polish users and 95.4% of global users. Other uses, such as education or sports/fitness, were also popular, highlighting the variety of uses of VR goggles. It is worth noting that none of the respondents

mentioned using VR goggles for shopping, probably due to the limited availability of VR shopping platforms.

The majority of respondents highlighted the immersive gaming experience as the main advantage of VR headsets. In addition, a significant proportion of users cited the ability to virtually explore remote locations as another advantage, especially when viewing 360-degree videos. Users also identified the advantages of VR headsets in sports, fitness, and professional training. However, none of the respondents mentioned the potential use of VR goggles in e-commerce, suggesting that this area has yet to be recognised and adopted.

In terms of disadvantages, respondents reported various issues, including the risk of physical injury from collisions while wearing VR goggles. Users worldwide expressed concerns about losing their sense of time while using VR, and both groups expressed concerns about privacy and surveillance. Some users reported discomfort and adverse physical reactions, such as nausea and eye fatigue, when using VR headsets. There were also concerns about addiction, detachment from reality, and potential risks to children.

The most important part of the survey, given the main objective of the study, concerned the potential advantages of online shopping in Virtual Reality. The survey strongly suggested that the ability to view products in three dimensions was considered an important advantage by the majority of respondents (79.5% of Polish VR users and 76.9% of VR users worldwide). Another highly rated advantage was the ability to view products in their original environment (68.8% of Polish VR users and 55.4% of global VR users). In addition, respondents envisaged more advanced applications, such as virtually trying on clothes or testing cars, indicating the potential for wider use of VR in various industries. Interestingly, only a quarter of respondents expressed interest in being able to touch products with VR gloves, suggesting limited experience with the technology. Some users (10.7% of Polish users and 15.4% of global users) did not see any benefit in VR shopping. It is worth noting that the survey showed a high level of correlation between the responses of Polish and global VR users, suggesting that the perceived benefits of VR shopping are consistent regardless of the user's location.

The survey also explored users' attitudes towards the use of celebrity avatars in virtual shops. While some users expressed interest in the concept, a significant proportion indicated that celebrity avatars would not influence their purchasing decisions. The author speculates that celebrity avatars may be popular in virtual online shops in the future, but this remains a hypothesis to be tested.

Given the opinions of VR users on the effectiveness of recommendation systems in VR environments, a slight majority agreed that they can be effective. Finally, the survey examined VR users' concerns about vulnerability to manipulation by AI-based software in VR e-commerce and a significant percentage of users acknowledged the potential risks.

In conclusion, the survey results suggest that VR users are open to the idea of shopping in Virtual Reality environments, recognising the advantages of immersive shopping experiences. However, the future of VR in e-commerce will depend on the availability and quality of VR shopping solutions in the market.

## 9.5 Summary of Chapter 5: Augmented Reality in E-Commerce

Incorporating Augmented Reality into e-commerce enriches the shopping process by connecting digital information to the physical world. Research highlights AR's ability to increase immersion and enjoyment, positively influencing consumer behaviour.

Implementing AR technology in e-commerce offers many tangible benefits. It enhances product visualisation, provides a virtual try-on experience, and increases customer engagement—each of which contributes to reducing purchase uncertainty and increasing customer trust in the brand. AR's ability to simulate a zoomed-in view of products and provide a 360-degree view of products eliminates the limitations of physical distance when shopping online. Furthermore, AR serves as an innovative marketing and branding tool, offering companies the ability to create campaigns and interactive advertising.

Nevertheless, it is important to be aware of the temporary nature of the “novelty effect” associated with AR. As time passes, consumers' initial

excitement may wane. For the use of AR to provide a competitive advantage in e-commerce, its implementation must go beyond mere novelty by providing significant value to users. Widespread user acceptance of AR is another hurdle, as AR is still a novelty with which not everyone is familiar.

Privacy issues are also important, as AR applications often involve the risk of accessing a significant amount of data, e.g., pictures of the consumer's surroundings, face, etc., which requires robust security measures and clear user consent protocols to protect consumer privacy.

The AR use cases presented in Chapter 5 illustrate the versatility of AR in providing enriched product information, as evidenced by the fashion and beauty sectors, where AR facilitates virtual fitting rooms or 3D product previews, IKEA, to help customers make informed decisions. Virtual showrooms and personalisation options are illustrated by the NIKELAND digital platform, while remote assistance, as seen in the Vuforia Chalk app, highlights the customer support brought by AR. Marketing campaigns integrated with AR are elevating traditional approaches to interactive experiences, as evidenced by the Pepsi and BMW campaign examples. The role of social media in AR commercialisation is evident in its integration with platforms such as Instagram, increasing brand visibility, and user engagement. Interactive product labels represent another dimension of AR's commercial potential, transforming packaging into a portal for extended brand storytelling and consumer interaction, as demonstrated by Pure Origin coffee.

The final part of the fifth chapter identifies developing trends in AR applications. Firstly, one promising direction is development of Extended Reality (XR), combining Augmented Reality and Virtual Reality. The combination of AR and VR will enable customers to visualise products in their real environment which, combined with sensory experience, can significantly enhance the shopping experience in a virtual environment. Secondly, AR-based social shopping is emerging as a significant trend. This will enable collaborative live shopping, integrating real-time interaction with friends and family. The use of AR in livestreaming and social commerce, where consumers can virtually try on products using AR filters and share the experience on social media, enhances whisper marketing, increasing brand reach. Thirdly, the use of AR can extend

beyond traditional wearables such as smart glasses and smartwatches. Fourthly, AR is catalysing increased product personalisation, which can be directly integrated into manufacturing processes. Finally, AR is increasingly being used for educational and corporate social responsibility purposes. It can enrich the product selection process by providing detailed visualisations and information overlays that not only illuminate product features, but also communicate values such as ethical sourcing.

In summary, the applications of AR in e-commerce are manifold, and the coming years will probably show many more ideas for the use of this technology in e-commerce.

## 9.6 Summary of Chapter 6: Social Commerce

Chapter 6 presents selected aspects and developments of community trading. User-generated content is a key element of social media, so the discussion on social commerce, once defined, began with a characterisation of UGC. Users on social media platforms share shopping experiences, product reviews, and recommendations, significantly influencing the purchasing decisions of those connected to social networks. This is based on the theories of social proof and peer influence. UGC, which includes various forms such as user ratings, testimonials, photos, videos, and social media posts, comes from everyday consumers sharing their authentic experiences and opinions. This transformation in consumer behaviour has shifted trust from traditional marketing activities to social media influencers. SMIs with a significant number of followers on platforms such as Instagram, YouTube, and TikTok have the ability to influence the opinions and behaviour of their followers. They bridge the gap between brands and consumers by creating sponsored and unsponsored content, including product reviews and recommendations. Influencer marketing requires authenticity, and brands are looking for SMIs whose values align with their own and whose followers represent their target audience. This strategy increases brand visibility, especially among younger consumers, and can potentially increase sales and brand loyalty.

E-commerce on social media platforms is a new trend that is likely to become an important part of commerce in the future. Platforms such as Instagram, Facebook, TikTok, and Pinterest are extending their functionality to include elements of the e-commerce marketplace. Companies can set up online shops directly on their social media pages, allowing users to discover, explore, and buy products without leaving the social media platform. Social commerce offers numerous benefits to users, including exposure to user-generated content, product recommendations, and reviews. In addition, personalised advertising integrated with social media platforms increases companies' marketing arsenal, enabling them to deliver tailored advertising and product recommendations. Additionally, social commerce has opened up new horizons for businesses of all sizes, even microbusinesses, enabling them to reach a wider audience and compete effectively in a dynamic marketplace.

As the social commerce environment is changing all the time, several key areas are predicted to have a significant impact on the evolution of social commerce. The first of these is increased personalisation. The increasing amount of user data stored by social media platforms, combined with the increasing effectiveness of machine learning algorithms, is expected to provide deeper insights into individual shopping preferences. This increased personalisation should contribute to improved conversion rates. The second area relates to social VR and AR experiences. The development of VR functionality on platforms such as Meta is significant with the potential for virtual storefronts, AR product visualisations, and interactive product try-ons bridging the gap between online and in-store shopping. The third area concerns the combination of social commerce and livestreaming. The integration of live commerce with social media platforms is gaining popularity, particularly through live shopping events created by influencers. Future innovations in this area could include Augmented Reality fitting rooms and live interactions with avatars of other users participating in live broadcasts using VR headsets and VR suits. Virtual influencers may also become increasingly used by businesses, given their cost-effectiveness and potential for 24/7 streaming. Another important direction for social commerce is social commerce on niche platforms serving specific interests or industries. These platforms will offer companies the opportunity to connect with

highly targeted audiences. It is also likely that the integration of instant messaging into social media platforms will play a significant role in the future. It is also important to note that future social commerce companies are likely to emphasise ethical and sustainable practices, aligning with consumers' growing awareness of social and environmental issues. Brands that integrate social responsibility into their strategies can gain a competitive advantage.

However, shopping on social media platforms has its drawbacks, including security and privacy concerns, as well as the problem of impulse buying. The risk of sophisticated persuasion algorithms taking control of user behaviour, especially in the context of social commerce, poses ethical and financial risks. These mechanisms exploit the fear of missing out and the influence of peers, potentially driving impulsive purchases. In addition, customers are vulnerable to fraudsters who, by exploiting trust in the social platform, can set up fake accounts and defraud customers of money and information. In addition, intrusive advertising and tracking of user behaviour on social media platforms can lead to users resenting these platforms or adopting ad-blocking tools.

In conclusion, social commerce is likely to grow rapidly, offering businesses and consumers many opportunities. As it evolves, responsible advertising practices, consumer education, and ethical considerations will play a key role in ensuring that social commerce remains a positive and user-centric force in e-commerce. Companies that are able to harness the innovations of social commerce, while at the same time behaving ethically, will be able to achieve a competitive advantage and strengthen their brand.

## 9.7 Summary of Chapter 7: Artificial Intelligence in E-Commerce

Consideration of the use of artificial intelligence in e-commerce began with defining the concept of artificial intelligence, which proved to be a non-trivial task. After pointing out several different approaches to defining the concept available in the literature, ChatGPT was asked how it would define the term. Analysing the proposed definition, it was felt

that the artificial intelligence tool correctly defined what AI is, and this definition was adopted for further analysis.

Due to the very numerous areas in which AI plays a role in e-commerce, only some of them were selected and are discussed in Chapter 7.

The role of artificial intelligence in e-commerce order fulfilment is increasingly important due to the critical importance of fast and accurate order fulfilment to meet customer expectations. Mobile Robot Fulfilment Systems introduce an innovative approach by combining mobile shelving, picking stations, and autonomous robots. These robots use advanced sensors, cameras, and mapping technologies to navigate complex environments, optimising picking routes, and improving productivity. Integrating these technologies into e-commerce warehouses offers a number of benefits, including continuous operation, minimised errors, and long-term cost savings. While the initial investment can be significant, the reduced labour costs, increased productivity, and reduced error rates can justify the expenditure on these solutions.

The impact of artificial intelligence on e-commerce inventory control has increased in recent years. Artificial intelligence, through machine learning and predictive analytics, improves inventory management. The use of artificial intelligence in demand forecasting outperforms traditional methods by analysing extensive data sources, including customer behaviour, market trends, and social media. These AI-based models offer more accurate demand forecasts, enabling companies to optimise inventory levels and reduce overstocking. Machine learning algorithms adjust re-ordering parameters based on changing trends, streamlining procurement processes, reducing errors, and freeing up human resources for strategic inventory management. Artificial intelligence also contributes to optimising stock allocation and warehouse management. Advanced AI algorithms analyse order frequency, product characteristics, and geographical demand patterns to determine the most efficient allocation of stock across multiple warehouses. In summary, artificial intelligence in warehouse management increases efficiency, reduces errors, improves customer satisfaction, and leads to cost savings.

The role of chatbots and AI-based avatars in e-commerce customer service has grown significantly in recent times. These virtual assistants,

powered by artificial intelligence, offer real-time personalised and interactive support, and streamline the shopping process. Chatbots and avatars use Natural Language Processing and machine learning to understand and respond to customer queries and requests. As artificial intelligence technology develops, these virtual assistants will better understand complex customer requirements and incorporate sentiment analysis and emotion recognition for empathetic responses. Recent advances in NLP, particularly with transformer neural networks, suggest that chatbots could become indistinguishable from human interaction.

Artificial intelligence (AI)-based personalisation and recommendation systems improve user satisfaction and drive sales when shopping online. Integrating sales systems with AI-based personalisation and recommendation tools offers numerous benefits, including increased average sales basket value and valuable insights into consumer behaviour for businesses. Challenges include privacy issues, data ethics, solving the cold start problem for new users, and ensuring transparency and fairness of algorithms.

Automated e-commerce ordering, based on artificial intelligence technologies, is an area that is likely to grow in the coming years. Such systems automate the ordering process by analysing customer data and using machine learning algorithms to generate personalised orders. The benefits of automated ordering include increased operational efficiency, faster and more accurate ordering, and time and money savings for customers. Challenges include data security, privacy, and algorithm transparency.

Artificial intelligence-based e-commerce advertising is gradually beginning to dominate online marketing. Artificial intelligence techniques, including machine learning and Natural Language Processing, play a key role in delivering targeted and engaging ads. These AI-based ads offer benefits such as better conversion rates, improved return on ad spend (ROAS), and increased marketing effectiveness. Balancing personalisation with customer privacy remains problematic. The huge demand for customer data requires constant tracking of customers, which is increasingly controversial.

The role of artificial intelligence in SEO and e-commerce content creation has increased dramatically in recent years. While this has traditionally been the domain of human SEO copywriters, NLP algorithms allow this process to be automated. Large language models such as ChatGPT can not only create product descriptions, but can create metatags, tags, and even HTML code changes to improve a page's ranking in search results.

However, several challenges and risks associated with AI-based content creation have also been identified. Disadvantages and risks include concerns about originality and uniqueness, as AI-generated content may inadvertently resemble existing content on the internet. Errors, inaccuracies, and a potential lack of nuance in language and context are cited as disadvantages, particularly for complex or technical products. Hallucinations, where artificial intelligence generates false information, are another issue that needs to be addressed. In order to avoid the aforementioned problems, it is necessary to use common sense when using AI-based generative models. The potential impact on job losses among copywriters in the e-commerce sector should also be mentioned.

Considering AI-based content creation tools in the context of SEO, future systems are expected to analyse the effectiveness of text based on sales performance and user metadata. Real-time generation of product descriptions and images tailored to user data is expected. Furthermore, integration with dynamically customisable front-end interfaces is expected, resulting in a fully personalised online shopping experience.

The implications of the widespread use of generative models for content creation in SEO were then analysed. The flood of free content generated by AI tools raises questions about search engine ranking algorithms. Competition between search engines, such as Google and Bing, may lead to discrimination against content generated by specific AI tools. In addition, search engines may change their algorithms to reduce the relevance of the amount of content on a website, as the ease of content creation using generative models may lead to the internet being flooded with content created by LLMs.

The final part of the seventh chapter presents an experiment on the use of ChatGPT in the field of search engine optimisation. The study

aimed to assess whether ChatGPT can improve the ranking of products for an online shop in Google search results. Three experiments were conducted, for three product groups. In the first experiment, product descriptions were reformulated using ChatGPT, resulting in unique descriptions. Google SERP rankings were measured, showing an upward trend for most products. In a second experiment, ChatGPT wrote additional paragraphs about the products. However, this experiment did not result in a consistent improvement in SERP rankings, and some products even experienced declines. In the third experiment, comprehensive SEO improvements were made, including reformulating product descriptions, adding new content, and improving metatags. This resulted in significant improvements in SERP rankings, with several products achieving high rankings. In summary, experiments have proved that LLMs can be used to improve search engine rankings. The best results were achieved when changes were made comprehensively, while piecemeal changes involving only the addition of new LLM-generated content did not produce the expected results, suggesting that efforts using LLMs in SEO should include not only content creation and modification but also technical SEO elements. However, larger-scale studies across different online shops and product categories are needed to reach more comprehensive conclusions. Potential major changes in search engine algorithms in the future lowering the rank of content should also be considered.

In summary, Chapter 7 presents a comprehensive analysis of selected applications of artificial intelligence in e-commerce. It presents various areas of AI applications, however, in the coming years it is expected that the scope of AI use will expand significantly, and new areas of e-commerce will emerge in which AI will be used.

## 9.8 Summary of Chapter 8: The Future—Directions E-Commerce Is Heading

The expert interviews covered seven questions covering the scope of the first seven chapters. Thanks to the diverse specialisations of the experts, the author managed to obtain multifaceted answers and interesting visions of the future of e-commerce. The most relevant findings from the experts, in the author's opinion, have been selected for the summary.

The following conclusions emerged from the interview with experts on the impact of e-commerce on the economy. Experts predict an increase in the share of e-commerce in total trade. This is attributed to generational changes, with younger people preferring e-commerce, especially mobile, and the rise of remote working, which encourages online shopping. The impact of e-commerce is expected to extend to various sectors, particularly labour markets and logistics. It may also affect the spatial economy through the development of logistics centres and parcel collection points. Experts indicated that e-commerce would create jobs in industries such as logistics, packaging, software development, and legal services dedicated to consumers and e-tailers. E-commerce is seen as beneficial for business development, especially in the SME sector. Despite the growth of e-commerce, traditional commerce will remain popular due to the social interaction aspect, especially in cultures where human interaction is an integral part of shopping. Shops and marketplaces are expected to expand internationally, leading to greater internationalisation of e-commerce and wider product availability. There is a trend among major e-commerce players to move from an online shop model to a marketplace model. The shift from traditional commerce to e-commerce is associated with economic growth due to a more efficient allocation of resources in the economy.

The future of e-commerce logistics, as discussed by experts, covers several key areas. There is an increasing focus on reducing the carbon footprint of deliveries and packaging. Experts emphasise the need for more sustainable practices, such as the use of reusable packaging, despite

the investment and changes in the logistics system required. The global reach of e-commerce is forcing the further development of air transport. Increasing demands for shorter delivery times will require new logistics centres located close to large urban areas. Increased automation of deliveries, including autonomous vehicles, is expected, especially with rising labour costs. Most experts are sceptical about the widespread use of drones for deliveries due to safety, privacy concerns, and practical challenges in urban environments. A network of parcel pick-up points, including lockers in retail chains or petrol stations, is expected to grow in popularity. For densely populated urban areas with transport problems, an underground pipe system linked to delivery lockers is proposed, although its feasibility may be limited to new housing developments. The future may bring fully automated warehouses and transport systems, and androids may replace human couriers in autonomous delivery vehicles. Overall, while technological advances including the development of artificial intelligence and environmental considerations are driving significant changes in e-commerce logistics and full automation, the use of drones and autonomous vehicles is still debatable.

The future of e-commerce payments, experts predict, includes several key trends. E-payments should be convenient, but with an appropriate level of security. Experts are quite sceptical about the widespread use of cryptocurrencies in e-commerce. However, blockchain technology may increasingly influence electronic payment systems. Cryptocurrencies may gain popularity in a global crisis or high inflation scenario. The development of barter services, where customers offer marketing services or energy production in exchange for goods, seems potentially possible. This includes prosumers using their own renewable energy sources. Payment models may evolve towards social media-based product recommendation systems, akin to multi-level marketing strategies. Competition will continue between global players such as PayPal, Visa, Mastercard, Google Pay, Apple Pay, Amazon Pay, and others and local systems such as BLIK or M-Pesa. With the gradual shift away from cash, cash-on-delivery payment requires payment acceptance terminals owned by couriers. There is a clear trend leading to simpler and faster payment processes. This is leading to the popularity of one-click payments without lengthy authorisation procedures. “Buy now,

pay later” systems are expected to have a significant impact on the growth of online retail. However, there are concerns about the potential escalation of consumer debt. In summary, the future of e-commerce payments involves a combination of technological innovation, a focus on convenience and security, and the development of new transaction models.

The future of Virtual Reality in e-commerce, as discussed by experts, presents a mix of scepticism and optimism, with various challenges. Experts noted that a barrier to the growth of V-commerce still remains the conundrum of having rather expensive VR equipment. However, the cost of the technology is expected to fall with popularity. Like internet cafés in the past, VR cafés may emerge as a temporary solution to using VR equipment. Some experts envisage a hybrid approach, where VR is used in physical shops to enhance the shopping experience. The development of easy-to-implement V-commerce solutions, especially open source, could lower barriers to entry. V-commerce is seen as more viable for global brands or luxury goods due to the high initial investment costs. The development of a realistic tactile interface using VR gloves and suits could increase the appeal of VR. Innovations are anticipated to enhance the comfort and naturalness of VR, possibly including scent transmission. Issues such as headaches and eye pain caused by prolonged use of VR are barriers to the widespread adoption of V-commerce. Virtual commerce comes with higher modelling, bandwidth, and server processing costs, which may be reflected in product prices, making it more suitable for luxury products. Opinions are divided on the value of celebrity avatars in virtual commerce, with some seeing potential, especially if popular characters are used. VR commerce could become popular with older people, especially those with mobility issues, also serving as a virtual social space. In summary, while e-commerce VR has the potential for immersive and innovative shopping experiences, its widespread adoption comes with cost and technology challenges.

Experts discussing the role of Augmented Reality in e-commerce predict an increase in popularity, particularly highlighting its potential in the home furnishings and clothing industries. AR is already frequently used and does not require consumers to own additional hardware, unlike Virtual Reality. It is intuitive and easy to implement. To add value for

customers, companies can use strategies such as QR code labels linked to competitions with attractive prizes, which can also increase engagement on social media. The widespread use of AR will depend on its ability to make the shopping process easier and more attractive. The popularity of AR solutions in shops is expected to grow as technology advances and image quality improves. Augmented Reality features for trying on or viewing products could be complemented by AI advisors or human advisors to help consumers with their selection. AR implementations in online shops are likely to be developed as ready-made modules, fitting into the composable commerce model that enables customisation of e-commerce platforms. AR faces challenges in accurately mapping certain aspects, such as fitting fabrics to different body silhouettes. Advances in deep neural networks and more extensive training data can help improve this. The future of AR may include 3D, perhaps holographic, product displays, with additional sensors such as gloves to enable tactile interaction with these virtual products. This approach is seen as more convenient than VR goggles. In summary, the popularity of AR in e-commerce will depend on technological advances, practical implementation, and the ability to improve the consumer experience.

The future of social commerce, according to experts, includes various trends and opportunities. A potential direction for social commerce is the integration of instant messaging and social media with shopping functions, similar to what WeChat offers. Influencers, especially those with high credibility, are seen as playing a key role in shaping consumer choices within social commerce. While social media platforms are expected to have a significant impact on purchasing decisions, most experts do not believe that they can become the shopping platforms of first choice. People who spend a lot of time on social media may be more susceptible to manipulation and the creation of artificial needs due to their prolonged exposure to the information environment on these platforms. However, the willingness of customers to use social commerce can vary widely across cultures and countries. An interesting model in opposition to commerce on social media platforms is the transfer of social media elements to sales platforms. This can include influencer videos, live-streaming commerce, product likes and comments, and community building opportunities within the commerce platform. The popularity of

this with customers remains uncertain. In the future, regulation of influencers' influence on consumer decisions may be needed. The future form of social commerce may be entirely new and currently unrecognised. In conclusion, social commerce is ripe for development, the exact shape, however, remains uncertain and open to new developments.

Experts discussing the use of artificial intelligence (AI) in e-commerce highlighted several important trends, opportunities, and concerns. A key one is the role of AI in providing expert, data-driven advice without marketing gimmicks. Customers expect AI recommendation systems, chatbots, and avatars to offer sound, quantifiable advice to inspire trust. Manipulations using AI can lead to criticism and opposition. It is expected that more and more consumer decisions will be made by AI applications. However, this shift raises concerns about the loss of critical thinking skills and the ability of large corporations to influence consumer choices. Transparency and the ability to explain decisions made by AI are crucial. Oversight systems may be needed to ensure the integrity of AI decisions, but there are challenges in ensuring objectivity and preventing lobbying influence. AI algorithms should guide customers through the entire purchasing decision-making process, including explaining the rationale behind their suggestions, to build trust and loyalty. These assistants could become as common as search engines, especially for consumers who value convenience. The quality of AI recommendations and the user experience will be key to their adoption. There may be a division of consumers between those who will fully accept AI for decision-making and those who will remain sceptical and prefer to remain autonomous. The increased use of sensors (Internet of Things) will provide AI with data for advisory processes, such as smart appliances automatically ordering spare parts or smart fridges generating shopping lists. AI will support improved search engine optimisation, including elements such as product descriptions, images, and metatags. Access by AI algorithms to sensitive data, such as customer financial information, may face resistance from privacy-conscious consumers. There are likely to be new, currently undefined application areas for AI in e-commerce. AI algorithms should be characterised by reliability, transparency, and honesty to be effective and trustworthy in e-commerce. In summary, while AI offers significant potential to improve e-commerce, it also

comes with challenges related to decision-making power, data privacy, and ensuring transparency and fairness in recommendations.

The last chapter looks at the potential future of e-commerce in key areas, i.e., customer ordering methods, delivery, and payment options.

In terms of customer ordering methods, several important trends and technologies are likely to impact the way consumers order. These include a shift towards purchasing directly through social media platforms, the growing role of influencer-based marketing, immersive experiences offered by Virtual Reality and Augmented Reality, and the rise of hyper-personalised shopping experiences driven by AI recommendation systems. In addition, he points to the potential of AI shopping assistants, voice communication, and even thought-based communication to transform the ordering process.

Turning to delivery methods, there are innovative trends and technologies that could change the way consumers receive orders. These include the proliferation of delivery points such as delivery lockers and pick-up centres, drone technology for faster delivery, autonomous delivery robots, and autonomous cars. There is a growing consumer expectation that same-day delivery will become more accessible. The potential for 3D printing of products will grow. Perhaps underground pipeline deliveries will emerge, and even the highly speculative concept of teleportation will find a theoretical solution. While some of these ideas may seem futuristic, they represent a wide range of possibilities that could redefine e-commerce delivery methods in the coming years.

The future of e-commerce payments is likely to be a mix of established and new methods. These include the further development of digital wallets such as Google Pay and Apple Pay, regional payment services such as BLIK, and evolving features of traditional payment platforms such as PayPal. Perhaps social media barter payments will emerge. The future of cryptocurrencies in e-commerce is debatable. Much more likely, however, is the rise in popularity of deferred payment models.

Chapter 8 offers an insight into the likely scenarios for change in e-commerce in the coming years. It highlights the solutions that will shape customer ordering methods, delivery systems, and payment options. While e-commerce is constantly changing, Chapter 8 provides a roadmap for understanding potential future developments in this dynamic field.

In summary, this book provides a comprehensive scientific exploration of key areas of e-commerce. Through the literature analysis undertaken, the analysis of statistical data as well as the analysis of case studies, surveys, and interviews with experts, the book makes a significant contribution to management science by zooming in on the complex dimensions of e-commerce and its future prospects. It serves as an invaluable resource for academics, industry professionals, and decision-makers who want to navigate the ever-changing field of e-commerce.

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