The Future of Commerce: Linking Modern Retailing Characteristics with Cloud Computing Capabilities

Christian Daase[a], Matthias Volk[b], Daniel Staegemann[c] and Klaus Turowski
Institute of Technical and Business Information Systems, Otto-von-Guericke University, Magdeburg, Germany

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Abstract: The future of retail will be shaped by the rapidly evolving digital landscape. New technologies such as big data analytics, artificial intelligence, virtual reality, and cloud computing are expected to play a crucial role in advertising products, making personalized offers tailored precisely to customers' needs, and thus meeting rising expectations in connection with the general improvement in living standards. In this paper, the characteristics of modern retailing and e-commerce in particular are examined in detail. Based on a systematic literature review, the nature of current and future retail business models is analyzed step by step, starting from more conceptual aspects to concrete underlying technological capabilities with the ultimate goal of leveraging cloud computing tools to realize them. Common proven practices are categorized, described, and assessed to provide a comprehensive overview of opportunities, challenges, and consequences in this area. Finally, the identified technological capabilities are aligned with adequate cloud services, exemplarily presented with tools of the Google Cloud.

1 INTRODUCTION

Digitization, as one of the major buzzwords of our time, is rapidly transforming almost every aspect of our daily lives. Thus, it may seem obvious that the quote "*The only constant in life is change*", which is attributed to the Greek philosopher Heraclitus, also applies partly to the sector of commerce (Sims, 2018). While the traditional role of a retailer was to serve customers and physically distribute products, more and more stages of the value chain, such as payment and delivery, are nowadays handled by third-party companies (Reinartz and Imschloß, 2017). But not only the businesses' perspective regarding the pursuit of financial efficiency is changing. Since the retail industry in general is dependent on the overall national economic situation and the living standards therein (Xue et al., 2017) and today's customers tend to adopt increasingly busy lifestyles (Shankar et al., 2021), the behavior of clients is evolving as well. While becoming more demanding, customers expect smooth and tailored processes, services, and offerings (Alexandrova and Kochieva, 2021; Farah et al., 2019; Marchand and Marx, 2020) across a multitude of channels (Tyrväinen et al., 2020). The modern retail industry faces a new generation of consumers that has been grown up with digital technologies and therefore expects companies that are after them as potential new customers to align with their preferences of how business is conducted (Kahn et al., 2018). The process that Grewal et al. summarize with the sentence "*The worlds of online and offline are converging.*" (Grewal et al., 2017) is closely related to the phenomenon of the classic stages of consumption, meaning need occurrence, actual transaction, and consumption itself, moving closer together (Reinartz and Imschloß, 2017). While the ability to buy products around the clock seven days a week across multiple online and offline channels might be a convenience for customers, the provision of these e-commerce platforms places pressure upon retailers (Kahn et al., 2018; Lim et al., 2022; Reinartz and Imschloß, 2017; Sasidhar and Mallikharjuna Rao, 2020).

In this article, the transformation of the retailing landscape is investigated from a technological point of view with respect to social and economic

[a] https://orcid.org/0000-0003-4662-7055
[b] https://orcid.org/0000-0002-4835-919X
[c] https://orcid.org/0000-0001-9957-1003

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developments. The data richness of the sector (Dekimpe, 2020), the explosive growth of social media and networking platforms (Grewal et al., 2017; Kahn et al., 2018), and external events such as the COVID-19 pandemic (Guha et al., 2021; Shankar et al., 2021; X. Wang et al., 2021) drive the need for adjustments up to the exploitation of the big shifts in business and society. Big data, the Internet of things (IoT), cloud computing, machine learning (ML), and artificial intelligence (AI) are just a few examples of technologies whose interplay might be the most promising revolution of the retail sector of the future (e.g., (Dekimpe, 2020; Grewal et al., 2017; Kahn et al., 2018; Sasidhar and Mallikharjuna Rao, 2020; Shankar et al., 2021)). Since cloud computing, as a paradigm in which networks of remote servers are used to store, process, and manage data (Shankar et al., 2021), has the ability to connect different digital technologies and can also be extensively utilized by smaller companies due to dynamic pricing models (i.e., *pay-per-use*, *pay-as-you-go*) (Adewumi et al., 2015; Chan et al., 2017; Khidzir et al., 2018), the focus of this work is on how to leverage cloud technologies for especially e-commerce-related retailing activities. Thus, the following research questions are in the center of investigation:

RQ1: Which characteristic trends shape the current and future sector of retailing and which consequences for managers and policy makers arise from these?

RQ2: Which necessary technological capabilities that could be handled or supported by cloud computing tools can be derived from these developments?

Subsequently to this introductory section, the methodology that is followed to propose possible answers to these questions is explained in more detail. This includes an overview of the overall research approach in accordance with the design science research methodology (DSRM) proposed by Peffers et al. (2007) and a detailed review protocol for the systematic literature review (SLR) conducted in this paper. Section 3 presents results from the SLR on expected technological key points of future retailing that should also be considered in e-commerce, thus answering RQ1. In section 4, explicit recommendable capabilities of modern (e-)retailing are categorized and matched against cloud computing tools of leading cloud service providers in section 5, thus answering RQ2. Finally, an outlook on future research and improvements is given in section 6.

2 METHODOLOGY

The research steps adopt a subset of the six activities described by Peffers et al. (2007) for the DSRM, considered as the theoretical part of a DSR project (Daase et al., 2022). The research in this paper includes the *problem identification and motivation*, *defining objectives of a solution*, and a preliminary *design* step. The *development*, *demonstration*, and *evaluation* are outlined in the conclusion as potential practical implementations of the findings of this work. The step of *communication* is conducted by sharing and discussing the results with the academic community. To achieve a higher scientific rigor, the first three steps, which are performed by means of an SLR, additionally factor in the recommendations of vom Brocke et al. (2009). The summarized research process is visualized in Figure 1.

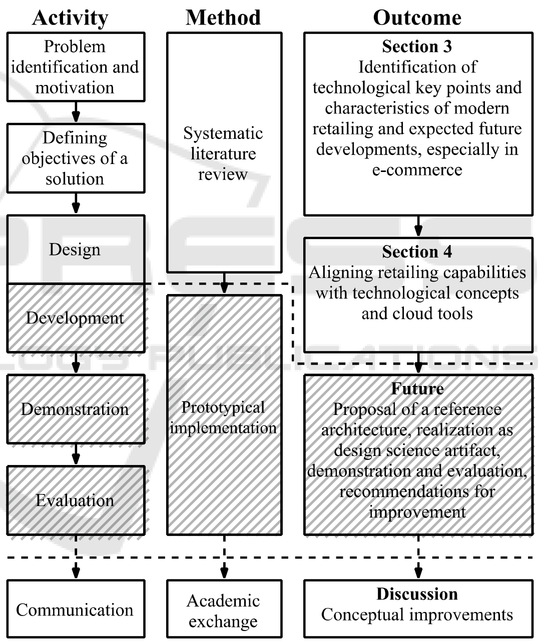

Figure 1: Design science research process with methods and outcomes of each step.

The first step for organizing the SLR is to define a search strategy in terms of textual queries, databases, inclusion and exclusion criteria, and a procedure for extracting the target information. Vom Brocke et al. (2009) note, that usually the quality of journal contributions can be considered higher than that of conference proceedings. Therefore, primarily established peer-reviewed journals covering a broad spectrum of diverse topics in sales-oriented business areas are included in the review. Secondarily, SpringerLink, with its collection of in-house journals and conferences, is included due to its widely recognized quality, as well as the abstract and citation database Scopus, which claims to be the largest database of its kind (Kitchenham and Charters, 2007). As a tertiary source for articles that may not be indexed in one of the largest databases, the first page of a Google Scholar search ranked by relevance is also included in the review.

As the primary source, the database ScienceDirect of the publisher Elsevier is chosen because of its extensive publication base of over 19 million items and its well-organized publication browser. The domain of *business, management and accounting*, and more specifically the subdomain of *marketing*, is considered as the starting point for this investigation. The determination for screening the journals to identify a suitable selection for further review is to consider the criteria of being established (more than 5 years active), geographically unaffiliated, and covering a wide range of topics related to businesses that are associated with retail. The four journals meeting these criteria are *Electronic Commerce Research and Applications*, *International Journal of Research in Marketing*, *Journal of Retailing*, and *Journal of Retailing and Consumer Services*.

Since the only journal in SpringerLink including the term *retail* in its title stopped publishing in 2010, the general advanced search of SpringerLink for all types of publications was used instead. The other secondary source of literature is Scopus due to its inclusion of abstracts and citation data from various full-text databases. Google Scholar is considered as an addition under reservation because it also references to uploads of papers on collaborative networks with possible unverified assertions. However, elaborations commissioned by a reputable institute or similar are reviewed.

To identify abstract capabilities and characteristics of future retailing from the Elsevier journals, the review workflow refrains from defining more restrictive search phrases for the journals *Electronic Commerce Research and Applications* and the *Journal of Retailing*. For the *International Journal of Research in Marketing*, the terms *retail* or *retailing* must appear in the abstract, because the concept of marketing is otherwise too broad, although it is an indispensable part of retailing. Publications orienting from the *Journal of Retailing and Consumer Services* must contain a form of *retail** (i.e., with an asterisk as wildcard) in the title, since sample searches have shown that the spectrum of articles is too vast for an unrestricted approach. Furthermore, only contributions marked as *research article* are considered. The investigation of publications included in the database of SpringerLink more specifically targets the influence of cloud computing technologies on retail and related areas. Therefore, using the advanced search, the title of articles must contain the terms *retail*, *retailing*, or *retailer*, respectively (i.e., requiring three separate searches), and at least the text body must contain the term *cloud*. The content type is restricted to articles and conference papers. Similarly, in Scopus, the title must contain the construct *retail** and the abstract must include *cloud*. The limitation to the abstracts is conditioned by the type of the database Scopus while the asterisk is a placeholder for characters, thus including terms such as *retail*, *retailing*, or *retailer*. Document types are limited to the same as SpringerLink. In Google Scholar, the simplified search consists of the phrase *future of retailing* with a sorting according to relevance (i.e., the provisioned mechanism of the search engine). Only the first page with its ten articles is added to the literature base.

Regarding the time frame, it is determined that the publications should not be released before 2017 to do justice to the designation of investigating the state of the art up to future-oriented assumptions on the retail industry. From the Elsevier journals, only the volumes published starting from the year 2017 are reviewed. The search ends with November 2022 and the respectively last completed volume. Table 1 summarizes the above sources of literature and the restrictions regarding the search process.

Table 1: Literature sources and specifications.

Source	Restrictions
All	- Published between Jan 2017 and Nov 2022
ScienceDirect	- marked as *research article*
Electronic Commerce Research and Applications	---
International Journal of Research in Marketing	- Abstract contains *retail**
Journal of Retailing	---
Journal of Retailing and Consumer Services	- Title contains *retail* or *retailing*
SpringerLink	- Title contains *retail*, *retailing*, or *retailer* - Text body contains *cloud* - *Article* or *conference paper*
Scopus	- Title contains *retail** - Abstract contains *cloud* - *Article* or *conference paper*
Google Scholar	- Search *future of retailing* - Sorted by relevance - Only first hit page

The criteria for the process of including and excluding publications that cannot be filtered with the build-in mechanisms of a database have to be transparent to allow readers to assess the exhaustiveness and reusability of the review's results for their own endeavors (vom Brocke et al., 2009). To do so, the criteria collected and presented by Kitchenham and Charters (2007) are adopted for this review. In summary, the inclusion and exclusion criteria can be described as in Table 2**.**

Table 2: Inclusion and exclusion criteria for the SLR.

Inclusion	Exclusion
The goal of the business area under investigation is to sell items and/or serve customers.	*No abstract is available, it does not state any information on the content of the paper, or the paper is unavailable.*
The study concentrates on one core section of the value realization chain in retail (e.g., trend forecasting, supply chain, customer management) after manufacturing (except when the manufacturer itself is the distributor) and before consumption or disposal.	*The study is an exact or a semantic duplicate, whereas the latter is considered as a publication on the same subject, by the same authors within a short period of time.*
The research is conducted from the company's perspective rather than from the customer's standpoint.	*The study specifically observes one country or geographic region, with no general or global applicability of the results to the retail sector.*
Statements on the state of the art and/or future directions are provided.	*No assessment is made of the impact of a concrete technological innovation or phenomenon.*

3 RELATED WORK

The literature review workflow is structured into three stages. First, the automatically retrieved articles are collected, counted, and sorted in a project internal table structure. Second, within a fast-screening review stage, the publication titles and abstracts are read to allow an exclusion of apparently unsuitable ones. Third, by reading the remaining articles in detail, the most important details for explaining the scientific fundamentals of the present project are extracted. Figure 2 illustrates the review process with numerical notes on how many articles where originally retrieved and then excluded based on the criteria established in section 2. From the initial 1106 potential contributions found in the Elsevier journals and databases using the above stated search queries and specifications, 205 were examined in detail of which in turn 49 were deemed as sufficiently useful for the explanations in the subsequent sections.

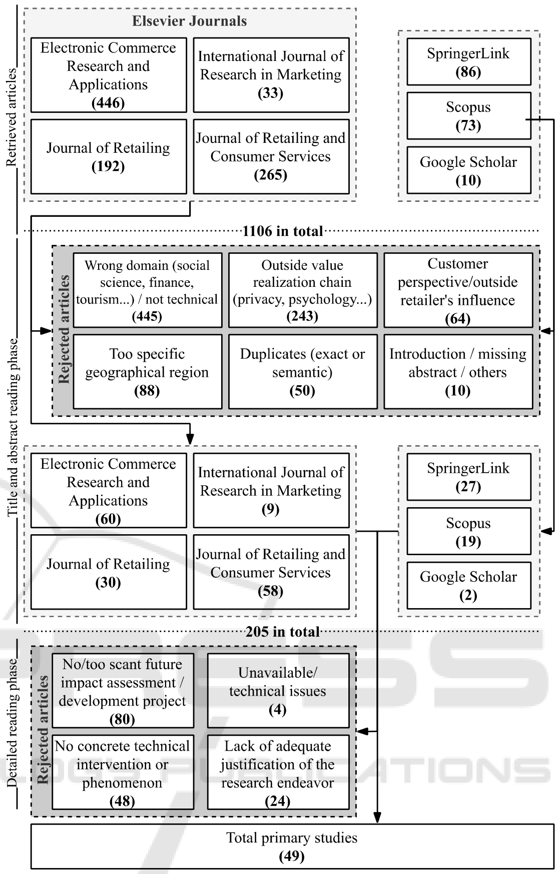

Figure 2: Literature review workflow visualization.

3.1 Modern Retail Environments

In this subsection, both currently established transformations of retail business models and development trends whose realization will be targeted more forcefully in the future are synthesized from the available literature. Thereby, essential parts of a possible answer to the first research question (RQ1) formulated in the introduction are compiled and put into context.

3.1.1 Changed Characteristics

The value chain of the future is characterized by a reordering of how and by whom products get into the hands of customers. The trend toward *disintermediation* (Gielens and Steenkamp, 2019; Shankar et al., 2021), which enables the elimination of layers in the distribution channel through online market platforms where manufacturers can sell their products to consumers with fewer intermediaries, has led not only to a reduction in the cost of intermediaries but also to the rise of new powerful players. Since companies such as Amazon and Alibaba are well aware of their established position in the middle of retailing processes, aspirations of pushing own private labels turn these enterprises partially from facilitators into competitors, thus deeply changing the retail landscape (Alexandrova and Kochieva, 2021; Gielens and Steenkamp, 2019; Grewal et al., 2017; Reinartz et al., 2019; Shankar et al., 2021). This development is largely driven by a generally changing customer behavior. Due to the extent of goods available online at various prices, it became increasingly normal to extensively search for the assumingly best purchase option, price-wise as well as regarding the quality of a product by comparing reviews of other consumers (Gielens and Steenkamp, 2019; Reinartz and Imschloß, 2017). More conveniently, platforms such as Amazon combine these capabilities so that it is only a small step for online shoppers to click on the perceived best offer instead of buying offline. The trend that platforms such as Amazon are able to compete with traditional retailers and the entirety of their business models, including payment systems and delivery strategies, is supported by the simultaneous rise of specialized third-party companies taking over substantial parts of the commercial processes, for example DHL (a German delivery service) for physical distribution or PayPal for payment transactions (Reinartz and Imschloß, 2017). However, it is worth mentioning that the stationary retail does incorporate new approaches to outsource operational activities for the sake of increasing profitability as well. Under the umbrella term *autonomization*, several service-, payment-, and delivery-related innovations have been introduced by the retail industry, such as chatbots, self-checkouts, and delivery drones (Bellis and Johar, 2020; Grewal et al., 2018; Shankar et al., 2021).

As a remarkable variation of disintermediation, *Direct-to-Consumer* (D2C) models allow brands to engage directly with customers by means of digital channels (Gielens and Steenkamp, 2019). In this context, due to today's widespread use of mobile devices, an increasing number of transactions is processed through websites or tailored mobile applications (Khidzir et al., 2018; Lim et al., 2022; Nikhashemi et al., 2021; Reinartz et al., 2019; Haiyue Zhang et al., 2021). One advantage compared to traditional sales points is that the brand does not need to compete with other brands on the same store shelf. However, as tempting as the opportunities of pure online shops may be, this development is not expected to replace physical stores entirely as consumer interfaces but to put a certain pressure on them to adapt more closely to customers' needs and desires (Ferracuti et al., 2019; Huddleston et al., 2018; Reinartz et al., 2019). Furthermore, traditional stores enable customers to evaluate a number of attributes of goods that simply cannot be experienced in online retailing, for example fit and wearing comfort of garments (Smink et al., 2019). Yet, online shops can reach customers living farther away from the store, which is why they can serve as sensible supplements (van Heerde et al., 2019). In conclusion, a partial redefinition of the customer journey in terms of an increasing number of touchpoints towards so-called *omnichannel retailing* can be observed whereas customers tend to seamlessly switch between the channels (Liao and Yang, 2020; Rudkowski et al., 2020; Tyrväinen et al., 2020).

While these developments relate to the most dominant part of retailing, the actual transaction, retailers should keep in mind that it builds upon another stage of the classic consumption model, the prepurchase phase of need occurrence (Reinartz et al., 2019; Reinartz and Imschloß, 2017). Attracting and directing customers' attention therefore is an essential task of any retailer (Huddleston et al., 2018). From the literature findings, the reformation of marketing strategies can be divided into two branches: the gathering of necessary data to create purposeful advertising concepts and the effective presentation of these. Summarized under the key term of *big data*, massive amounts of analyzable data from all available sources, such as social media, sales data, demographics, or other historical internal or external data, are collected and processed (Dekimpe, 2020; Grewal et al., 2017; Grewal et al., 2018) in order to increase efficiency and profits, improve customer experience and demand prediction, and to gain a deeper understanding of customer behavior in general (Grewal et al., 2017; Kaur et al., 2020; Sasidhar and Mallikharjuna Rao, 2020).

The literature indicates that some of today's retailers are becoming increasingly interested in micromanaging the optimization of their stores. For example, examining customer behavior through in-store video analytics (Kaur et al., 2020; Liciotti et al., 2017) and customizing displayed advertisement (Han et al., 2022), or studying that customers are used to counter-clockwise aisle arrangements in countries with right-handed traffic (Ferracuti et al., 2019) are a reality nowadays. Worth noting, the underlying capabilities of data analysis (e.g., storage, networking, and computation power) require dedicated digital infrastructures that are associated with costs.

With the overarching theme of this article in mind, the effort and cost of deploying efficient and scalable solutions can be mitigated by taking advantage of the emerging field of cloud computing (Adewumi et al., 2015; Chandrashekhara et al., 2019; Lee, 2017). Modern marketing, or more broadly termed *dissemination of information that can stimulate a purchase*, resorts to a variety of newer phenomena, such as social media and video-to-retail applications (Alexandrova and Kochieva, 2021; Dolega et al., 2021; Grewal et al., 2017; Huaizheng Zhang et al., 2020), and old but adapted institutions, like temporary pop-up shops (Rudkowski et al., 2020; Shankar et al., 2021). *Personalized advertising* using enhanced data analysis techniques to craft individually tailored advertisements can improve customer experience and loyalty (Tyrväinen et al., 2020). Note that it should not to be confused with *personalization*, meaning the provision of personalized offers based on (historical) customer data (Reinartz et al., 2019; Tyrväinen et al., 2020) only when a customer actively visits a store or website (Gironda and Korgaonkar, 2018), thus transforming retailing from a product-centric to a customer-centric environment (Gupta and Ramachandran, 2021). However, uncertainty about how customer data were obtained can have a serious negative impact on trust, whereby studies suggest that this threat could be alleviated by simply disclosing that an advertisement is in fact personalized and where the respective data were found (Grewal et al., 2018; Marchand and Marx, 2020). Despite this general statement, if the data are private and not directly consciously or unconsciously shared with the company (e.g., data orienting from social media profiles), the personalized advertisement can be expected to elicit strong negative reactions (Gironda and Korgaonkar, 2018).

Lastly in this subsection, the adaptation of supply chains is not neglected by modern retail enterprises. Significant cost reductions of up to about 12 percent by means of effective information sharing (Chan et al., 2017), substantial savings by adopting 3D technologies for virtual prototyping (Shankar et al., 2021), and augmented reality (AR) to allow customers to get realistic ideas of a product before ordering and eventually returning it (Nikhashemi et al., 2021) are just a few examples provided by the literature. More commonly, forecasting demand as part of efficient logistics has been widely established whether to reduce costly unnecessarily storage capacities (Sasidhar and Mallikharjuna Rao, 2020) or to avoid stock outs and missed selling opportunities (Dekimpe, 2020; Wolters and Huchzermeier, 2021). Besides these organizational considerations, the adoption of robotics within the journey of a product in the form of warehouse robots and delivery drones has an increasing impact of the modern retail world (Grewal et al., 2017; Shankar et al., 2021). Concluding these observations, two hypotheses can be set up. First, domains traditionally handled by service employees are currently in a phase of transformation, in a way that staff members can add less and less value as consultations are overtaken by online reviews, payment transactions by third-party systems, and delivery and returns by robots (Bellis and Johar, 2020). Second, the competition of the future is technological (Reinartz and Imschloß, 2017). Retailers unable to exploit vital technologies can be expected to face serious difficulties and, in the long term, a decline in their business.

3.1.2 Potential Challenges

Available infrastructure and knowledge can evolve into the main bottlenecks while integrating technological advances (Chan et al., 2017; Dekimpe, 2020; Gottlieb and Bianchi, 2017). In addition, if the perceived benefits for the retailer are not tangible enough, the adoption is further inhibited (Shankar et al., 2021). However, the outbreak of the COVID-19 pandemic has not only strengthened the role of technologies for online retailing but has also urged the industry to build up and switch to innovative business models, preferably with reduced physical contact (Guha et al., 2021; Shankar et al., 2021; X. Wang et al., 2021). A clash between the inertia to stick to established models and the pressure to adapt to a new reality therefore seems conceivable. Thereupon, two existing issues might gain intensity. On the one hand, a phenomenon called *showrooming*, where customers visit physical shops solely to inspect a product that they are likely to buy online later under better price conditions (Kokho Sit et al., 2018; Lee, 2017; Schneider and Zielke, 2021; J. Wang and Wang, 2022), may become a more vexing problem as the stationary retailer invests time and money without reaping the rewards. Occasionally, a counter-concept called *webrooming* can be observed, where consumers visit online shops only for the purpose of assessing products informationally but then make the actual purchase offline (Smink et al., 2019; Z. Wang et al., 2021). This practice indicates that the desire to be consulted in person is still present and is furthermore valued.

A second issue, product returns, was ever existing but has reached a new level through customers' online shopping behavior (Smink et al., 2019). The main reason is the intrinsic uncertainty whether a product, for example garments, meets the expectations (e.g., fit and coloring) when buying online (Li et al., 2019; Haiyue Zhang et al., 2021). To overcome these challenges, new strategies to communicate the attributes and benefits of a product and to handle the natural behavior of consumers must be developed.

From the largely established characteristics, a few possible development tendencies outlined in the literature can be derived. The demographic change towards a generation of *digital natives* as well as the successful integration of technologies by industry leaders (*early adopters*) will foster the adoption by rather risk-averse retailers (*fast followers*) (Shankar et al., 2021). Hazardous events such as the pandemic and financial fraud will drive the need for enhanced safety, contactless payment, and security systems (Liao and Yang, 2020; Rudkowski et al., 2020; Shankar et al., 2021; X. Wang et al., 2021). Furthermore, legal regulations will certainly force the industry to conceptualize strategies to track the movement of goods to ensure, for example, food safety (Shankar et al., 2021), but also to limit oneself to anonymized customer data when it comes to segmentation and behavior analysis (Gironda and Korgaonkar, 2018; Kakatkar and Spann, 2019). Regarding the issue of showrooming, retailers might rethink their physical stores as showrooms intentionally to give customers the chance to experience their products while the transaction is performed online on purpose (Li et al., 2019; Shankar et al., 2021; Haiyue Zhang et al., 2021). Whether forecasting trends or demand, optimizing prices, stores, or customer experience, the future of retailing will hold fascinating developments from which all have one aspect in common: digital technologies based on buzzwords such as artificial intelligence, big data, and the Internet of Things (Alexandrova and Kochieva, 2021; Bellis and Johar, 2020; Guha et al., 2021; Marchand and Marx, 2020; Sasidhar and Mallikharjuna Rao, 2020; Shankar et al., 2021). The characteristic evolutional tendencies in the retail sector, connected to their overarching domain, are summarized in Figure 3 along with associated consequences and important issues that need to be considered by retailers.

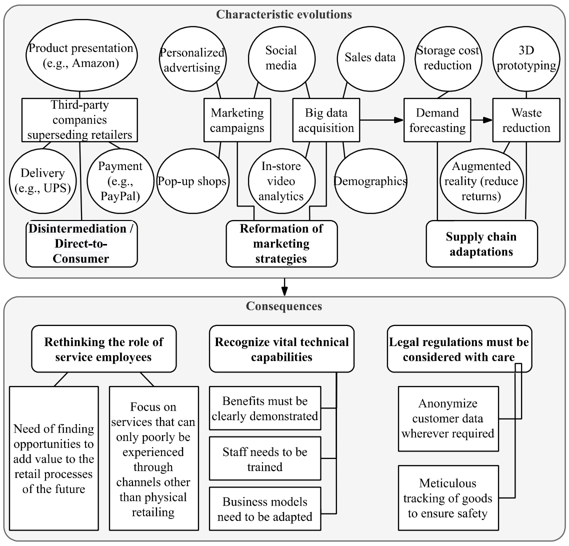

Figure 3: Overview of development tendencies in retail and associated consequences.

4 MODERN (E-)RETAILING CAPABILITIES

In the following, the four fields of *marketing and customer engagement*, *store management and representation*, *prediction and forecasting*, and *product assessment and shopping experience* are connected with corresponding enabling technologies. These elaborations serve as the first part of an answer to RQ2.

4.1.1 Marketing and Customer Engagement

Mobile applications by retailers have been established as vital tools and more specialized interfaces than websites to get in contact with customers (Lim et al., 2022; van Heerde et al., 2019). Through such apps, both sides of personalization (i.e., data collection and presentation of individual offerings) can be efficiently realized. Based on the phenomenon of *big data analytics* (BDA), personalization is assumed to provide a number of advantages. Studies indicate that the provision of offers that are likely to fulfill a customer's current needs is valued (Farah et al., 2019; Reinartz et al., 2019), leading to an improved customer experience and loyalty (Tyrväinen et al., 2020), and ultimately tends to increase the chances of sales (Kaur et al., 2020). From a legal point of view, data for the purpose of marketing research often must be anonymized. Due to the wide availability, however, a segmentation of customers is possible, although the granularity is limited (Jansen et al., 2021; Kakatkar and Spann, 2019).

Recommending specialized offers as a combination of identifying consumers' needs and matching products accordingly based on big data also involves a realistic potential use of *artificial intelligence* (Bellis and Johar, 2020; Grewal et al., 2017; Zhu et al., 2022). Moreover, a report by McKinsey & Company (a major management consulting firm) projects that, out of 19 industries, the most valuable impacts of AI will occur in the retail sector (Bellis and Johar, 2020; Guha et al., 2021). Marchand and Marx conclude that the current developments, especially the widespread use of smart devices, are moving the society "*into an age of artificial intelligence-based assistance provided by automated recommender systems*" (Marchand and Marx, 2020). Social media networks such as Facebook and Instagram have emerged as suitable platforms for advertising campaigns and - depending on their scope, complexity, and brand status - generally have a positive impact on sales figures (Dolega et al., 2021; Grewal et al., 2018). For example, data on emerging trends and customer behavior could be analyzed in a cloud environment, and the knowledge gathered could be used to automatically and regularly post relevant content on a social media presence (Kaur et al., 2020).

Since this kind of marketing is rather impersonal without giving customers or other interested parties much space for interaction, companies are also trying to find a compromise between exploiting the modern technological capabilities, especially those enabled by the Internet, and traditional events to push products, such as trade fairs. *Virtual reality* (VR) paved the way for virtual trade shows in which exhibitors can connect with visitors remotely without having to physically attend the event (Gottlieb and Bianchi, 2017). With respect to the lessons learned during the COVID-19 pandemic, VR-enabled opportunities to stay in close contact with customers, partners, or even competitors by means of trade shows while avoiding critical physical proximity can be expected to attract further interest.

4.1.2 Store Management and Representation

As explained in section 3.1.1, mere online retailing is not expected to replace stationary shops entirely. The management of a store and its representation to the outside, however, is assumed to be reformed based on the reviewed literature. Besides the automation of marketing activities, as described in the previous section, consumer processes such as purchasing can be increasingly automated by means of the IoT and smart household appliances that order certain products (e.g., food or detergent) when the stock is low (Reinartz et al., 2019). Robotics in the form of checkout automation, drones, and driverless vehicles further reduce the human effort needed to complete the distribution of purchased items (Grewal et al., 2017; Noble et al., 2022) while e-wallets for mobile payment facilitate financial transactions, thus saving time and potentially personnel (Liao and Yang, 2020).

Inside a store, video analytics can help to better understand customers and to design the interior as well as the assortment accordingly (Kaur et al., 2020; Liciotti et al., 2017). Outside of stores, video analytics can help assess customer sentiment in review videos (Agrawal and Mittal, 2022). The central component of such systems might be a cloud environment, including capacities to store the vast amount of visual data and analytical capabilities to draw the right conclusions from the consumers' movements and product selections (Ferracuti et al., 2019; Liciotti et al., 2017). One step further towards micromanaging a store, *eye tracking* made it possible to evaluate exactly what a customer is looking at, in what order, and for how long (Huddleston et al., 2018). In all these applications, it can be argued that AI in general and ML as a subcategory form the backbone of such analyses.

4.1.3 Prediction and Forecasting

Keeping inventory for no specific reason simply because the demand does not correspond with the number of ordered items is an unnecessary yet avoidable expenditure since storage capacities are usually not for free (Sasidhar and Mallikharjuna Rao, 2020). On the other hand, ordering to small quantities can lead to stock-outs that also result in financial losses (i.e., generating lower profits than possible) (Dekimpe, 2020). Extracting purchase patterns from historical data in cloud environments to predict future buying behavior for anticipatory shipping is already a reality in a number of successful businesses such as H&M and Zara, two fashion companies from Sweden and Spain, respectively (Alexandrova and Kochieva, 2021; Lee, 2017). Additional to organizational data, information acquired from social media (i.e., *social media data scraping*) can be used to better forecast sales, design campaigns based on trend analyses, and ultimately increase customer satisfaction (Kaur et al., 2020). Another aspect adding to the complexity of inventory management is pricing, which must be factored into the interdependencies between supply and demand. ML models, trained with different features of a product and historical sales data, can serve as a decision support to choose an appropriate pricing policy for a specific product (Chandrashekhara et al., 2019).

4.1.4 Product Assessment and Shopping Experience

In order to make an informed purchase decision with minimal risk of returning the product, certain properties of a good must be carefully assessed by the customer. Studies suggest that technologies supporting the realistic perception of an item, such as AR and VR, can have a positive impact on the intention to buy it (Arghashi, 2022; Arghashi and Yuksel, 2022; Nikhashemi et al., 2021; Z. Wang et al., 2021). As a side effect, a more direct shopping experience can promote trust, leading to a higher willingness to disclose personal information (Smink et al., 2019). The two key technologies, AR and VR, differ in the way the visualization is presented and thus in which scenarios a particular approach is most suitable. VR places the user in a computer-generated, entirely artificial environment while hiding the surrounding real world and thus creates a highly immersive experience (Farah et al., 2019; Gottlieb and Bianchi, 2017). With that in mind, VR in retail is primarily appropriate for promoting products that either do not require to be examined in context with other present items or do require a specific atmosphere to be optimally presented. For example, a virtual world consisting of an open road at sunset to get a realistic feel for a customized car would likely create greater anticipation for purchasing the vehicle than just a virtual model of the car in a real-world showroom. The latter approach corresponds to the definition of AR where a product can be inspected by overlaying a virtual model onto the real-world surroundings or even the own body (Smink et al., 2019). One possible application therefore is to try on clothes before buying via virtual fitting rooms (Li et al., 2019). Both technologies can help to prevent the issue of showrooming, although stationary retailers might not be the beneficiaries of this development. Since the customers' uncertainty about a product due to the lack of tangible information can be viewed as the main reason for showrooming (Kokho Sit et al., 2018), a direct realistic vision of an item provided by the capabilities of VR or AR can help to reduce the doubts about buying it. Thus, the perceived need for the customer to physically inspect the product could be reduced and a retailer's resources (e.g., time to consult with a customer) might be spared. Figure 4 summarizes the findings derived from the literature that was available following the strict methodological approach, without claiming completeness. Firstly, the outermost boxes wrap the four categorized parts of retailing, which are further divided into several more specific activities of the respective parts. Lastly, concrete technologies associated with these activities are stated. The different gray colorings link technologies that are mentioned more than once.

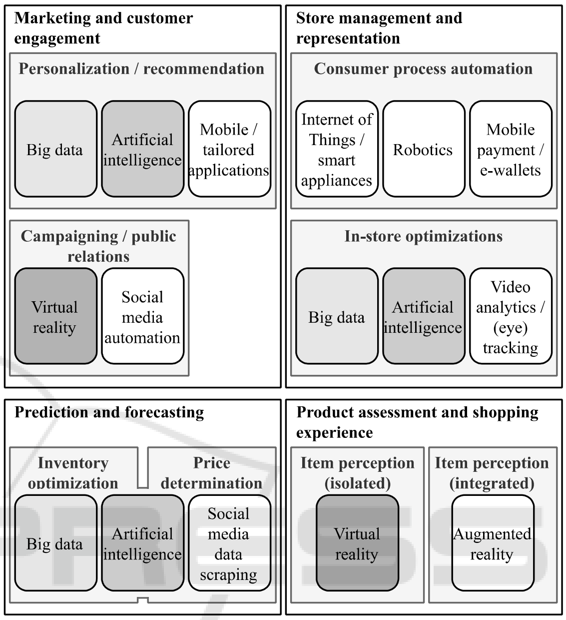

Figure 4: Categorization of identified future technological (e-)retailing capabilities.

5 MATCHING CLOUD TOOLS WITH THE CAPABILITIES

The following brief explanations originate from the official Google Cloud website, including the documentation and blog posts. Even though the information given there may be glossed over for marketing reasons, the presentation of an exemplary selection of suitable tools for the technological capabilities stated above does serve the purpose of proving that such cloud-based solutions exist.

Big data is a broad field concerned with acquiring, storing, analyzing, and presenting large quantities of data, to some extend in real time. The GC offers a range of services suitable for these capabilities or specific parts of them. For example, *Cloud Spanner* can be used as a relational database with practically unlimited volume, *Bigtable*, on the other hand, serves as a NoSQL database, and *Cloud Storage* might be used as an extensive storage for binary objects. For data streaming, *Pub/Sub* is a service usable for fast voluminous data transfers based on a publisher/subscriber model, as the name suggests. *Dataflow*, thereupon, can be used for stream and batch processing of the gathered and stored data. Visualizing and exploring data is made possible by using *Cloud Datalab*. One tool particularly appropriate for storing and analyzing big data in combination is *BigQuery* since this service links the capacities of a data warehouse with the analytical capabilities of machine learning through the integration of *BigQuery ML*. Thus, huge amounts of data can be stored and employed to train and evaluate machine learning models.

Considering AI and ML more generally, Google Cloud provides a wide range of tools for different use cases. With text conversion via *Speech-to-Text* and, inter alia, *Text-to-Speech* APIs, Google's *Natural Language API* to extract information from unstructured texts, and *Vision AI* to identify texts, objects, properties, and logos on images, a large selection of solutions can be specified for a variety of use cases that revolve around the topic of text and image analytics. Additionally, *AutoML* and *Vertex AI* are provided as tools for the creation of general machine learning models to classify, predict, and forecast data values. Since this is only an exemplary overview, it must be noted that Google does provide an even larger collection of earmarked products as well as rather uncommitted ML tools such as BigQuery ML, which can be used for any given tabular dataset.

Mobile and web applications can be made available by using any Google Cloud tool that can provide an application to an audience through the public Internet. *App Engine*, for example, is a fully managed serverless platform, meaning that a developer does not have to care about underlying infrastructure since it is handled as well as automatically scaled by Google. The standard version supports several popular programming languages and frameworks (e.g., NodeJS, PHP, and Python). The developers' task hereby is solely to write the application and, if necessary, adjust the service account for the App Engine to enable access to other services inside the cloud since Google allows for an easy connectivity between cloud services without complex authentication techniques as required when developing locally. This way, data storage, analytics tools, and App Engine to present something to an external user could be linked. Other exemplary options for offering an application would be via *Compute Engine*'s virtual machines or by containerizing the application and deploying it on a *Google Kubernetes Cluster*. Not limited to cloud products but also usable in combination with them, the *Google Pay API* adds a way for users to pay with their Google accounts for offered services in apps or on websites.

Since the technologies AR and VR are mostly reliant on massive data computing and real-time rendering (i.e., high-performance computing), Google Cloud does not offer one particular tool but a variety of combinations of services. For instance, with Compute Engine, compute-optimized virtual machines with up to 96 vCPUs with 8 gigabyte memory each can be created. The same applies to the Google Kubernetes Cluster whose nodes run on Compute Engine instances themselves. Thus, developers of AR and VR projects can benefit from the high-performance computing capabilities offered by Google Cloud.

Regarding social media integration, a field report by the company Computerlogy shows how cloud tools can be utilized for data collection and analytics from popular social media networks. As foundational infrastructure, a Google Kubernetes Cluster running on Compute Engine instances delivers a highly flexible and cost-efficient basis through embedded autoscaling capabilities. With a deployed Elasticsearch search engine, the developers track with this approach information from, for example, Facebook, Twitter, and Instagram that are subsequently further processed with BigQuery's analytical tools. Visualizations are realized with *Google Data Studio*. At this point, it is worth noting that cloud tools are often suitable for multiple scenarios, while the ultimate benefit depends on the exact architecture. Google Cloud offers a high degree of flexibility and thus a reduction in the effort required to familiarize with specialized tools.

Especially for IoT systems, *IoT Core* is a fully managed service to connect and manage IoT assets. The cloud handles security, communication, and device management for the users and links the necessary tools to process the data. For example, in an approach taken from the documentation, Dataflow might be used for streaming and batch analysis, while Pub/Sub is responsible for managing input connections. Again, BigQuery and Vertex AI store the data and help develop machine learning models for analytics. In addition, with the *Google Maps Platform*, Google offers the ability to integrate location intelligence for geographic tracking of IoT devices.

For video analytics (i.e., the last of the technological capabilities mentioned in Figure 4), Google offers two solutions, *Video Intelligence API* and *AutoML Video Intelligence*, which differ in their ability to annotate videos with custom or predefined labels. Both products help extract information from video material, such as objects, locations, actions, texts, logos, faces, and others. The outlined tools are summarized in Table 3 below and constitute the second part of an answer to RQ2.

Table 3: (E-)retailing capabilities matched with Google Cloud tools.

Capability / technology	Exemplary Google Cloud tools
Big data	Cloud Spanner, Bigtable, Cloud Storage, BigQuery (storage); Pub/Sub, Dataflow (processing); Datalab (exploration)
Artificial intelligence and machine learning	Speech-to-Text/Text-to-Speech, Natural Language AI (text analytics); Vision AI (image processing); AutoML, Vertex AI, BigQuery ML (general use cases)
(Mobile/tailored) applications and payment	App Engine, Compute Engine, Google Kubernetes Cluster (app provision); Google Pay API (payment)
Virtual and augmented reality	Compute-optimized virtual machines (Compute Engine, Google Kubernetes Cluster)
Social media integration	Compute Engine, Google Kubernetes Cluster (foundation); BigQuery ML (analytics); Google Data Studio (visualization)
Internet of Things	IoT Core (foundation); Dataflow, Pub/Sub (processing); BigQuery, Vertex AI (analytics); Google Maps Platform (tracking)
Video Analytics	Video Intelligence API, AutoML Video Intelligence

6 CONCLUSION AND FUTURE IMPROVEMENT

In the near future, traditional stationary retail and its business models are expected to undergo massive changes due to new digital technologies such as big data, artificial intelligence, virtual reality, and social media networks (Alexandrova and Kochieva, 2021; Bellis and Johar, 2020; Guha et al., 2021) and due to rising customer expectations, living standards, and the desire for more freedom of choice (Alexandrova and Kochieva, 2021; Farah et al., 2019; Marchand and Marx, 2020; Xue et al., 2017). On the journey into the digital age, cloud technologies can provide a useful, cost efficient, flexible, and easily accessible addition to present retail channels. Based on an extensive body of literature reviewed through a systematic literature search, this paper provides possible answers to the questions of what characteristics and technological capabilities are likely to shape the future of retailing. In addition, an exemplary cloud tool selection from Google Cloud is presented and explained. In future research endeavors, more of the identified technological capabilities are to be integrated into purposeful cloud reference architectures.

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