Artificial intelligence in retail: applications and value creation logics

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Abstract

Purpose – This paper seeks to answer three questions about how retailers can benefit from AI. (1) What are the main strategies for retailers to improve their AI-related data management? (2) How do retailers use AI to provide solutions in business processes? (3) What are the value creation logics of AI applications in retail?

Design/methodology/approach – Data- and solution-centric perspectives, as well as the concept of value creation logics, serve to build the analytical framework. The grounded theory multiple-case analysis of 54 representative retailers' adoptions and implementations of AI between 2008 and 2018 help to investigate the firm's AI applications and value creation logics.

Findings – This study identifies five main strategies for AI-related data management and reveals 28 AI-powered solutions, changing 14 business processes, with five management areas involved in AI applications to create value via four logics: automation, hyper-personalization, complementarity and innovation.

Research limitations/implications – This paper advances the research into AI applications in business and management by providing research propositions with an integrative framework to understand how firms can use and benefit from AI. However, secondary data and exploratory study still limit the findings.

Practical implications – The findings provide retail managers with an analytical framework that can help them to develop a rationale for their strategic choices and best practices relating to the adoption and implementation of AI.

Originality/value – The originality of this paper lies in its systematic examination of AI applications and value creations in retail. The findings provide managers with guidance, rational strategic choices and best practices to take action to embrace the great business opportunities created by AI technologies.

Keywords Artificial intelligence, AI application, Value creation, Digital transformation, Retail sector

Paper type Research paper

1. Introduction

Artificial intelligence (AI) is considered to be a revolutionary technology that will substantially change all aspects of society, life, firms and employment (Makridakis, 2017). While it is important to look forward, it seems more meaningful for managers to get advice on how their existing business can benefit from AI because the leading firms in AI applications have already made differences compared with those lagging in their industry (Brock and von Wangenheim, 2019).

To address this issue and understand how firms can use and benefit from AI, we performed a grounded theory multiple-case analysis of 54 retailers' AI applications from between 2008 and 2018. We focus on the retail sector for three reasons. First, deep studies of AI applications and value creation should concentrate on a small number of industry segments to control for industry- or segment-specific differences (Garbuio and Lin, 2019). Second, the retail sector can provide rich data for our study because it has already experienced disruption resulting from AI technologies (Infosys, 2018). Third, according to McKinsey (Chui and Francisco, 2017), more than 41% of the retailers it investigated were uncertain about the benefits of AI, specifically the business cases and the return on

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investment. Thus, it is important to understand how retailers can benefit from swiftly adopting and implementing AI.

By providing research propositions in an integrative framework, our findings help to advance the research into AI applications in business and management and to understand how firms can use and benefit from AI. More specifically, this research examines two foci of AI applications: data management, which enables firms to have AI applications that are digital technology-ready, and other management areas (i.e. customer service, store, supply chain, marketing, and cybersecurity and risk management) where AI empowers solutions. The two foci create value for firms and their customers via four logics: automation, hyper-personalization, complementarity and innovation. The findings also offer managers the guidance, rational strategic choices and best practices needed to take action and embrace the business opportunities created by AI technologies.

2. Relevant literature and research questions

2.1 Conceptualizing AI

AI relates to a machine that is not a simple mechanical device only capable of applying pre-programmed decisions (Makridakis, 2017) but a system that can learn how to learn (Haenlein and Kaplan, 2019; Humerick, 2018). Thus, AI is defined as *a system's ability* (Haenlein and Kaplan, 2019; Namaki, 2018; Wirth, 2018).

Concretely, this ability refers to the capabilities to simulate human intelligence, particularly those involving cognition, such as *learning* and *problem-solving, within an ever-changing environment, based on its continuing collection of data* (Humerick, 2018, p. 396).

These processes allow a system to perceive its environment and to take actions that maximize its chances of success (Wirth, 2018). Thus, AI's abilities enable a system to *achieve specific goals* (Haenlein and Kaplan, 2019).

Combining these discussions, we propose an expanded definition of AI: AI is a system's ability to continuously learn from and solve new problems in an ever-changing environment, based on its continuing collection of data, to achieve specific goals. With this expanded definition of AI, we can better distinguish firms' AI-related activities from other activities in our empirical study.

2.2 Understanding AI applications from both data- and solution-centric perspectives

How can firms use AI in their business? Two main approaches appear in the literature: data-centric and solution-centric perspectives. Data-centric perspectives assert that AI applications are highly data-driven and need to focus on data management (Brock and von Wangenheim, 2019; Shankar, 2018). Firms' data management capabilities, especially cloud computing (Shankar, 2018), make their data ready for AI to analyze (Brock and von Wangenheim, 2019) and ensure that firms' computing is powerful enough to support advanced algorithms (e.g. machine learning (ML), deep learning and neural networks) and produce the desired results for firms (Seranmadevi and Senthil Kumar, 2019). Vice versa, the adoption of AI technologies boosts firms' data management, especially big data capabilities. AI enables firms to collect huge volumes of data in real time, treat various data (including numeric, text, voice and visual/image/video data) and analyze big data more effectively (Shankar, 2018). While some studies (Seranmadevi and Senthil Kumar, 2019; Shankar, 2018) have discussed the relationship between AI and data management, there has been little research into the digital strategies that firms can use to improve their AI-related data management (Brock and von Wangenheim, 2019). Thus, we ask:

RQ1. What are the main strategies for retailers to improve their AI-related data management?

Solution-centric perspectives highlight how AI applications provide solutions to help address business issues. They also focus on analyzing the applications' landscape (Garbuio and Lin, 2019). AI systems' contributions are more likely to be a function of how they integrate and interface with other hardware, software, policies, procedures and organizational arrangements that collectively constitute an improved business process (Duchessi *et al.*, 1993; Kumar *et al.*, 2019). While it has been growing, the research about AI-powered solutions in retail remains limited. Most studies investigate solutions in only one retail activity, such as retail segmentation (Boone and Roehm, 2002), customer service and relationship management (Chopra, 2019; Kumar *et al.*, 2019; Seranmadevi and Senthil Kumar, 2019) or warehouse management (Mahroof, 2019). Although many studies (e.g. Grewal *et al.*, 2017; Shankar, 2018; Weber and Schutte, 2019; Mahmoud *et al.*, 2020) enlarge their scope and broadly envision AI applications in various retail management areas, they are usually descriptive and provide no details about how AI can be used or have an impact on retailers' business processes. More studies, especially multiple-case ones, are needed to investigate best practices concerning AI applications in retail. Thus:

RQ2. How do retailers use AI to provide solutions in business processes?

2.3 Value creation logic

How can firms benefit from AI applications? Studies have mostly adopted the value creation perspective to understand why firms can benefit from the application of new digital technologies (Amit and Zott, 2001; Sjödin *et al.*, 2020). While studies (Dirican, 2015; Garbuio and Lin, 2019; Riikkinen *et al.*, 2018; Singh *et al.*, 2019) have followed this perspective to analyze AI's impacts on business and economics, they have investigated the value creation of AI applications in fragmented ways with few systematic examinations in the literature.

The literature has proposed the concept of value creation logic to investigate and systematically categorize the mechanisms of value creation (Amit and Zott, 2001; Stabell and Fjeldstad, 1998). The concept of value creation logic, which was originally developed by Stabell and Fjeldstad (1998), refers to the typology of the alternative value creation forms for expressing and exploring how firms differ in terms of competitivity. They applied the work of Porter (1985) to analyze and suggest three value creation logics: transformation of inputs into products (the value chain model), (re)solving customer problems (the value shop model) and linking customers (the value network model). However, Amit and Zott (2001) suggested that no single theory can fully explain the logic of value creation and that different theories are necessary, especially in the context of highly interconnected and innovation-driven markets. Thus, they applied a multiple-theoretical framework that included value chain analysis, Schumpeterian innovation, the resource-based view of the firm, strategic networks and transaction cost economics to analyze value creation logics in the context of e-business.

Vargo and Lusch (2004), Vargo and Lusch (2016) and Vargo and Lusch (2017) developed the theory of service-dominant logic (SDL), which reflects a paradigm shift that places service exchange (not goods) and consumers (not producers) at the core of value creation. This alternative theory helps to understand human value co-creation. It allows a more holistic, dynamic and systemic perspective to analyze value creation in terms of its service ecosystems perspective. Since firms' AI applications require multiple actors to be involved (Kaartemo and Helkkula, 2018; Wright and Schultz, 2018) and consumers to be engaged throughout the service exchange (Pantano and Pizzi, 2020), we adopt the concept of value creation logic and use the analytical framework suggested by Amit and Zott (2001) but completed by the SDL theory to address the question:

RQ3. What are the value creation logics of AI applications in retail?

3. Research method

3.1 Design

We chose a qualitative multiple-case study design to achieve our research objective. The qualitative study matches the state of current theory – about AI still being in its infancy (Kaplan and Haenlein, 2020; Mahroof, 2019) – and our study's exploratory goals. The case method is suitable for two reasons. First, it is applicable to identify emerging themes and patterns since it allows one to acquire rich and detailed data about a phenomenon (Eisenhardt and Graebner, 2007). Second, this method offers reliable indications of future research while providing a new, deep and nuanced understanding of previously unexplored phenomena (Boddy, 2016). The use of multiple case studies also allows for a replication logic that tends to yield better-grounded theories and more generalizable results than single-case studies do (Eisenhardt and Graebner, 2007). We followed the procedure recommended by Eisenhardt and Graebner (2007) and Yin (1994).

3.2 Identification of the sample firms

Given that the application of AI is developing rapidly in retail (Shankar, 2018), we used the Factiva database to identify the most mentioned retail firms at the level of AI applications across the world. We used the keywords *artificial intelligence* and *AI* in the search. We only searched articles in English whose headline and title included the keywords in the retail industry in Factiva, from an undefined ending on December 31, 2018, the last date of the previous year of data collection. We collected 6,917 articles published between 2001 and 2018.

Using the information in these 6,917 articles, we first identified retailers' strategic activities and practices relating to AI according to our definition of AI. We identified the 54 most mentioned retailers (Appendix 1) and their AI application cases from the 6,917 articles, and the timeframe of the firms' AI application cases is 2008 = 2018. The sample firm selection is suitable for two main reasons. First, there was a high level of retail sector representativeness. The sample list included not only traditional physical store-based retailers (e.g. Walmart, Carrefour) but also new business model-based retailers, such as Stitch Fix Inc. and Meituan-Dianping. Second, these firms were highly diverse concerning country of origin, firm age, sector of activity and firm size. Despite the dominance of US retailers, which accounted for 50% of the sample, the sample firms were located in 10 countries. The top three industries applying AI in firm activities are Internet and direct marketing retailers (31.5%), department stores (11.1%) and food retailers (9.3%). We then sought to supplement the emerging material for these firms by looking at the information provided by the other databases (e.g. EBSCO, Euromonitor and EDGE) and firm websites.

3.3 Data analysis procedure

With information mainly available in Factiva, we analyzed each firm's AI applications by using a grounded theory content analysis (Corbin and Strauss, 2008). To address our research questions, one main researcher on the project conducted a three-stage data analysis. First, we identified the sample firms' main strategies to improve their AI-enabled data management. Second, we mapped the AI application landscapes relating to AI-powered solutions, as well as their impacts on the relevant business processes and management areas. Third, we identified these solutions' value creation logics. We used NVivo 10 to assist our qualitative data analysis because it helps to structure the analysis on multiple data sources simultaneously and create a track record of the analytical process, which increases the research's rigour and transparency (Sinkovics and Alfoldi, 2012).

3.3.1 Identifying the sample firms' main strategies to improve AI-enabled data management. We used an open-coding procedure to identify preliminary concepts that fit the data relating to the sample firms' activities about their adoption and implementation of AI-related data technologies. For instance, we assigned the label *AI-related acquisition* to the

announcement "Amazon has acquired PhotoTime creator Orbeus. . . This would be the latest in a string of acquisitions in the area of deep learning". We analyzed the next unit of data and compared it with the first. If it was similar, we gave it the same label; if not, we coded it with a different label. This process continued until we had identified nine empirical codes (nine firm strategies). We discussed these codes with three experts in the field and retained five after removing duplicate or inappropriate ones.

3.3.2 Mapping the AI application landscapes. First, we used an open-coding procedure to identify preliminary concepts that fit the data relating to the sample firms' AI applications, but only applications that provided the firms with solutions. For instance, we assigned the label *AI-powered image search* to capture the AI-powered solutions provided by AI application cases described in the data as follows: "A key technology that JD.com has developed is JD Camera+. JD Camera + facilitates ease-of-shopping for users by allowing customers to quickly and easily search for their favourites products with just a photo rather than detailed language descriptions". We continued our analysis until we had identified 32 empirical codes (32 AI-powered solutions). We discussed these codes with three experts in the field and retained 28 after removing those that were duplicates, ambiguous or inappropriate.

Second, we conducted axial coding to search for relationships among the empirical codes (i.e. AI-powered solutions) and then assembled them into subcategories. We categorized the empirical codes by grouping them into subcategories based on their underlying similarities (i.e. changing the same business process type). For instance, we grouped the similar empirical codes AI-based visual merchandizing, AI-based category management and AI-based merchandizing algorithms under the label *optimizing store merchandizing* because these three AI-powered solutions can all change the same business process relating to store merchandizing operations.

Third, we continued axial coding to search for relationships among the subcategories (i.e. AI-driven changes to business processes) and then assembled them into categories (i.e. the management area involved in AI applications). A category eventually emerged, according to the definition of categories of retailers' activities in the literature (Karanja and Rosso, 2017; Swoboda *et al.*, 2008). For instance, because optimizing replenishment, automating warehouse operations and optimizing and automating delivery service all related to supply chain and fulfilment management, we classified them as subcategories of the main category supply chain management.

Throughout the coding procedure, we strictly followed theoretical sampling and a constant comparative method to continue the data analysis until we reached data saturation (Corbin and Strauss, 2008), which improved the data interpretations' reliability. To enhance the research results' validity and reduce the potential for bias, we also asked two experts to review a summary report of the framework and the definitions. We again did axial coding following their feedback, grouping the 28 empirical codes into five categories and 14 subcategories (Table 1).

3.3.3 Identifying the value creation logics of the AI-powered solutions. To identify the value creation logic of the AI-powered solutions, we analyzed the consequences of each solution for every firm. The objective was to understand the mechanisms of AI value creation by identifying *causal links* between a solution and its consequences. The consequences were observed from two dimensions: value created for consumers and the firm (Sorescu *et al.*, 2011; Cao *et al.*, 2018). For instance, the speciality floral gift retailer 1-800-Flowers.com said it used the AI-powered solution "Voice command" based on the voice-activated Amazon Alexa platform to automate customers' orders. We observed that this solution enabled customers to interact with the firm in convenient ways (e.g. getting answers to their questions quickly; hands-free ordering). Thus, both the firm and its customers saved on transaction costs. Furthermore, this AI-based activity has a novelty value because it created a new channel and made new services available to customers. We assigned the labels "saving transaction costs",

Management areas mostly involved in AI applications	AI-driven changes in business processes	AI-powered solutions	Examples of best practices
Customer service management	Facilitating customers' search information	AI-powered semantic search	Alibaba's API
		AI-powered image search	Burberry's AI image search
		AI-powered voice search	1–800-Flowers.com using the Facebook Messenger chat platform
	Guiding customers to find relevant products and services	AI-powered recommendation algorithms	Amazon AI-based recommendation system
		Virtual try-on system	Gap's augmented reality application
	Facilitating customers' buying and after-sales experience	Voice command	1–800-Flowers allowing customers to order via the Alexa voice-activated AI platform
		Checkout-free system	JD.com using facial recognition to automate checkout
Store (physical and virtual) management	Optimizing store merchandizing	AI-powered visual merchandizing	Amazon's ImageIQ
		AI-powered category management	eBay's Grouped Listings
		AI-powered merchandizing algorithms	Tesco's AI operating system
	Automating store operations	Autonomous shelf-scanning robots	Walmart's in-store robots
		Autonomous store atmospheric control	Lawson's store lighting and temperature control system
	Assisting store staff to serve customers	In-store chatbot	Best Buy using Alexa at its stores to answer customers' questions
		AI-powered sales assistance	Aeon's store staff equipped with AI-based smartphones
Supply chain management	Optimizing replenishment	AI-powered demand forecasting	Myntra's smartbot
		Autonomous order processing system	Morrisons's autonomous order system
	Automating warehouse operations	Autonomous mobile robots	Gap's warehouse robots
		AI-powered sorter system	Flipkart's GreyOrange Linear Sorter systems
		Collaborative robots	Ocado's Star Wars-style robots in warehouses
	Optimizing and automating delivery service	Drone delivery system	Amazon Prime Air
		Self-driving car	Ocado delivery van
		AI-powered delivery modelling	Scotts LawnService using AI-based system Pointserve

Table 1. Mapping AI application landscapes in retail

(*continued*)

Management areas mostly involved in AI applications	AI-driven changes in business processes	AI-powered solutions	Examples of best practices
Marketing management	Setting dynamic prices	AI pricing	Staples adopting AI-enabled pricing software from Mountain View
	Automating and optimizing communications	Autonomous product catalogue creation	Carrefour using Sigmento's service platform
		AI-powered ad-spend optimization	Arcadia using Tinyclues AI-first marketing platform
	Choosing the right store locations	Location intelligence technology platform	Subway adopting SiteZeus's location intelligence technology platform
Cybersecurity management	Automating cybersecurity management	AI-powered security platform	Coop Group adopting the Cognito™ AI threat-hunting platform
	Automating fraud prevention	AI-powered fraud detection	Amazon using AI to detect fake reviews

Table 1.

"new services" and "new channels and retail formats" to the solution powered by the Amazon Alexa platform at the level of value creation mechanisms. This within- and cross-case analysis enabled us to identify 14 mechanisms of value creation in AI-powered solutions in retail.

A general category (i.e. value creation logics) eventually emerged, since all the mechanisms belonging to the same value creation logic anchored the same specific characteristics of AI. For instance, since saving on labour costs, saving transaction costs, increasing the speed of the value chain process and improving operational accuracy all shared the aspect of control (value creation via AI's business automation), we classified them as subcategories of the main category *automation*. We found four value creation logics for AI-powered solutions in retail that create value for firms and their customers (see Table 2). We will now present these in detail.

4. Research findings

4.1 Five main strategies for retailers to improve their AI-related data management

Five axes relating to retailers' main strategies in AI-related data management emerged: building a strategic partnership with a leading digital technology provider, making an AI-related acquisition, establishing an R&D lab, hiring AI experts to build technology teams and changing the organizational structure.

AI adoption concerns not only small-scale pilot tests, however. Retailers should integrate AI applications throughout their value chain. Thus, working with multiple technology service providers on different activities of a value chain is a problematic choice. Most sample firms selected a leading digital technology services company to build a long-term strategic (rather than a short-term contractual) relationship, thereby creating a robust AI technology foundation. For instance, the partnership between A.S. Watson and Infosys accelerates the retailer's AI and digital transformation initiatives.

Acquisition is the fastest way for retailers, especially large ones with abundant financial resources, to enter a specialized AI technology area. For example, Amazon acquired PhotoTime creator Orbeus, an AI start-up that specializes in photo recognition technology.

Value creation logics	Mechanisms	Examples of AI-powered solutions
Automation	Saving labour costs	AI chatbot providing 24/7 customer services; AI-powered robotic solutions in the warehouse; automatic data management; auto shelf replenishment, cashier-less store
	Saving transaction costs	Auto-ordering; voice-based ordering; automated agents for decisions; automating to target right persons and trigger conversation to lead to buy
	Increasing the speed of the value chain process	Automated coupon creation; AI-based design system to shorten the fashion cycle; AI assisting to capture real-time data and making instant actions; drones providing faster delivery services; chat-based bot providing speed services
	Improving operational accuracy	AI automating product catalogue creation process without errors; AI-powered inventory management to reduce inventory shrinkage
Hyper-personalization	Improving a relevant offering	Robotic companion providing unique product recommendation
	Providing unique shopping experiences	AI-enabled visual or robotic personal shopping assistant; AR/VR-powered shopping services
	Creating consistency across channels	AI-based streamline and unobstructed customer journey management
Complementarity	Creating synergies between AI and retailers' employees	AI-based sales assistants; intelligent algorithms assisting human stylists; machine learning-enabled merchant assistants
	Creating synergies between AI and customers	AI-powered online search process assisting shoppers to search products; AI-enabled mobile apps helping shoppers to navigate stores
	Creating synergies between AI and other technologies	Combination of AI and cloud computing, IoT, blockchain, 3-D printing and mobile technologies
Innovations	New products	AI-designed products
	New services	AI-enabled image recognition
	New channels and retail formats	Voice bots; checkless stores
	New business models	AI-powered on-demand business model; AI-powered inscription business model

Table 2.
Value creation logics in AI-powered solutions and their mechanisms

Large retailers, especially third-party digital marketplace providers, establish R&D labs worldwide to keep pace with the latest digital and AI technologies, experiment with these new technologies and incorporate them into their business models. The labs are often located in the cluster regions of hi-tech companies or well-known universities nearby. For instance, Alibaba has launched eight research bases in China, Israel, the USA, Russia and Singapore to work on AI, quantum computing and fintech.

Retailers are also aggressively hiring AI experts to build their technology teams. JD.com recruited more than 100 data scientists from Australia in 2017.

Retailers are also changing their organizational structure to embrace AI and digital technologies. Flipkart has created a new internal unit, AIforIndia, which reports directly to the company's senior business and technology leaders. The idea is to put AI at the centre of the firm's business.

4.2 AI applied to five retail management areas

We analyzed the AI application landscapes in our sample and identified five main management areas where retailers apply AI: customer service management, (physical and virtual) store management, supply chain management, marketing management and cybersecurity and risk management (Table 1).

4.2.1 Customer service management. Retailers especially apply AI to customer service management, where it is making an important difference. Retailers can use AI-powered solutions to change their interactions with their customers at different stages of a customer journey. Retailers can use AI to make customers' search information easier, faster and more personal and natural. To this end, AI provides three main solution types: *AI-powered semantic search*, *AI-powered image search* and *AI-powered voice search*. Retailers can also use AI to help customers to make the "right" buying decision, strengthen customers' confidence to buy and reduce the buying return rate. AI provides two related solutions: *AI-powered recommendation algorithms* and *virtual try-on service*. Furthermore, AI allows retailers to facilitate customer buying and getting relevant shopping assistance and after-sales support. Accordingly, AI provides two solutions: *voice command* and *checkout-free service*.

4.2.2 The management of physical and virtual stores. Retailers use AI alone or alongside store staff to improve the efficiency of both physical and virtual store management and to streamline customers' shopping experiences. For a retail store, AI-powered operating systems can ensure the right products in the right quantities are in the right place at the right time. AI optimizes retailers' online and offline merchandizing via three main solutions: *AI-powered visual merchandizing*, *AI-powered category management* and *AI-powered merchandizing algorithms*. Moreover, retailers intend to use robots to perform in-store tasks that are repeatable, predictable and manual, thereby giving staff the freedom to spend more time helping customers. Robotics process automation provides two solutions: *autonomous shelf-scanning robots* and *autonomous store atmospheric control*. AI also assists staff in gathering information in real time, provides personalized recommendations to customers and checks in-stock positions via two main solutions: *in-store chatbots* and *AI-powered sales assistance*.

4.2.3 Supply chain management. Adopting AI technologies to optimize supply chain management is a key driver of AI's growth in retail. AI empowers retailers to optimize their ordering and replenishment management via two main solutions: *AI-powered demand forecasting* and *autonomous order processing systems*. Retailers use automated systems, robots and specialized software to transport materials, perform various tasks and streamline/automate warehouse processes. The warehouse robotics can help retailers to improve their warehouse operations' efficiency. Here, AI provides three main solutions: *autonomous mobile robots*, *AI-powered sorter systems* and *collaborative robots*. Furthermore, AI can help retailers to optimize and automate their delivery service via three main solutions: *drone delivery service*, *self-driving cars* and *AI-powered delivery modelling*.

4.2.4 Marketing management. AI systems can analyze vast quantities of dynamically changing data and help retailers to make smart marketing decisions. AI enables retailers to dynamically adjust prices and offer customers different prices based on external factors and individuals' buying habits to meet a certain goal, such as boosting sales or maximizing profits. Here, AI provides its main solution: *AI pricing*. In addition, AI can help retailers to manage communication via two main solutions: *autonomous product catalogue creation* and *AI-powered advertising spending optimization*. Given the heavy sunk costs of opening a new physical store, store location decisions are critical to retailers. AI helps to reduce the risk of these decisions via its *location intelligence technology platforms* solution.

4.2.5 Cybersecurity and risk management. Cybersecurity is one of the most challenging issues for retailers in the digital economy. Data breaches and other fraud events in a network can result in considerable losses for retailers. Today's retailers suffer immense pressure to

reduce the time to detect and respond to attacks. Their security teams are overwhelmed by the manual task of triaging and correlating security events. To automate cybersecurity management, AI provides the *AI-powered security platform* solution to increase cybersecurity operational efficiency and efficacy.

Fraud actions (e.g. fraudulent payments, fake reviews and counterfeit products) are growing in degree and complexity and often have a completely different digital footprint or pattern, sequence and structure, which make them undetectable if using rules-based logic and predictive models alone. AI can provide an *AI-based fraud detection* solution, which deploys predictive analytics, behavioural analytics and ML to find anomalies in large-scale data sets in seconds.

4.3 Four value creation logics in AI-powered solutions

4.3.1 Value creation via business automation. Our data analysis pointed to automation as a primary value creation logic in AI-powered solutions. AI-powered business automation helps retailers to improve business efficiencies and, therefore, to generate more value in several ways, such as *saving on labour and transaction costs*, *increasing speed* and *improving accuracy* in their operational processes.

Retailers have many labour-intensive operations. The automation of AI, such as AI chatbots and AI-powered warehouse robotic solutions, can take on some traditionally human jobs and enable retailers to save on labour costs.

Furthermore, AI systems help retailers to save on transaction costs. For instance, AI-powered recommendation algorithms make it possible for retailers to better match supply and demand, thereby reducing negotiation costs.

Applying AI can accelerate retailers' value chain processes. For instance, AI-powered demand-forecasting systems allow fashion retailers to shorten the fashion production life cycle significantly.

Retailers deal with many details every day. AI systems are never tired or sick. They can help retailers to improve operational accuracy, for example with merchandizing and inventory management: AI systems automate the product catalogue creation process without errors – from collecting data, enriching data and creating product experiences to normalizing product attributes.

4.3.2 Value creation by offering hyper-personalized products and services. Our data analysis also pointed to hyper-personalization as a key value creation logic in AI-powered solutions. AI systems can delve deeply into customer data, find trends and capture cues and preferences of individuals that they themselves may be unaware of. Thus, AI-powered personalization is evolving, superseding most current personalization, and can be considered as hyper-personalization. AI-powered hyper-personalization gives customers more satisfactory experiences and helps retailers to reach their sales targets. It creates value in various ways by *improving a relevant offering*, *providing a unique shopping experience* and *creating consistency across channels* for customers.

AI enables retailers to look at an individual shopper in the moment, fully understand what they want (even their latent needs) and help them find the "right" items. Furthermore, deep learning AI can understand product characteristics at a granular level, even when they do not appear in a product database. Thus, AI-powered recommendation algorithms help retailers to improve their product recommendations' relevance for customers.

Customers increasingly demand VIP treatment from firms and want retailers to respect their time and individual demands and inspire them in unique and personal ways. AI technologies can help retailers to respond to such demands. For instance, AI-enabled visual or robot shopping assistants provide to-one interactive services to customers.

With its very strong capabilities to treat multiple data sources in real time, AI allows retailers to provide each customer with tailored yet consistent services or communication

content throughout their shopping journeys across retail channels. For instance, AI software associates a consumer behaviour with a product catalogue's attributes in real time and then generates personalized content in e-mails, on websites and via other channels that reach consumers.

4.3.3 Value creation by creating synergy through complementarity. Our data analysis pointed out that AI can help persons to create value, and vice versa. AI-based complementarity creates value whenever a bundle of AI and other actors or resources come together, such as *AI and retailers' employees*, *AI and customers* and *AI and other technologies*.

The real benefit of AI is when it is used to improve people's lives. Beyond replacing some people's jobs in retail, AI is also helping employees to save time so they can focus on key activities (e.g. when activities require creative, emotional and subjective skills) and strengthen their capabilities in short timeframes to provide better customer service or to take more optimal decisions. For instance, robots and AI-based sales assistants are providing retail staff with the latest product, inventory and sales details and analyzing customer behaviour patterns in stores.

Retailers do not apply AI in isolation; they integrate existing and new technologies to power revolutionary solutions via effective and imaginative combinations of AI and other technologies. For instance, ML associated with cloud computing improves retailers' operational efficiency, and AI systems associated with 3-D product configuration technologies create personalized scenarios for shoppers.

4.3.4 Value creation by enabling innovations. Our data analysis revealed that AI is enabling retailers to innovate and create value by introducing *AI-based new products*, *new services*, *new channels* and *new business models*.

Retailers are using AI-powered demand forecasting to improve existing products and to create new ones. For instance, wholly AI-designed T-shirts (i.e. the patterns, colours and textures) with no intervention from a human designer are being sold on the fashion website Myntra.

AI systems and technologies are behind many new services. For instance, AR and VR are helping customers to make choices and improve their shopping experiences.

The rapid development of AI technologies is powering the creation of new channels (e.g. voicebots) and new retail formats (e.g. cashierless stores, like Amazon Go) that make it possible for retailers to inform, communicate and transact differently with customers.

AI enables retailers to move to new (e.g. data-driven and on-demand) business models, and Stitch Fix has reported success within its data-driven, AI-powered inscription business model.

5. Discussion

This study's research findings reveal two foci of firms' investments in AI: (1) technologies and (2) people and processes. Investing in technologies, especially in data management, enables firms to acquire and test new technologies and to transform their organizations to adapt to the applications of these new technologies (Seranmadevi and Senthil Kumar, 2019; Shankar, 2018). We identified five strategic axes for retailers to invest in AI-related data management. These strategic activities include multiple actors (e.g. leading digital technology service providers, start-up technology companies, universities, AI experts and employees) involved in firms' digital capability development. This finding is in line with suggestions in the literature (Kaartemo and Helkkula, 2018; Wright and Schultz, 2018). Building open innovation ecosystems favours firms developing AI-enabled digital capabilities (Brock and von Wangenheim, 2019; Garbuio and Lin, 2019). Our findings show that some firms (e.g. Amazon and JD.com) establish their own ecosystems, while others (e.g. eBay and Walmart) join an existing one.

Based on the reasoning above, we advance the following proposition:

P1. The focus of firms' AI-related data management investment is to build open innovation ecosystems.

Investing in people and processes allows firms to integrate AI systems into their business processes and to transform AI and other technologies into solutions for business issues (Garbuio and Lin, 2019; Kumar *et al.*, 2019). This research identified 28 AI-powered solutions that can change 14 business processes, as well as five diverse management areas. Among the 54 sample firms, 83.3% applied AI in customer service, 38.9% in store, 35.2% in the supply chain, 20.4% in marketing and 9.3% in cybersecurity management. We argue that AI applications in retail are not adequately scaled (Grewal *et al.*, 2017; Shankar, 2018; Mahmoud *et al.*, 2020; Weber and Schutte, 2019). A few pioneering firms (e.g. Walmart, Amazon) have applied AI in all five management areas. However, most firms apply AI in limited management areas. The firms still struggle to integrate AI into their organizational decision-making structures (Shrestha *et al.*, 2019). Retailers' AI applications in their business processes can vary because of many factors, such as firm size (larger vs. smaller retailers), level of organizational digital capabilities (third-party marketplace vs. traditional physical store) and retail industry sector (food retailer vs. luxury goods). Thus, we suggest the following proposition:

P2. In terms of firms' specific features, retailers select their focus of AI applications from among the five management areas: customer service, (physical and virtual) stores, supply chain, strategy and cybersecurity.

In line with Brock and von Wangenheim (2019), the two investment types need to work together for AI applications to create value for both a firm and its customers. For example, the A.S. Watson Group invested in building a data enterprise platform for easier AI application plug-in. This data platform can shorten current and future machine learning tools' rollout lead time by 50–80%. The firm also applies machine learning tools to its business operations, such as promotion operations, which allows tailor-made promotion strategy recommendations. The AI applications in the business operations enable the firm to consolidate the data from different business units and sources and, in turn, facilitate its big data platform development.

Based on this reasoning, we advance the following proposition:

P3. Firms benefit from the interaction effects of their investments in both AI-related data management and AI-powered business processes.

To understand why firms benefit from AI applications, the literature (Dirican, 2015; Garbuio and Lin, 2019; Riikkinen *et al.*, 2018; Singh *et al.*, 2019) has adopted the value creation perspective, but in fragmented ways. Following the concept of value creation logic, this research has systematically examined the value creations of AI applied in five diversified retailers' management areas. Thanks to the integrative analytical framework suggested by Amit and Zott (2001) and completed by the SDL(e.g. Vargo and Lusch, 2004; Vargo and Lusch, 2016; Vargo and Lusch, 2017), this study revealed four main value creation logics: automation, hyper-personalization, complementarity and innovation. These logics are more or less discussed in the literature relating to AI in retail. For example, Ameen *et al.* (2021) state that AI's benefits are increased levels of automation, cost reduction, increased flexibility and streamlined customer interactions. Kumar *et al.* (2019) examine the role of AI in aiding personalized engagement marketing. Jarrahi (2018) highlights the complementarity of humans and AI to strengthen organizational decision-making processes. Oosthuizen *et al.* (2020) adopt a customer-centric innovation view to understand AI's value creation. The research findings of this study also show the cross-linkages between the AI-powered

solutions and the value creation logics. As Table 2 shows, an AI-powered solution can follow more than one logic to create value, such as automation and complementarity, for an AI-powered sorter system. Thus, we suggest the following proposition:

P4. Firms can benefit from AI applications concerning one or more of the four value creation logics: automation, hyper-personalization, complementarity and innovation.

Figure 1 summarizes our research findings in an integrative framework to show how firms can use and benefit from AI.

6. Conclusions

Increasing numbers of retailers have ambitious plans for AI investments and expect them to improve their business performance. Although the literature recommends understanding AI applications from both data- and solution-centric perspectives, there has been little deep, multiple-case analysis to provide managers with practical advice on how their firms can use and benefit from AI in their existing business. Based on our grounded theory multiple-case analysis of 54 representative retailers' adoptions and implementations of AI between 2008 and 2018, we tackle three questions regarding how retailers can use and benefit from AI: (1) What are the main strategies for retailers to improve their AI-related data management? (2) How do retailers use AI to provide solutions in business processes? (3) What are the value creation logics of AI applications in retail? Our study proposes that firms build open innovation ecosystems to boost their developing AI-enabled digital capabilities. Specifically, retailers can follow five strategic areas to develop their AI-related data management: building a strategic partnership with a leading digital technology provider, making an AI-related acquisition, establishing an R&D lab, hiring AI experts to build technology teams and changing the organizational structure.

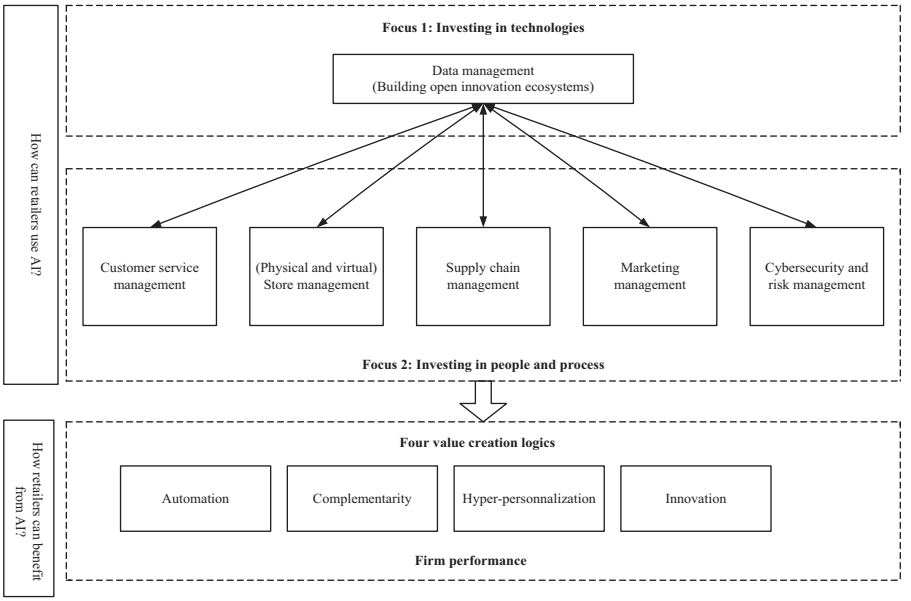

Figure 1.
An integrative framework for understanding firms' AI applications and their value creation

At the level of AI applications, our study shows that firms need to identify the relevant AI-powered solutions and integrate them into their business processes in the management areas, where AI can make a significant difference. Our findings point to 28 AI-powered solutions that can change 14 business processes, as well as five management areas: customer service management, (physical and virtual) store management, supply chain management, marketing management, and cybersecurity and risk management.

Finally, we find that AI applications can create value for firms and their customers in terms of one or more of the four value creation logics: automation, hyper-personalization, complementarity and innovation.

The findings have implications for theory development, practitioners and future research on AI applications in retail. While some scholars (e.g. Grewal *et al.*, 2017; Shankar, 2018; Mahmoud *et al.*, 2020; Weber and Schutte, 2019) have pointed out the need for cross-functional thinking about AI applications in diversified retail management areas, it has been unclear which foci are needed to invest, what the relationship between the foci is and which value creation logics the focal investments should follow. In this paper, we sought to address this gap by providing an integrative framework that outlines the interactions between the two foci of AI-related investments and the effects of these investments on firm performance through four main value creation logics.

The results presented in this paper are linked to managerial practices. First, based on multiple case studies, our findings confirmed that AI not only relates to the future but has been broadly used by retailers in their various management areas and already created value for firms and their customers. Thus, our study strengthens the confidence of firms, at least of retailers, to take action to embrace the business opportunities created by AI technologies.

Second, we provide managers with an analytical framework (see Figure 1) that can help them to create a rationale for their strategic choices relating to the adoption and implementation of AI. Our results show that AI applications concern both data management and other management areas where AI empowers solutions. Thus, we raise managers' awareness that investing in people and processes is as important as investing in technologies. Focusing on organizational digital transformation projects and AI-powered solutions used in current business processes is important when firms adopt and implement AI in business.

Third, our findings led us to identify five main practices to improve AI-related data management and 28 detailed AI-powered solutions in five management areas. Thus, we provide retail managers with guidance about best practices of AI applications.

Our study opens up many possibilities for future research. First, using longitudinal data gathered from secondary sources has important advantages (e.g. diverse AI development and public availability of data) for investigating AI's wide applications in retail. Our study enabled us to systematically review AI applications in diverse retail business processes across the world. However, to understand how retailers change their cultures and organizations to scale AI across organizations, secondary data remain a limitation. Thus, we need further research using primary data collected via deep interviews with retail managers and field observations in firms.

And second, we investigated the value creation logics of AI-enabled retailer activities to understand the mechanisms through which AI applications can influence firm performance. A qualitative study based on multiple-firm cases is relevant since the development of AI in retail is fairly new. Our study is exploratory, and we would welcome more quantitative studies to provide further empirical evidence on diverse AI-enabled activities' impacts on firm performance.

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Appendix

Company	Country of origin	Year founded	Primary industry sector	Total revenue in 2017 (in US $, unless otherwise indicated) (in millions)	Number of employees
1-800-Flowers.com Inc.	USA	1976	Internet and direct marketing retail	1193.6	4,785
A.S. Watson & Company	China (HK)	1828	Specialty stores	N/A	818
Aeon	Japan	1758	Hypermarkets and supercenters	8210145.0 (JPY)	156,739
Alibaba Group Holding Ltd	China	1999	Internet and direct marketing retail	22880.7	101,958
Amazon.com	USA	1994	Internet and direct marketing retail	177866.0	647.5
Arcadia Group Ltd	UK	1903	Apparel retail	N/A	2,143
Best Buy Co Inc	USA	1966	Computer and electronics retail	39403.0	125
Burberry	UK	1856	Apparel, accessories and luxury goods	2766.0 (GBP)	10,332
Carrefour SA	France	1959	Hypermarkets and supercenters	79908.0 (EUR)	363,862
Coop Group	Switzerland	N/A	Food retail	29008.0 (CHF)	75,515
CVS Health Corp	USA	1963	Healthcare services	184765.0	295
Earth Fare	USA	1975	Food retail	N/A	3,204
eBay Incorporated	USA	1995	Internet and direct marketing retail	9927.0	14
Etsy Inc.	USA	2005	Internet and direct marketing retail	441.2	1,209
Everlane	USA	2010	Internet and direct marketing retail	N/A	N/A

(*continued*)

Table A1. Profile of the sample and detailed information

Company	Country of origin	Year founded	Primary industry sector	Total revenue in 2017 (in US $, unless otherwise indicated) (in millions)	Number of employees
Farmstead	France	1984	Packaged foods and meats	N/A	243
Fast Retailing Co Ltd	Japan	1949	Apparel retail	1861917.0 (JPY)	52,839
Flipkart Internet Private Ltd	India	2007	Internet and direct marketing retail	N/A	4.31
Gap	USA	1969	Apparel retail	15516.0	135
Gazaro	USA	2007	Interactive media and services	N/A	N/A
H&M Hennes & Mauritz AB	Sweden	1947	Apparel retail	200004.0	177
IKEA International AB	Sweden	1982	Home furnishings	36602.0 (EUR)	149
Isetan Mitsukoshi Holdings	Japan	2008	Department stores	1253457.0 (JPY)	13.2 11
JD.Com	China	1998	Internet and direct marketing retail	52380.5	179
Kohl's Corp	USA	1962	Department stores	19681.0	81.5
Lawson Inc.	Japan	1975	Food retail	631288.0 (JPY)	10,395
Livraria Cultura SA	Brazil	1947	Specialty stores	N/A	1.8
LVMH Moët Hennessy	France	1923	Apparel, accessories and luxury goods	42636.0 (EUR)	141,914
Lowe's	USA	1946	Home improvement retail	65017.0	245
Macy's Incorporated	USA	1830	Department stores	26564.0	130
Marks & Spencer Group PLC	UK	1884	Department stores	10622.0	80,787
Meituan-Dianping	China	2003	Internet and direct marketing retail	37978.1 (HKD)	58.39
Morrisons	UK	1899	Food retail	16317.0 (GBP)	100
Myntra Designs	India	2007	Internet and direct marketing retail	N/A	1,039
Nordstrom	USA	1901	Department stores	14757.0	74
North Face	USA	1966	Leisure products	N/A	859
Ocado Group PLC	UK	2000	Internet and direct marketing retail	1454.5 (GBP)	14,163
Original Stitch	USA	2012	Internet and direct marketing retail	N/A	N/A
Overstock.com Inc.	USA	1997	Internet and direct marketing retail	1744.8	2.06
PetCareRx	USA	1998	Internet and direct marketing retail	N/A	100
Scotts Miracle-Gro	USA	1868	Fertilizers and agricultural chemicals	2642.1	5.6
Sears Holding Corp	USA	1899	Department stores	22138.0	89

Table A1. (*continued*)

Company	Country of origin	Year founded	Primary industry sector	Total revenue in 2017 (in US $, unless otherwise indicated) (in millions)	Number of employees
Shoes.com	USA	1996	Internet and direct marketing retail	N/A	193
Show Pony Group	Australia	2010	Apparel retail	N/A	N/A
Snapdeal	India	2007	Internet and direct marketing retail	N/A	784
Staples	USA	1985	Specialty stores	17908.0	61,503
Starbucks	USA	1971	Restaurants	22386.8	346
Stitch Fix Inc.	USA	20 11	Internet and direct marketing retail	977.1	6.6
Subway	UK	2010	Eating places	N/A	N/A
Tesco PLC	UK	1919	Food retail	55295.0	440,658
Under Armour	USA	1996	Apparel, accessories and luxury goods	4989.2	11
Uniqlo	Japan	1974	Apparel retail	829795.0 (JPY)	14,881
Walmart Inc.	USA	1962	Store and Internet retail	485873.0	2,200,000
West Elm	USA	2001	Home furnishing retail	N/A	80

Table A1.

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