CFR Course Note #006: Artificial Intelligence (AI) in Retail

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Artificial intelligence (AI) was established as a research topic already in the 1950s, but more recent developments in data availability and computing power have enabled AI to grow from an academic topic to one that transforms business operations in ways that are likely to have a profound impact on both society and the economy in the future. In fact, many experts argue that AI will impact the world as profoundly as the invention of the personal computer, the internet, or the smartphone.

Companies across all industries are beginning to reconceptualize their business processes and organizational structures for the age of AI. This is also true for the retail industry. In fact, many retailers have been on the forefront of digital transformation using advanced data and predictive analytics to make data-driven decisions. Through AI, retailers are now taking further steps into data-driven business processes and innovating new ways to blend digital and physical channels and touchpoints.

In the following course note, we will provide a brief overview of the literature on AI in retail and introduce some key constructs related to AI.

What is artificial intelligence?

Kaplan and Haenlein (2019, p. 17) define AI as "a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation". AI can thus be understood as making machines capable of simulating human intelligence.

The term AI includes many different technologies for example natural language processing, computer vision, and artificial neural networks (Wang et al 2021). Of specific interest for retail is the subset of AI techniques called machine learning (ML), which denotes techniques that are capable of learning from data and making predictions and/or decisions. ML algorithms learn through a training experience (e.g., historical purchase data) with respect to some task (e.g., growing customer lifetime value) and their success is typically judged using some kind of performance metric (e.g., variance explained or accuracy of prediction). Other relevant technologies are focused on perceiving data (e.g., natural language processing or computer vision) or controlling, moving, and manipulating objects based on learned information, through robots or other connected devices (Kaplan and Haenlein 2019).

Often several AI technologies are combined in solutions that are implemented by retailers. For example, in retail chatbots natural language processing is used to understand and communicate with customers using human language. At the same time, machine learning

algorithms enable chatbots to learn and evolve as they get access to more data. This means that the chatbot will get better over time.

How is AI used in retailing?

At the heart of AI are data and data science models that help predict and prescribe actions. A key benefit for AI is prediction, that is, the way they enable use of information that is available to generate information that is not (Agrawal et al., 2017). Guha et al (2021) proposes that the rich availability of data in the retail industry makes it likely to be very affected by AI. They also distinguish between two types of AI applications: demand side applications (i.e., applications of AI in customer-facing activities such as smart windows or augmented reality applications) and supply-side applications (i.e., applications of AI used in operational activities such as self-service checkouts or smart inventory and pricing systems).

Following the same distinction, Shankar (2018) points out the following examples of AI uses in retailing:

On the demand side, AI can help retailers understand and anticipate customer needs and make optimal decisions to enhance the lifetime value of customers. Retailers can also use AI to identify new sources of revenue and to implement profitable customer relationship management (CRM) strategies. AI technologies such as natural language processing and computer vision can be used to understand customer journeys. For example, L'Occitane used these technologies to identify causes of customer frustration on its mobile site which enabled modifications that resulted in about a 15% increase in mobile sales. Another common use case is personalization and recommendation systems. Mining various data from customers, retailers can develop AI systems to predict what customers will likely buy and make personalized product recommendations. An example is how Amazon and Netflix uses data on different customers to understand what to recommend a given customer in a given situation. Increasingly, in-store technologies, service offerings, and payment solutions used by retailers are also enabled by AI.

On the supply side, AI can enable supply chains to become more efficient and help optimize inventory management and logistics. For example, AI-based automation coupled with AI-backed demand forecasting is used by retailers to plan inventory and sales more efficiently. This practice is becoming quite common among big pharmacy chains. To successfully manage medication inventory, pharmacy planners implement AI tools that can automate chain-wide forecasting and replenishment. AI is also changing logistics and transportation through intelligent route planning, self-driving vehicles, and robot deliveries. An example is the Ocado platform which is offering a fully automated solution for online grocery retailing, thus tying together many of these developments. The current growth of the Internet of Things (IoT) -- connected devices ranging from radio frequency identification (RFID) tags on specific products to appliances with real time Internet connectivity -- is likely to accelerate AI adaption. Notably, there are potential demand effects of this development as well, but the most immediate benefits are likely found on the supply side of retail. AI enabled automation is also likely to continue to grow and replace or reshape several jobs in the retail sector.

Although many of the examples of AI used in retailing tend to be consumer facing, Guha et al (2021) propose that retailers are more likely to initially implement supply-side applications, especially in offline (vs. online) contexts. What is more, the likelihood of adapting AI is dependent on the value potential (that is how much money can be earned and/or saved) and

ethical risks related to privacy concerns, algorithmic biases, and regulations. It should also be noted that AI can also be used by shoppers and consumers in decision-making, potentially altering their relationship with retailers, but this type of AI use is beyond the scope of this course note.

Research point to important aspects that drive successful implementation, such as 1) accuracy of data management processes (i.e., being able to sort, connect and collect data in a way the prepares for AI introduction), 2) relevant problem definitions (i.e., being able to set up the right decision task for the AI to work on), and 3) the need to understand how managerial decision making will change with the implementation of AI (i.e., what decisions can be handed over to AI and what decisions will remain with managers) (e.g., Ascarza et al 2021; Guha et al 2021). It is also important to think about AI adoption over time, as the systems tend to improve with more data-points enabling more learning.

What value can AI bring to retailing?

Cao (2021) identifies four main sources of value creation of AI in retailing: 1) value creation via business automation, 2) value creation via hyperpersonalization, 3) value creation through synergy and complementarity, and 4) value creation by enabling innovation.

Value creation via business automation allows retailers to improve business efficiencies, for example reducing labor and transaction costs by increasing speed and improving accuracy in operational processes. An example could be self-service checkouts in stores that free up employee time, but also AI tools that automate forecasting and replenishment decisions.

Value creation via hyperpersonalization focuses on using AI to analyze customer data in a way that allows retailers to improve their product and service offerings and provide a unique shopping experience tailored to individual customers in real time. For example, many retailers and marketing organizations have adopted AI-based technology such as the Adobe Marketing Cloud that uses data from content analysis and user behaviors to deliver individualized, AI based personalization across web, email, sms, offline and IoT devices.

Value creation through synergy and complementarity refers to the value created when retailers use a bundle of AI and other resources to reinforce and strengthen each other. For example, AI based marketing automation systems (like the Adobe Marketing Cloud platform) can be integrated with other internal systems like CRM systems, customer support systems, web shops, and transport systems. Such integration enables each system to provide data to the AI and further strengthens its ability (for example, in terms of initiating leads and additionally improving personalization).

Finally, value creation by enabling innovation occurs when retailers use AI to create new products, services, channels and/or business models. Examples of such innovations are voicebots (new channel) and cashierless stores (new retail formats) that make it possible for retailers to inform, communicate and transact differently with customers.

What can be challenges implementing AI in retail?

Many companies see the value of AI, but there are also major barriers to successful implementation. One such barrier is talent shortages, meaning that it is difficult to recruit

employees that have the right skills in terms of balancing business understanding with technical skills (e.g., Ascarza et al 2021). Other barriers are IT infrastructure that doesn't measure up and poor quality of data collected through such systems (e.g., Guha et al 2021). Relatedly, automation through AI is likely to affect employees in retail dramatically. Although automation has affected manufacturing for some time its impact on service jobs is still ongoing (e.g., Huang and Rust 2018). Finally, many retailers are struggling when it comes to identifying, prioritizing, and implementing strategies for adoption and commercialization for AI. This will require making accurate estimates of the potential return on investments in AI and balancing trade-offs between benefits and cost of different AI applications. As with any changes in organizations, the success of implementing AI will also be highly dependent on how people within organizations react and use the technology.

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Tips: Curious to find out more about how AI works, try this open access course: https://course.elementsofai.com/