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Tracking technology diffusion in-store: a fashion retail perspective

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Abstract

Purpose - Continuous change has long been recognized as a core characteristic of retailing, its recent acceleration unprecedented, yet innovation in retailing remains under-researched, especially within fashion retailing. Therefore, the aim of this paper is to generate a deeper understanding of if, and to what extent, fashion retailers across different market segments are innovating in terms of in-store technology diffusion over time by taking a longer-term perspective over five years.

Design/methodology/approach - Drawing on retail change and innovation diffusion theory, the study takes a qualitative approach, using direct observation of 71 fashion stores in London (UK) in 2014 and 2019. In total, 142 stores were tabulated in Excel and qualitatively analysed using content analysis.

Findings - The findings identify the innovation adoption strategies implemented, the types of in-store technologies adopted over time, and the fashion retail innovation adopters.

Originality - The research offers new knowledge in terms of retail innovation and retail change, specifically on retail diffusion of innovation and the importance of in-store technology integration. Several practical implications for improving technology innovation management are also identified.

Keywords: In-store technologies, Diffusion of innovation theory, Retail change, Retail innovation, Fashion.

Paper type: Research paper.

Introduction

Retail is facing a torrid future. Amid a global pandemic that has irreversibly destabilized the industry, which was already challenged due to changes in technologies and consumption patterns, some scholars are referring to a "retail apocalypse" (Grewal *et al.*, 2020; Helm *et al.*, 2019; Paul and Rosenbaum, 2020). There were predictions in 2020 that the worst hit sector by COVID-19 would be the global fashion industry, which was forecast to decline by 25-30% (BoF McKinsey, 2021). In particular its physical stores that have suffered from limited accessibility due to COVID-19 related lockdowns, combined with the growth of online fashion sales (GlobalData, 2020). At a time of profound change, there is an imperative for retailers to evolve to avoid becoming obsolescent (Mende and Noble, 2019). Market volatility and transformation, call for innovative approaches to reimagine retailing and technological innovations provide one such approach (Inman and Nikolova, 2017, Hoyer *et al.,* 2020).

Although continuous change has long been recognized as a core characteristic of retailing (Brown, 1987) and the recent acceleration of change is unprecedented, research on innovation in retailing remains limited and fragmented (Hristov and Reynolds, 2015; Pinto *et al.*, 2017). While generally, retail has been criticized for being less technologically innovative compared to other business sectors (Lewrick *et al.,* 2015; Reynolds and Hristov, 2009; Ringel *et al.* 2019), the fashion sector has tended to be more engaged with consumer-facing technologies. Rapid technological advancement has propelled the proliferation of channels and touchpoints between customers and retailers that has transformed the shopping journey (Foroudi *et al.*, 2018; Souiden and Ladhari, 2019). This has led to the increasing integration of physical and digital retailing, whereby successful physical retail spaces should be both experiential and functional to meet high service, personalization, and convenience expectations (Grewal *et al.*, 2020; Mosquera *et al.*, 2018). Consequently, in-store technologies are becoming more diverse and interactive (Savastano *et al.*, 2019).

The term in-store technologies (IST) refers to the different consumer-facing devices that facilitate the shopping process in the physical store and are distinct from in-store technologies with which consumers cannot interact (Mosquera *et al.*, 2018). Such in-store technologies provide new opportunities to influence customer attitudes, behaviours, and, ultimately, experience (Colombi *et al.*, 2018), and this effect is suggested to be particularly strong in fashion retailing (Pantano and Vannucci, 2019). Since the in-store experience is part of the customer journey, in-store technologies are seen to be important consumer touchpoints in facilitating retailer–customer interactions (Grewal *et al.*, 2020). For example, Canada Goose's "journey" store carries no inventory but encourages consumers to experience the brand by mimicking arctic outdoor conditions in-store, with the sales associates, acting as tour guides, facilitating purchases using touchscreen technology (Rastello and Sambo, 2019). Similarly, Nike's Speed Shop combines the convenience of online with the experience of offline retail to be more responsive to consumers' needs (Friend and Houghton, 2018). In-store technologies can therefore change the customer experience, making it more convenient or more experiential (Grewal *et al.*, 2020).

Studies of technology usage within physical stores have three perspectives: a focus on consumers acceptance of innovative technologies (Pantano and Di Pietro, 2012; Perry *et al.*, 2019), retail management of their integration (Hagberg *et al.*, 2017; Pantano *et al.*, 2018), and their role in atmospherics to enhance the shopping experience (Blázquez, 2014; Poncin and Ben Mimoun, 2014). However, their focus tends to be on in-store technology at a given time, while an approach that reflects the dynamics of the industry is required (Grewal *et al.,* 2020).

Industry reports of retail technology innovation have been widespread, specifically in the fashion sector (Deloitte, 2017; Moran, 2020) yet empirical studies dedicated to innovation diffusion remain scarce (Bhattacharya, 2015; Cao and Li, 2018; Pantano and Vannucci, 2019; Tsai *et al.*, 2010). Moreover, there are no known studies that focus on fashion retailing, a sector significantly challenged by the Coronavirus pandemic (McKinsey, 2020). Given the pace at which technology is changing retailing, scholars and practitioners in retailing are increasingly concerned by the nature and extent of its impact (Grewal *et al.* 2020; Hoyer *et al.* 2020). Therefore, generating a deeper understanding of, and to what extent, fashion retailers are innovating in terms of in-store technology and its diffusion, and how this may change by taking a longer-term perspective over five years, will help close this knowledge gap.

Thus, merging retail change and innovation-diffusion perspectives (Rogers, 2003), this research explores the extent of in-store technology diffusion within fashion retail, using qualitative observations of 71 stores located on Oxford, Regent, and Bond Streets, London (UK) in 2014 and 2019, to assess the extent of innovation diffusion over time.

The following research questions ensue:

> *RQ1:* To what extent are fashion retailers innovating in terms of in-store technology diffusion over time?
> *RQ2:* What types of in-store technologies are diffused across different fashion retail value segments over time?
> *RQ3:* Which fashion retailers are the innovation adopters in terms of in-store technology infusion?

This study contributes to the literature on in-store technologies and retail innovation. First, it offers new insights on the extent of retail change related to in-store technologies (Brown, 1987; Etgar, 1984, Shankar *et al.*, 2020). Second, it extends our understanding of innovation management by focusing on the fashion retailers' perspective (Hristov and Reynolds, 2015; Pinto *et al.*, 2017). Third, given the paucity of research on innovation diffusion theory from a retailing perspective, it contributes new knowledge through the diffusion of technology typologies in fashion stores (Bhattacharya, 2015; Cao and Li, 2018; Pantano and Vannucci, 2019; Tsai *et al.*, 2010). Fourth, it proposes the extent to which fashion retailers are innovating. Fifth, it strengthens the argument of technology adoption as an enabler in generating a seamless customer purchase experience. Finally, in contrast to existing research on innovation diffusion theory that is limited by the cross-sectional and quantitative research design used, it is the first known study focusing on retailing channels to take a longitudinal qualitative approach in order to provide an enhanced understanding of change in retailer adoption of in-store technologies.

The paper is organized as follows: the next section reviews the literature on retailing, innovation, and technologies, and, specifically, the diffusion of innovation (DOI) theory as it applies to retail. The subsequent section focuses on the research methodology, which is followed by the presentation and discussion of the key results. The last section details the theoretical and managerial implications, and concludes by discussing limitations and directions for future research.

Literature review

Retailing, innovation, and technologies

Digitalization has transformed retailing (Hagberg *et al.*; 2017; Hoyer *et al.*, 2020). An increasing number of technologies are available to retailers that are capable of enhancing both the operations and the customer experience. It has been posited that those retailers that innovate and experiment with these technologies are likely to be the most successful (Grewal *et al.*, 2020).

Recent research has demonstrated the development of different devices that innovate the shopping journey and processes in the store (Mosquera *et al.*, 2018; Willems *et al.*, 2017), with their distinctiveness lying in being visible and consumer-facing. They include Fit technology found in magic mirrors and virtual fitting rooms (Beck and Crié, 2018), augmented reality (Rauschnabel *et al.*, 2019; Reses *et al.*, 2017), self-checkout (Lee, 2015), and retail apps (Pantano and Priporas, 2016; Perry *et al.*, 2019; Watson *et al.*, 2013). In-store technologies can be classified into five typologies according to their application (Pantano *et al.*, 2017) and function: product display; shopping experience; information search; payment; and other uses. These typologies are contextualized to fashion retail in Table I.

<<Insert Table I about here>>

Extant literature on innovations in retail technologies is defined by offline and online, customer and firm perspectives. Offline studies focus on consumer adoption and acceptance to use certain innovative technologies (e.g. Beck and Crié, 2018; Gross, 2015; Kim and Forsythe, 2009; Pantano and Priporas, 2016; Roy *et al.* 2018; Zhu *et al.*, 2013). Consumer adoption of online technologies examines mobile technologies and apps. These tend to study customers' perceived ease of use, usefulness, and attitude towards the technologies; typically through the technology acceptance model (TAM) (Davis, 1989) or TAM combined with one or more other theories of adoption (Yadav and Pavlou, 2020). A second strand of research focuses on retail management strategies towards the merging of online and offline technologies, to examine their transformative effect on retail and in particular, their effect on omnichannel retailing (e.g. Hagberg *et al.*, 2017; Savastano *et al.*, 2019; Willems *et al.*, 2017). A further line of research concerns innovations that examine technology adoption in non-retailing contexts from a consumer perspective (e.g. Gupta and Arora, 2017; Jahanmir and Cavadas, 2018). However, they focus on a few existing and potential new technologies, while technological innovation and consumer expectations are shown to constantly evolve (Hoyer *et al.*, 2020). The final strand focuses on future technology innovations (e.g. Grewal *et al.*, 2020; Shankar *et al.*, 2020). Nevertheless, conflicting perspectives towards fashion retailers' level of adoption of in-store technologies have emerged, with some scholars considering them to be innovators (Mosquera *et al.*, 2018; Pantano and Vannucci, 2019), while industry reports criticize them for being slow to adopt in-store technologies (McKinsey, 2017; Thomson, 2019). Given the challenges facing the sector, changing consumer expectations of technologies, and the rapid speed of technology innovations, the need to track the extent of change in retail innovation diffusion is necessary.

Retail change and diffusion of innovation theories in retailing

Continuous evolution has characterized retailing for decades and generated extensive scholarly interest with the conception of a number of theories that attempt to model and predict retail change (Brown, 1987; Hristov and Reynolds, 2015; Pinto *et al.*, 2017). Fundamental studies on the evolutionary processes of institutional change in retailing, like the "wheel of retailing" and the "retail accordion" (Brown, 1987; Hollander, 1966; McNair and May, 1978) have inspired studies that explore drivers and patterns of retail model innovation (Christensen and Tedlow, 2000; Pinto *et al.*, 2017; Sorescu *et al.*, 2011) and their adoption (Davis, 1989; Rogers, 1995).

Understanding if or why innovations are adopted is critical for the theory and practice of innovation (Jahanmir and Cavadas, 2018). DOI theory (Rogers, 1995) describes the adoption of new technologies (MacVaugh and Schiavone, 2010) and has influenced many adoption model iterations such as the theory of reasoned action (TRA) (Ajzen and Fishbein, 1980), TAM (Davis, 1989; Venkatesh and Davis, 2000), the technology readiness index (TRI) (Parasuraman, 2000), and the unified theory of acceptance and use of technology (UHAUT) (Venkatesh *et al.*, 2003, 2012). In DOI, innovation is defined as "an idea, practice, or object that is perceived as new by an individual or another unit of adoption" (Rogers, 1995, p.11), while diffusion is recognized as the process by which an innovation is adopted by individuals, societies, or organizations communicated over time (Grover *et al.*, 2019). McVaugh and Schiavone (2010) clarify these as three domains of new technology adoption: the market/industry, macro, domain. A second, meso domain is constituted by the relationships shaping the social system in which the potential adopters are located and a third level of analysis is at the individual (micro) domain. Within marketing studies, most focus on understanding reasons and likelihood of adoption of new technological innovations from a consumer perspective (Jahanmir and Cavadas, 2018; MacVaugh and Schiavone, 2010). Similarly, new product development studies attempt to identify the stages of consumer adoption to achieve market success (Agag and El-Masry, 2016; Moreau *et al.*, 2001). Although often used with TAM in studies of adoption, DOI theory differs in its ability to assess the temporal adoption of technologies in a given market; in this study, it concerns the temporal adoption of in-store technologies within fashion retail.

As innovativeness depicts the speed at which an entity (in this study, retail sector) adopts new innovation as compared to others, adopters are classified into five categories (Rogers, 2003):
1. *Innovators*: venturesome, technology enthusiasts, who are usually first to use a new technology but are small in number, approximately 2.5% of a sector.
2. *Early adopters*: these tend to adopt the technology early and act as role models for others, representing 13.5% of a sector.
3. *Early majority*: those that adopt new technology when it has become widely adopted, referred to as deliberators; they constitute 34% of a sector.
4. *Late majority*: those that are more conservative and reluctant to adopt new technologies compared to others, constituting 34%.
5. *Laggards*: those that are negative and sceptical towards new technologies, constituting 16% of a sector.

Table II categorizes usage of DOI theory in terms of setting, context, research design and focus. Empirically, DOI theory has been used extensively in the field of information technology but scholars acknowledge that research on technology diffusion in retail settings is scarce (Bhattacharya, 2015; Cao and Li, 2018; Pantano and Vannucci, 2019). Within the latter, offline retail studies tend to focus on the firm and are characterized by the introduction of new technologies, such as RFID (Bhattacharya, 2015; Tsai *et al.*, 2010), cross-channel integration

(Cao and Li, 2018) or by a generalized cross-sector and cross-sectional research design approach (Pantano and Vannucci, 2019). By contrast, customer focused DOI research offline examines personal shopping assistants (Evanschitzky *et al.*, 2015), whilst online studies, in a similar way to those using TAM, assess consumer trialling of mobile apps (Natarajan *et al.,* 2017), online subscription services (Tao and Xu, 2018) and other use of digital technologies (Grover *et al.*, 2019; Lennon *et al.,* 2007).

<< insert Table II about here>>

Research attempting to document the rate of adoption remain scarce, even though speed is a key diffusion factor (Claudy *et al.*, 2015; Jahanmir and Cavadas, 2018), and even less so from a retailer perspective (Etgar, 1984). Moreover, few prior studies take a longitudinal approach to research design and none within retail settings with a focus on in-store technology adoption, despite scholarly recognition that a dynamic approach is necessary to understand the nature and extent of technology change (Shankar *et al.*, 2020; Tao and Xu, 2018). Therefore, in contrast with prior studies, our research takes a novel, qualitative longitudinal approach to assess change in retailer adoption of in-store technologies over time. No known studies focus on the retailer perspective to track in-store technology diffusion over time. Therefore, this study aims to address this knowledge gap by exploring fashion retailer innovativeness towards in-store technology adoption over a five-year period.

Methodology

As this research was interested in tracking retailers' innovativeness towards in-store technology adoption over time, an exploratory qualitative perspective, using direct observation and photo elicitation, was taken. These methods provide access to in-depth knowledge, perspectives, and actions about the problem by observing how things work *in-situ* (Denzin and Lincoln, 2005). Observation is often used to generate a deeper understanding of different phenomena and associated behaviours (Grove and Fisk, 1992) and to overcome issues regarding participants mis-reporting what they see or how they behave, often associated with other methods (Marshall and Rossman, 1995; Wells and Sciuto, 1966). In this study, it provided clarity on the types of technologies available to consumers and their interactions with them. A five-year time period was selected (2014–2019) because the development of in-store technologies in retail settings has become established in the retail literature over this timeframe (Grewal *et al.*, 2020; Savastano *et al.*, 2019). Five years is a generally recognized planning timeframe (Williams and Naumann, 2011) and provided a long enough period for retailers to respond to significant changes in technologies adoption. The fieldwork was undertaken in 2014 and 2019 as the retailing literature suggested increasing implementation of technology touchpoints during this period (Colombi *et al.*, 2018; Deloitte, 2017; Mosquera *et al.*, 2018).

The unit of analysis was fashion retailers. Fashion clothing has been identified as one of the top ten categories most influenced by the in-store use of digital devices (Mosquera *et al.*, 2018). The sample of stores further recognized London as a global fashion destination and a key centre for store openings (Remy *et al.*, 2014; Savills, 2019). The selection of the most significant shopping streets to situate the study (Oxford, Regent, and Bond Streets) was proven to be apt based on highest footfall (New West End Company, 2020), market segment (mass, mid, luxury) (Alexander, 2019), and use by technology-led consumers (Tao and Xu, 2018).

Data were collected through direct observation of fashion stores, photographs, and field notes taken during each store visit regarding the types of in-store technologies available (see Table I). To ensure consistent recording of data and limit collection bias, a research protocol was used to guide the data collection at each visited store (see Table III). Specifically, this involved recording store location, market segment (mass, mid, premium/luxury), presence of in-store technologies, typology of technologies (see Table I), and customer and frontline staff interactions (usage) with the technologies. In addition, where possible, intercepts with frontline staff to generate feedback on the in-store technologies were conducted. Each observation lasted 15–20 minutes. Over the period, the number of fashion stores recorded in each street fluctuated due to the provision of technologies as well as store closures, refits, or changes of ownership. The number of stores where technologies were recorded consistently across the time period was 71 (12 mass-market, 33 mid-market, and 27 premium/luxury market) out of a total of 97 stores that comprised the initial fashion retailer list, based on the New West End Company's store listings (covering Oxford, Bond and Regent Streets). Each street was visited by two researchers between February and March in 2014 and 2019, respectively. The data were cross-referenced and where only one of the two researchers recorded a technology, the record was accepted as valid as some technologies may not have been observable or accessible during an observation. Qualitative content analysis was used to systematically and objectively describe and quantify the phenomenon under study, rather than to deduce generalizations (Schreier, 2014). Three phases of content analysis were followed: immersion, reduction and interpretation (Miles and Huberman, 2013). From the three shopping streets, 259 photographs and field notes were collected and considered holistically in the first phase. Next, the corpus was coded, and 142 (71 from 2014 and 2019, respectively) stores tabulated in Excel and also qualitatively analysed in NVivo. The initial stage of analysis coded the technologies by their street location, market segment and year of data collection. A further stage in the analysis was to identify the relative frequency and saliency of in-store technologies and their typology according to Table I, from which coding trees were deduced (Guest and McLellan, 2013; Silverman, 2014). Detailed records concerning the protocol, codebook and database of each stage of research were kept for procedure transparency, and inter-researcher reliability was conducted during the analysis phase, to add rigour to the codes and categories deduced (Guba and Lincoln, 1994). Lastly, the data was interpreted against the DOI theory (Rogers, 2003) to formulate the results (Miles and Huberman, 2013).

<<Insert table III about here>>

Results and discussion

In-store technology diffusion over time

The types of in-store technologies adopted by fashion retailers and how these changed over the five-year period are shown in Figure 1. A total of 76 technologies were recorded in 2014, increasing to 183 by 2019 across the 71 stores. The most prevalent in-store technology typologies (from Table I) related to product display and information search. Non-interactive digital screens were most common across the time period, followed by tablets, both self-service and staff assisted, which significantly increased over the period. Shopping experience and payment technologies including interactive screens, magic mirrors, QR codes, digital photobooths, and self-checkouts were scarce other than mobile apps that were mainly lifestyle-led and non-transactional, which notably increased over time. Other technologies like click and collect increased significantly over the period to become the most diffused technology-enabled

service offered, demonstrating the rapid shift towards omnichannel retail by fashion retailers (Mosquera *et al*., 2018).

<<insert Figure 1 about here>>

Types of in-store technologies diffused across different fashion retail value segments over time

The diffusion of types of in-store technologies by market level and how these changed over time is depicted in Figures 2 (mass market), 3 (mid-market), and 4 (premium/luxury market).

<<insert Figures 2, 3, and 4 about here>>

Product display technologies

Digital screens were the most pervasive in-store technology in mass and mid-market retailers and second only to tablets for luxury retailers. Typically, screens were attached to store structures and fittings, although in a few cases they were mobile. Roggeveen *et al*. (2016) proposed the analysis of different screen sizes in different store formats, and in fashion stores the screens varied in size from small to very large (over five metres in length) that covered a large part of the shop wall.

Midmarket stores demonstrated the most extensive use of digital screens for showing fashion collections and brand campaigns over the duration of study, followed by luxury stores, which used them for presenting catwalk shows. While these added to the retail experience, this group of stores made extensive use of tablets for product information and availability. The use of digital signage was limited to mass and mid-market retailers; whilst absent from stores in 2014, only one or two retailers were using them by 2019. Similarly, digital windows were used by mass market retailers only (M&S in 2014 and Gap in 2019), but both were non-interactive.

Information search technologies

Tablets were the second most diffused technology, which became more prevalent over the period across market levels, but especially so within luxury and mid-market retailers. Tablets assumed a more functional role for inventory availability search, to demonstrate products, sales, and consumer feedback surveys, and to provide customer information. Interconnectivity through QR codes has been shown to have potential for customer look-up functions (Pantano and Vannucci, 2019). However, it was found in only two stores, at the mass and luxury level.

Shopping experience technologies

While augmented reality (AR) and virtual reality (VR) have been widely discussed for retailing (e.g. Beck and Crié, 2018; Rauschnabel *et al*., 2019), especially to enhance the shopping experience (Parise *et al*., 2016), there was limited evidence of their use in fashion stores during the period across market levels. Two employees referenced trials of AR and VR, which were not extended, and whilst there was very limited adoption of such technologies in 2014, a few more isolated cases of AR technologies were observed in the mid- and luxury-market segments in 2019.
Within mid-market sportswear, Nike, Adidas, and Timberland were observed for their interactivity in delivering product personalization, a growth area across mid and luxury segments over the period. Similarly, a body-scanner was observed at only one mid-market

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retailer, Speedo, offering personalized fit for technical products. Virtual mirrors were recorded at one luxury store, Burberry in 2014, but were removed by 2019, and later in one other luxury store, Tommy Hilfiger. Hilfiger's interactive mirror more fully integrated the experience with an accompanying slogan, explicitly inviting customers to enhance their experience behind the mirror.

Digital photobooths were found in two stores across mass- and mid-market levels, a relatively new development enabling customers to integrate their digital social media presence with a physical store presence.

Interactive screens remained relatively underused throughout the period, mostly adopted by the mid-market segment, especially sports and outdoor retailers, where they enable consumers to discover the brand, to check availability of products, and to customize them. One luxury brand installed screens where customers could take pictures and share them with their global brand community.

The use of apps by fashion retailers was nascent across the retailer sample in 2014, but widely adopted by 2019, when they became more significant as an online medium. However, the findings demonstrated an inconsistent use of apps. Within luxury retailers, the apps were mostly for lifestyle engagement and not purchasing, whereas in the mass and mid-markets, apps typically offered a means for ordering and delivery.

Payment technologies

Although the use of mobile devices for payment has been discussed (Fernandes and Pedroso, 2017; Ryu *et al.*, 2019), there is little evidence of their widespread adoption, which were absent in 2014, and with only one mid-market retailer using self-checkout in 2019. Self-checkout has made a considerable contribution to customers taking control over a convenient payment system and is a technology type that presents widespread opportunities for adoption by fashion retailers (Lee, 2015).

Other technologies

Click and collect more than doubled over the period of study and increased significantly within the mid- and luxury-market level retailers. For some stores, in 2014, their small size created a problem in retaining collectable stock, and the logistics of central London deliveries made it more difficult to supply customers accurately and quickly. Click and collect was not generally well communicated in-store and was difficult to locate with clearly defined pick-up points. By 2019, the problems of stock holding had been overcome and click and collect was far more prevalent.

Overall, findings show that the types of in-store technology diffusion in fashion retailers are relatively basic and non-interactive, with greatest emphasis given to technologies that support customer information and convenience, rather than shopping experience. Moreover, these in-store technologies changed incrementally over the period, with highest adoption rates shown in channel-integration services like mobile apps and click and collect, and screens and tablets, rather than experimentation with new forms. Observation both of customer and frontline staff interactions with in-store technologies was limited over the period. Whilst there were less in-store technologies to use in 2014, by 2019, usage remained restricted to tablets and interactive screens for personalization, given that much of the in-store technologies infused were non-

interactive. Indeed, intercepts with frontline staff indicated some of the benefits and barriers to technology diffusion in-store, with a lack of omnichannel practices and greater credence given to customer service over technologies in 2014. Whilst both reduced over the period, a lack of retailer innovation, technology malfunction, and low customer usage were issues more recently expressed.

Fashion retailer innovation adopters

The analysis focused on the extent to which fashion retailers across market levels are willing to adopt in-store technologies. Over the period, our results show the greatest diffusion across technology types within the mid-market retailers, followed by luxury retailers, and, finally, mass-market retailers; however, there is significant variance across retailers within segments. It is therefore too simplistic to apply Rogers's (2003) typology of adopters at the market-segment level, as the results assume most fall into the majority category, with relatively conservative adoption and even laggard tendencies, revealing a lack of in-store technology infusion. Rather, disaggregation is required to examine the specific fashion retailer innovators. Figure 5 depicts the top 10 retailers across the market segments that have adopted the most types of in-store technologies. There was an absence of innovators within the mass-market segment. Within the mid-market segment, sports retailers Nike and Adidas are clear leaders in technology diffusion, while within the premium/luxury segment, Tommy Hilfiger stands out as the most experimental adopter of in-store technologies. Significantly, all retailers, with the exception of M&S and Hollister, increased their number of in-store technologies over the period, showing a willingness and commitment to trial and infuse. Moreover, some retailers that showed nascent use of in-store technologies in 2014, like H&M, Benetton, and Tommy Hilfiger, have significantly increased their usage and investment over the period.

 <<insert Figure 5 about here>>

As technological innovation in retailing is limited and fragmented (Hristov and Reynolds, 2015; Lewrick, 2015), with its spread within retail settings being nascent (Pantano and Vannuci, 2019) and scarce within fashion retail, the aim of the study was to explore the extent of in-store technology innovation diffusion among fashion retailers across different market segments and the level of change over a five-year period. Based on retail change and the DOI theory (Rogers, 2003), the results show that very few fashion retailers are innovating with in-store technologies. Indeed, out of the 71 retailers observed, consumer-facing in-store technologies were absent from 33 in 2014 and 15 in 2019. Whilst this number has halved over the period, almost a quarter of fashion retailers still show laggard traits towards in-store technology adoption, according to Rogers's (2003) adopter categorization. A total of 25 out of 71 stores had more than three different types of in-store technologies, demonstrating relatively low levels of diffusion amongst those stores classified as early adopters. From a segment perspective, mid-market and premium/luxury players were depicted as the innovators and early adopters, with particular technology push evidenced from sportswear brands, perceived as venturesome with technologies, according to Rogers (2003). Their widespread use of in-store technologies was typically consistent with their performance-based positioning strategies. Conversely, mass-market retailers depict the early and late majority, as deliberators of in-store technologies, with some reluctance to adopt. Retailer laggard examples are shown across all market levels, with the absence of, or very limited, infusion of in-store technologies. These exceed in number the 16% allocated by Rogers (2003) to this category of adopters. The results provide an indication of the extent of fashion retailer innovativeness towards in-store technologies over time, as shown in Figure 6. The findings reveal that retailers are dedicating

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greatest attention and investment to services, in particular click and collect and mobile applications across offline and online channels, rather than in-store technologies. This reinforces the importance of connecting digital and physical spaces to improve the customer shopping journey (Hoyer *et al.*, 2020; Jocevski, 2020) In terms of actual types of technologies, retailers are tending to focus on those that drive information and convenience rather than customer experience.

<<insert Figure 6 about here>>

Conclusion, implications, and future research

This research provides empirical evidence of the implementation of technologies in retail stores in prestigious shopping streets in London over five years. It demonstrates a spectrum of technologies: relatively well-established non-interactive screens have evolved to show moving images on larger surfaces as incremental innovations. More complex technologies are interactive screens and devices for customization, and the most radical are AR and VR devices. These are rarely found and have low rates of adoption by retailers.

The research makes a number of theoretical contributions. First, it contributes to the development of in-store technologies and retail innovation (Grewal *et al.*, 2020; Hagberg *et al.*, 2017) by providing evidence about the limited, consistent use of in-store technologies in fashion stores. In doing so, it offers a counterpoint to extant studies positing diverse and interactive in-store technology adoption (Pantano and Vannucci, 2019), especially within the previously acknowledged pioneering fashion sector (Colombi *et al.*, 2018; Mosquera *et al.*, 2018). There are several exceptions, Hilfiger, Nike, and some other sports retailers, yet Marks and Spencer and Burberry demonstrate that progress towards technological infusion can be reversed, as they reduced the number and type of in-store technologies over the period. The study thus provides new insights into this developing field (Hristov and Reynolds, 2015) and supports previous findings about the lack of innovative practices in retail (Lewrick *et al.*, 2015; Ringel *et al.*, 2019).

Second, it offers new insights into the extent of retail change related to the temporal development and infusion of in-store technologies, from no in-store technology to full integration and widespread diffusion (Etgar, 1984; Hossain *et al.*, 2019; Ryu *et al.*, 2019). The longitudinal data demonstrates a process of incremental change, with the greatest increase in click and collect and app provision and the implementation of low-cost and well-tried technologies, primarily non-interactive screens and tablets. There was little evidence of sustained implementation of experiential technologies, including interactive mirrors, AR, and VR. The findings support existing scholarly recognition that investment in in-store technologies needs to be prioritized (Grewal *et al.*, 2020; Roggeveen *et al.*, 2016).

Third, the research provides new knowledge regarding DOI theory in retail, a nascent field of study (Bhattacharya, 2015; Cao and Li, 2018; Pantano and Vannucci, 2019) by demonstrating the extent of diffusion of in-store technology types across different fashion-market segments and the rate of adoption. The findings reveal that adoption does not move at the same speed for all retailers and that sectors prioritize technologies for their market. In so doing, it suggests a revision to extant studies that infer accelerated in-store technology diffusion (Mosquera *et al.*, 2018; Pantano and Vannucci, 2019).

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Fourth, our study contributes to current scholarly debate on the importance of integrating in-store technologies (Colombi *et al*., 2018; Mosquera *et al.,* 2018; Savastano *et al*., 2019) by revealing actual diffusion across market levels of fashion retailers and the extent to which fashion retailers are innovators. Results inferred a low number of innovators and a relatively high number of laggards. Thus, this study sheds light on the types of technologies that fashion retailers have invested in and adopted over a period of time.

Fifth, the findings highlight that retailers are leveraging in-store technologies to merge physical and digital spaces in pursuit of an omnichannel strategy rather than merely adopting stand-alone in-store technologies. Thus, strengthening scholarly argument of technology adoption as an enabler in fostering a seamless customer experience across the purchase journey (Grewal *et al*., 2020; Hoyer *et al*., 2020). In this sense, retail innovation is evidenced in the study, whereby in-store technologies are used as enablers in retail process innovation. The findings therefore not only address the conceptual question of *who* is innovating in retailing but points towards the need for further research to address the question *how* retailers are innovating.

Finally, prior research focusing on DOI theory has been limited by the preponderance of cross-sectional research design. Our research addresses this gap as the first known study to take a longitudinal approach to provide an enhanced understanding of change in retailer adoption of in-store technologies. In doing so, it reveals how Roger's theory evolves over time thereby helping to predict future adoption and those technologies with the greatest potential for retail transformation (Lennon *et al*., 2007; Shankar *et al*., 2020).

Practically, the study offers several retailer implications. First, it depicts the actual extent of fashion retailer innovation regarding in-store technologies across a selection of 71 different retailers (comprising mass, mid, and premium market segments) (Alexander, 2019) over five years. It provides a benchmark of competitor activities towards in-store technologies, specifically which types of technologies they are investing in, which can be used to inform technology investment decision-making. Second, it depicts the level of innovativeness within fashion retail, specifically by categorizing retailers according to their level of adoption; it therefore challenges retailers to push innovation and to take action to inform and develop their competitive strategy. Further, it reveals that retailer in-store technology priorities over the period have been aimed towards omnichannel integration by offering services like click and collect and mobile apps, and reveals opportunities to explore and expand infusion of payment and shopping experience types of technologies to integrate and optimize the physical store within the customer shopping journey (Foroudi *et al*., 2018; Hagberg *et al*., 2017; Mende and Noble, 2019). As the offline store channel continues to be challenged, identifying and utilizing those technologies that serve as important touchpoints to customers in their quest for convenience or experience will validate their continuing value and serve to improve retailers' management of technology innovation.

The limitations to the research include the problem of store closures, refurbishment, or changes of ownership that affected a number of stores, which made rigorous comparisons difficult and resulted in a reduced sample size. Moreover, the study is bound by scale, geography, and sector. Therefore, similar studies could be undertaken in countries or cities where high expectations for in-store technology exist, as well as retailer responsiveness towards them. Since sportswear showed high technology diffusion, a comparative case study approach on the level of innovativeness and adoption of such retailers would be worthy of further study. As this study was limited to retailer adoption of in-store technologies, future research projects could further examine consumer and frontline staff responses towards such technologies over time;

specifically, their experiences and choices may help shed light on their propensity towards in-store retail innovation and why some retailers are perceived as more or less innovative than others. Moreover, our study reveals limited retail change through the infusion of in-store technologies over time, therefore future studies could adopt a change management approach to explore innovation adoption processes from the retailer's perspective. Finally, researchers in this field have often argued for technological change either on the basis of a few, innovative examples of retailers' installations wherever they appear or on the potential of new technologies. There is a need both to study in more detail the extent of technological adoption, and to examine narratives that describe technologies and their contribution to the future of retailing.

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Table I. Typologies of in-store technologies.

Technology typology	Digital technology	Example	Function
Product display	Digital screen / signage / window	Adidas's four-dimensional display screens showcasing product and campaigns.	Experience / convenience
Shopping experience	AR / VR: Virtual mirror / fitting room, touch-screen, mobile app	Nike's "Speed Shop" customization studio; Adidas's "immersive" fitting rooms and app used for the "Bring it to me" function; Ted Baker's interactive window.	Experience
Information search	Tablet, QR code	Adidas's "Hype Wall": shoppers scan shoe QR codes to add drop dates to calendar; Schuh's iScan tablet device.	Convenience
Payment	Self-checkout	Zara, Benetton, and Decathlon's express self-checkouts; Target's mobile wallet; Radley's mobile checkout.	Convenience
Other (services)	Click and collect, self-service kiosk, vending machine	Nike offering instant check-out, reserve online, and try on in-store; Walmart's "Pickup Towers" self-service kiosks.	Convenience

Table II. Prior relevant studies on diffusion of innovation (DOI) theory in comparison with our study.

| Empirical setting	Study	Context	Research design	Focus
Retail channels (offline)	Pantano and Vannucci (2019)	Technology adoption and diffusion across a range of retailers in a shopping street.	Cross-sectional, qualitative, observations.	Firm level
Retail channels (offline)	Bhattacharya (2015)	RFID adoption stages in retail.	Cross-sectional, mixed method, quantitative.	Firm level
Retail channels (offline)	Evanschitzky *et al.*(2015)	Consumer trial, continuous use, and economic benefits of a retail service innovation – personal shopping assistant.	Cross-sectional, quantitative.	Customer level
Retail channels (offline)	Adhiarna *et al.*(2011)	RFID adoption and diffusion in developing countries.	Literature review.	Firm level
Retail channels (offline)	Tsai *et al*. (2010)	Effects of innovation, organization, and supply chain integration on RFID retail adoption in Taiwan.	Cross-sectional, quantitative.	Firm level
Retail channels (cross)	Cao and Li (2018)	Retailer cross-channel integration from the perspective of innovation diffusion.	Longitudinal, (8-year), quantitative.	Firm level
Retail channels (online)	Tao and Xu (2018)	Consumers' perceptions and adoption intentions of fashion subscription service retailing.	Cross-sectional, qualitative.	Customer level
Retail channels (online)	Natarajan *et al.*(2017)	Uses TAM and DOI theory to propose a new model orientated to the intention to use mobile apps for shopping.	Cross-sectional, quantitative.	Customer level
Retail channels (online)	Lennon *et al.*(2007)	Online apparel shopping adoption in rural consumers using DOI theory.	Longitudinal, (3-year) quantitative.	Customer level

IT, internet, technology	Grover *et al.* (2019)	Blockchain technology diffusion in different industries, using literature and social media.	Cross sectional, literature review and social media (Twitter) data.	Firm level
IT, internet, technology	Kim *et al.* (2018)	Factors affecting the adoption of web technology for the integration of big data using the TOE framework and DOI theory.	Cross-sectional, quantitative.	Firm level
IT, internet, technology	Papagiannidis *et al.* (2015)	Investigation of technologies in web development, diffused over time.	Longitudinal (13-years), using Wayback Machine for data collection.	Firm level
IT, internet, technology	Jahanmir and Cavadas (2018)	Determinants of late adoption of digital innovations by consumers.	Cross-sectional, quantitative.	Customer level
IT, internet, technology	Park *et al.* (2015)	Consumers' response towards new technology-driven products.	Cross-sectional, quantitative.	Customer level
IT, internet, technology	Lee (2014)	Factors influencing early adopter smartphone adoption.	Cross-sectional, quantitative.	Customer level
IT, internet, technology	Lin and Wu (2013)	Determinants of broadband adoption by diffusion stage.	Longitudinal (12-years) quantitative.	Policy level
IT, internet, technology	Zhu *et al.* (2006)	Assimilation of internet-based e-business innovations by firms internationally using DOI theory and the TOE framework.	Cross-sectional, quantitative.	Firm level
IT, internet, technology	Lee *et al.* (2003)	Effect of new product radicality and scope on the extent and speed of innovation diffusion across time and industries.	Longitudinal (16-years), quantitative.	Firm level

Services	Agag and El-Masry (2016)	Customers' intention to participate in an online travel community using the DOI theory and TAM model.	Cross-sectional, quantitative.	Customer level
Services	MacVaugh and Schiavone (2010)	Combines marketing, innovation and science literature to explain the diffusion of innovation.	Literature review.	Customer level
Retail channels (offline)	*Our paper (2021)*	*In-store technology adoption and diffusion across fashion retailer market levels, over-time to track change and determine level of retailer innovativeness*	*Longitudinal, (5-year) qualitative, observations.*	*Firm level*

Table III. Research protocol used during store observations.

Store name
Store location (Oxford, Bond, or Regent Street)
Market level / segment (mass, mid, premium/luxury)
Presence of in-store technologies (yes/no)
In-store technologies typology (product display, shopping experience, information search, payment, others)
Cross channel services, e.g. click and collect, mobile app, etc. (yes=1 / no=0)
Consumer interactions with in-store technologies (yes=1 / no=0)
Frontline staff interactions with in-store technologies (yes=1 / no=0) and feedback offered

Figure 1: In-store technology diffusion across fashion retail over time
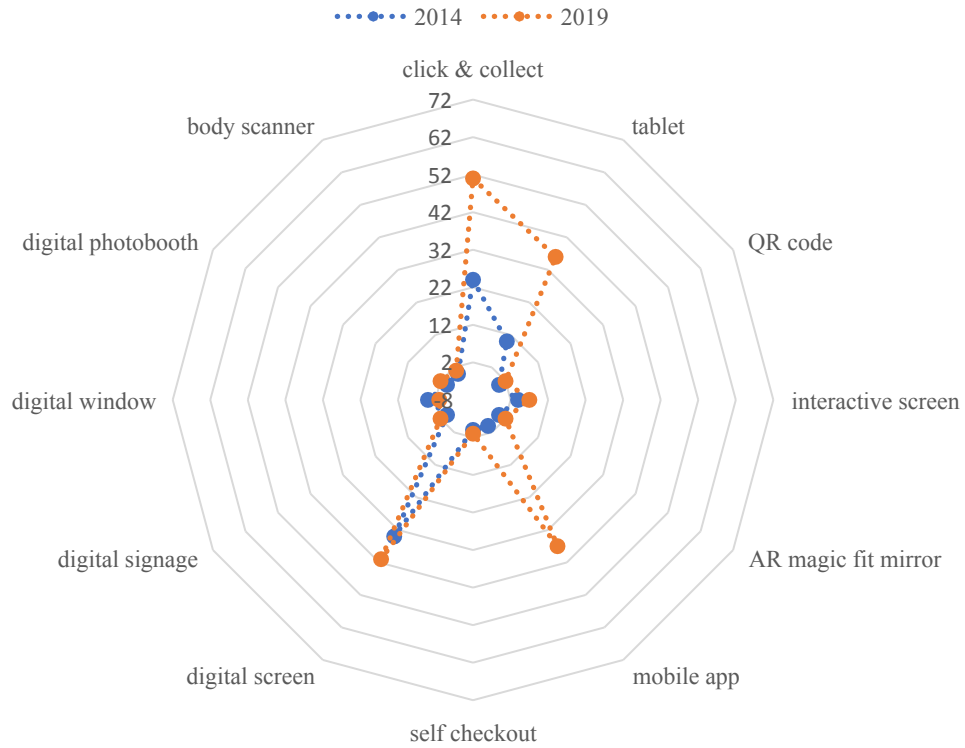
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Figure 2: In-store technology diffusion across mass-market fashion retail over time
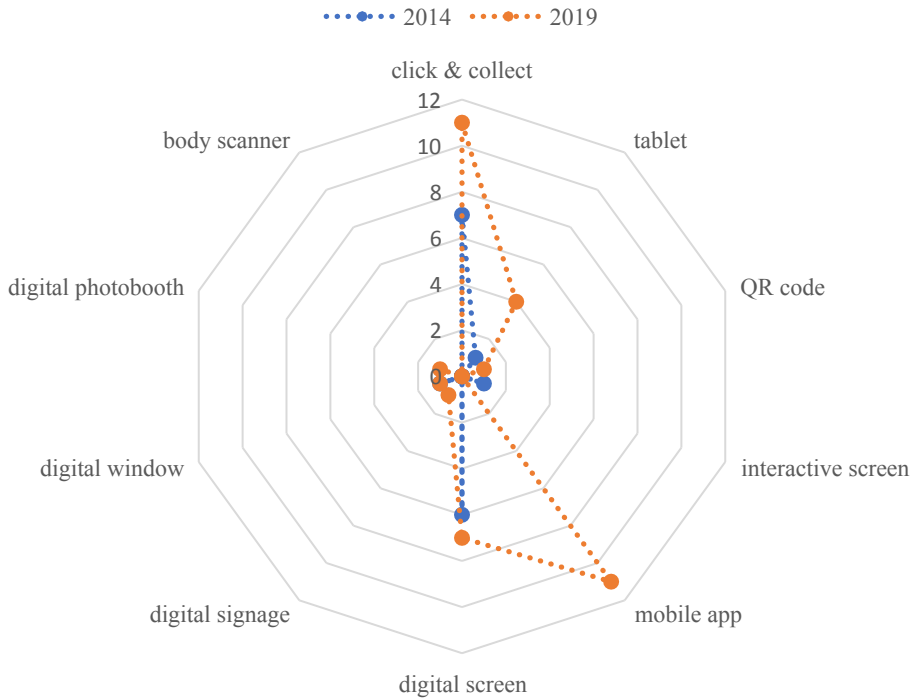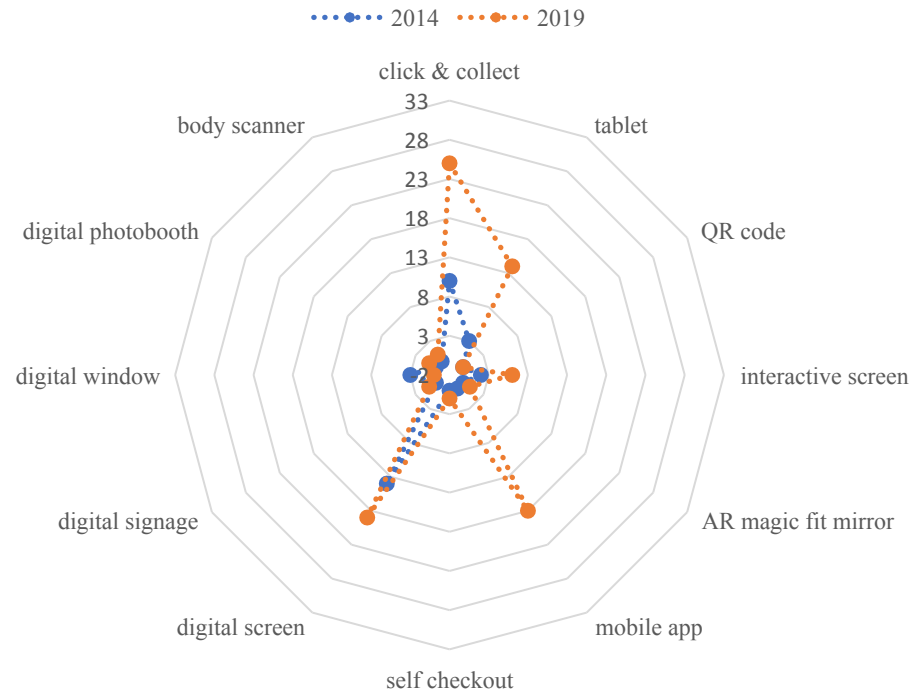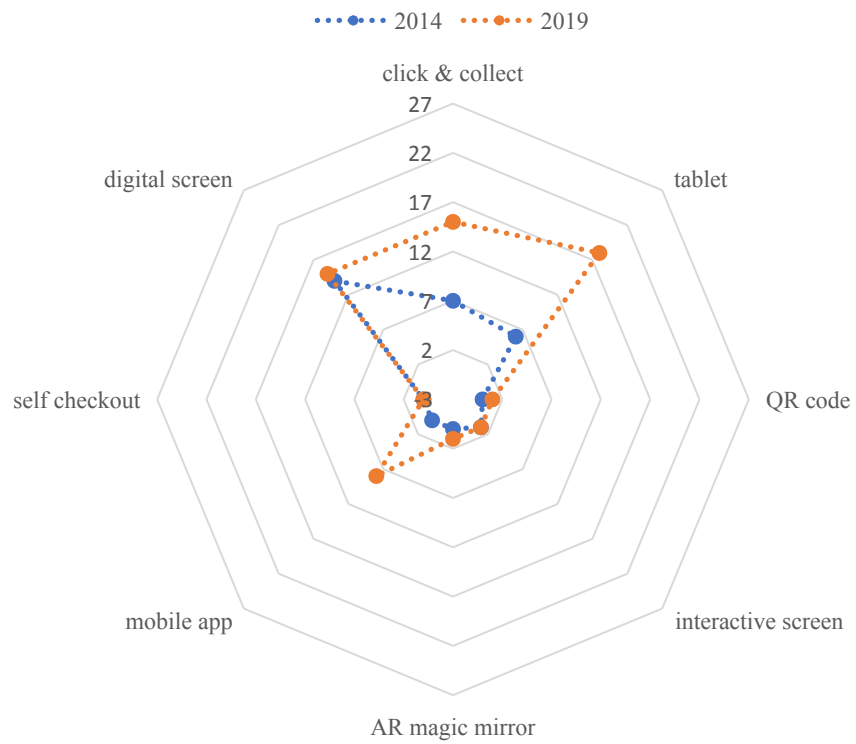
Figure 3: In-store technology diffusion across mid-market fashion retail over time

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Figure 4: In-store technology diffusion across premium/luxury-market fashion retail over time
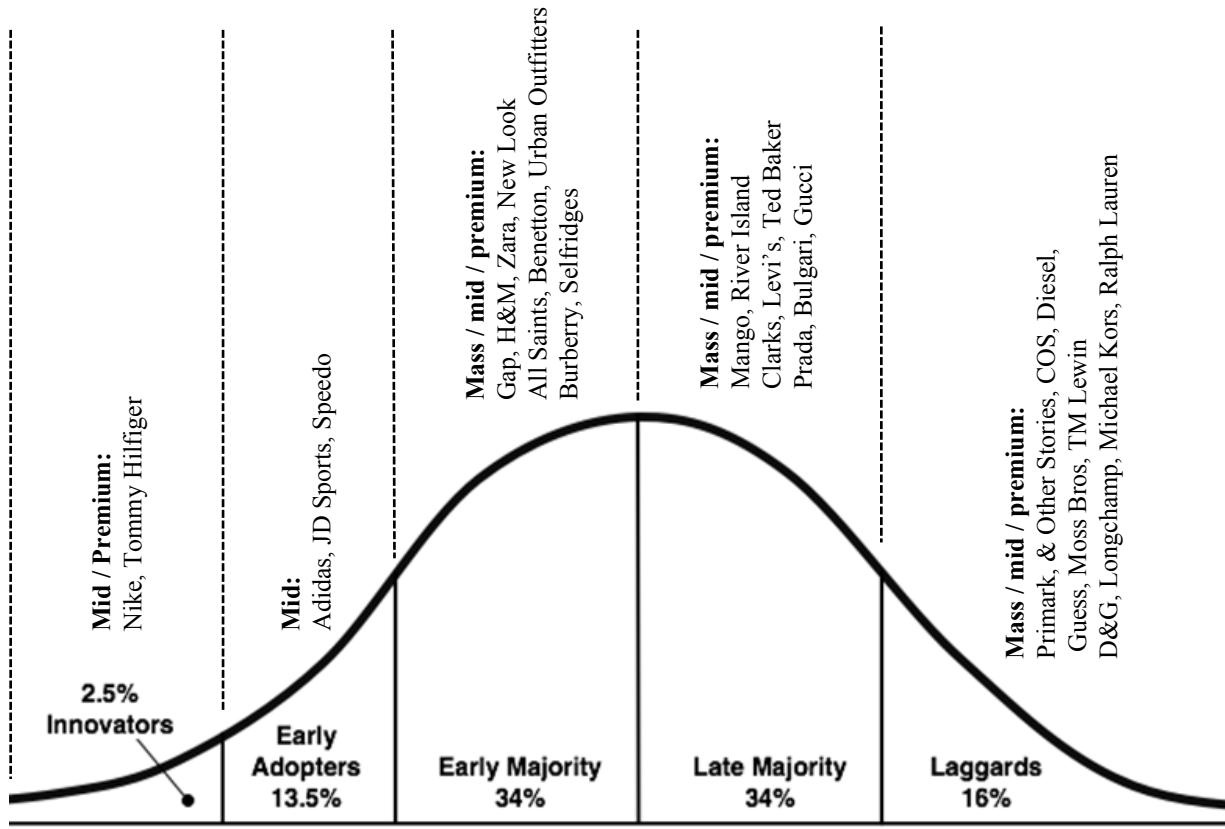
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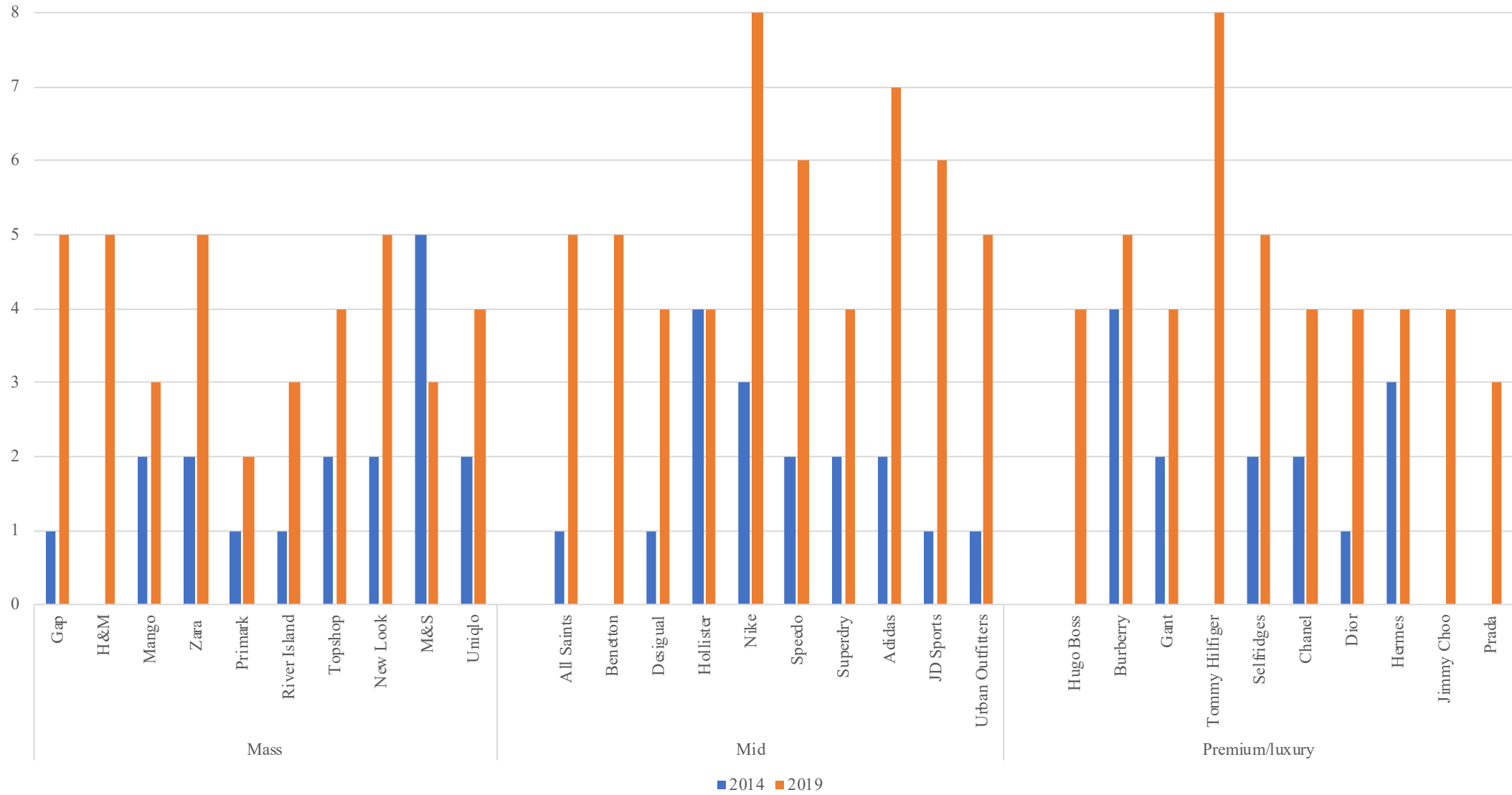5   Figure 5: Number of in-store technology types by fashion retailer
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Figure 6: Fashion retailer in-store technology diffusion of innovation (DOI)

Mid / Premium:
Nike, Tommy Hilfiger

Mid:
Adidas, JD Sports, Speedo

Mass / mid / premium:
Gap, H&M, Zara, New Look
All Saints, Benetton, Urban Outfitters
Burberry, Selfridges

Mass / mid / premium:
Mango, River Island
Clarks, Levi's, Ted Baker
Prada, Bulgari, Gucci

Mass / mid / premium:
Primark, & Other Stories, COS, Diesel,
Guess, Moss Bros, TM Lewin
D&G, Longchamp, Michael Kors, Ralph Lauren

2.5%
Innovators

Early
Adopters
13.5%

Early Majority
34%

Late Majority
34%

Laggards
16%

Source: Everett Rogers *Diffusion of Innovations* model

Figure 5: Number of in-store technology types by fashion retailer