The State of Fashion
Technology

McKinsey & Company

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Technology
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This special edition is part of a series that *The Business of Fashion* and McKinsey & Company are publishing to complement our annual State of Fashion report. While the main report analyses the shifts shaping the global fashion industry in the year ahead, the special editions focus on specific subsectors, verticals, geographies and topics. For this edition, the authors have chosen to analyse existing and emerging technologies addressing the industry's biggest challenges and opportunities.

ACKNOWLEDGEMENTS

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Executive Summary

Technology has already revolutionised the way that global fashion companies do business. The Covid-19 pandemic further cemented the pivotal role technology plays in the industry, accelerating e-commerce adoption among consumers and further embedding digital tools in day-to-day workflows and decision making. Though the focal point to date has largely been on customer-facing technologies, brands now have an opportunity — born out of necessity in today's volatile operating environment — to expand the breadth and depth of technology application in the industry. Fashion brands and retailers are leaning into technology not only to become more resilient to supply chain and other disruptions, but also to become more responsible and transparent as the world seeks sustainability solutions.

Against this backdrop, we expect fashion companies to ramp up their investments in technology, from between 1.6 and 1.8 percent of sales in 2021 to between 3 and 3.5 percent by 2030. Investors, meanwhile, will pour capital into companies whose technologies aim to make fashion players more nimble and more environmentally and socially responsible. Fashion players that fail to embrace these technologies will face existential challenges, while their tech-savvy counterparts should see measurable bottom-line benefits.

Technology's impact is evident in key business areas, such as creating exceptional customer experience and engagement; helping to address sustainability issues; and upgrading internal processes and operations. This applies to fashion players across value segments, though the solutions may play out differently for luxury and mass market brands to accommodate varying customer needs and strategic priorities.

This report identifies the business opportunities on which fashion leaders should focus their technology resources and investments, based on executive and other expert interviews, analyses of public and private companies, market intelligence and consumer research. By focusing on these opportunities, the report aims to help leaders look beyond hype and buzzwords to explore how technologies can alleviate real pain points and have a tangible impact on business results.

When it comes to hype, there is no shortage in the matter of the metaverse — the interconnected, virtual ecosystem that overlaps with or offers an alternative to physical reality. But it is difficult — and potentially unwise — for fashion brands to ignore the fact that in 2021, global spending on virtual goods reached around $110 billion, more than double the total in 2015. That spend is expected to be worth at least $135 billion by 2024. While many experiments in the metaverse at this stage are largely marketing exercises, innovative fashion brands over the next five years could generate up to 5 percent of their revenue from activities in the metaverse. Virtual skins in digital worlds will be a big driver of that revenue stream, while NFTs can help to solve industry pain points and bolster customer loyalty.

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As companies lean into digital opportunities, they will look to the hyper personalisation of experiences to increase customer loyalty. Shoppers have learned to expect curated, personalised service in other industries thanks to players like Netflix and Spotify, which harness AI to provide experiences specific to individual customer tastes and needs. But the fashion industry has been largely ill-equipped to move beyond basic customer segmentation owing to technology and talent restrictions. Brands that invest in AI modelling and Big Data to create one-to-one, personalised shopping experiences may see customer acquisition rates and sales increase as a result.

In a similar vein, executives should leverage technology in their physical stores to augment the omnichannel customer experience. As brands and retailers adopt and adapt in-store technologies, they will bridge the gap between online and offline channels. For example, in-store mobile apps for store associates can offer a frictionless way to serve customers, while in-store customer apps engage customers and result in more time spent in store. Meanwhile, beyond the shop floor, robotics and stock optimisation software, among other tools, can help brands and retailers set up micro-fulfilment centres, integrating physical stores as digital nodes in their distribution and delivery networks. Micro-fulfilment technologies can increase efficiency and reduce fulfilment costs by up to 90 percent, while also improving customer satisfaction thanks to faster delivery times.

Behind the scenes, technology is set to impact internal processes along the value chain, from demand forecasting to transport operations. While many parts of fashion companies' value chains are already digitised, a challenge for many players is that digitisation has happened in siloes, creating bottlenecks and other inefficiencies when it comes to sharing data and knowledge between functions. As a result, fashion executives believe integrating digital processes throughout their organisations will be among their top-five areas for digitisation as they look ahead to 2025. The benefits of such integration include increased speed to market and full-price sell through rates, as well as lower manufacturing costs.

Digital connectivity of the supply chain is important in another key area for fashion: sustainability. Traceability software — which helps brands identify, monitor and manage products across entire lifecycles and in different parts of a supply chain — is essential for the industry's sustainability efforts, while seeking to address demands from regulators, investors and customers for greater transparency around brands' environmental and social impact. These traceability efforts cannot work in isolation, given the enormity and urgency of the sustainability challenge. Brands should consider joining forces with each other, start-ups and industry bodies to establish a common data standard, and to share data and knowledge via software platforms, open ledgers and Big Data technologies.

For decision makers across value segments and at all stages of the technological adoption curve, this report translates each of these opportunities into clear, actionable steps for brands and retailers seeking to be part of fashion's tech acceleration.

To date, few brands or retailers have embraced technology with a truly competitive mindset. Now, fashion and technology go hand in hand to enable companies to expand into new markets, win deeper levels of customer loyalty, and establish data-driven strategies and decision making. As fashion leaders seek further digital transformations across their organisations, they will need to prioritise technology and align their companies' talent and resources accordingly.

Get Ready for the Great Tech Acceleration

In 2021, fashion companies invested between 1.6 and 1.8 percent of their revenue in technology, on average.[1] By 2030, that figure is expected to increase to between 3 and 3.5 percent.[2] Indeed, after a steady, decades-long technological ramp up focused on the digitisation of customer-facing interactions, fashion technology advancements are now accelerating across the entire value chain. With widespread automation and sharper AI-driven analytics, technology is eating fashion — from internal processes to customer experiences.[3]

Why is this happening now? As experts point out, in the next decade we will witness more technological progress than in the past 100 years.[4]

By 2024, AI-generated speech could power more than half of all human interactions with computers, while 50 percent of work across all industries could be automated by 2025, both with deep repercussions for the skills companies will need.[5] Meanwhile, more than 75 percent of enterprise-generated data will be processed by cloud or edge computing,[6] improving website and app loading times and enhancing customer experiences. By 2030, more than 80 percent of the global population is expected to have access to 5G networks,[7] enabling faster connectivity and data transfer across Internet of Things devices.

Meanwhile, fashion consumers' digital adoption, which was cemented by the pandemic, is set to endure. On average, people spent nearly 4 hours per day on the internet on their mobile phones in 2021.[8] Of the customers who made the move from offline to online shopping channels in 2021, 48 percent said they did so because of the Covid-19 pandemic, 27 percent cited convenience, 11 percent cited product availability and a further 11 percent cited promotions.[9] The pandemic also increased fashion customers' digital interactions with brands, with 72 percent of customers reporting they interacted with brands online in 2021. In the year ahead, this is expected to stabilise at 66 percent on average.[10]

Companies that leaned into technology to weather the pandemic and other recent challenges learned valuable lessons for excelling in today's, and tomorrow's, digital ecosystems. Those that have embedded AI technologies into their businesses to increase operational efficiencies and improve customer engagement could realise a 118 percent cumulative increase in cash flow by 2030. For companies just starting on this journey, implementing AI-driven initiatives between now and 2030 could generate a 13 percent increase in cash flow. Laggards with no such initiative before 2030 should expect a 23 percent relative decline.[11]

Now, fashion executives must lean into technology to not only grow their businesses and optimise profitability and cash flow, but also to address the industry's most pressing challenges — from hitting ambitious sustainability targets to de-risking their supply chains.

Thus, while a significant proportion of the industry's investment in technology up until now has been directed towards e-commerce, digitisation of internal processes is now also moving into focus. The top-three areas in which fashion executives plan to make digital investments between now and 2025 are personalisation, store technologies and end-to-end value chain management.[12]

Brands from across segments are increasing investment in AI and machine learning for processes such as demand planning and pricing.[13] [14] [15] Inditex committed to invest €2.7 billion (approximately $2.9 billion) in online capabilities and technology solutions under its 2020-2022 plan,[16] while Nike is

accelerating its transformation by investing in digital capabilities such as demand forecasting, insight gathering and inventory management.[17] Meanwhile, LVMH has partnered with Google Cloud to use cloud-based AI and machine learning technologies to enhance demand forecasting, inventory optimisation and personalised services.[18]

Moves such as these are creating a new paradigm for fashion, whereby the science of Big Data, advanced analytics and digital workflows are augmenting traditional creative processes. This transition will need to be underpinned by new talent capabilities, as brands seek to hire more data scientists, engineers and analysts, while also pursuing partnerships and acquisitions.
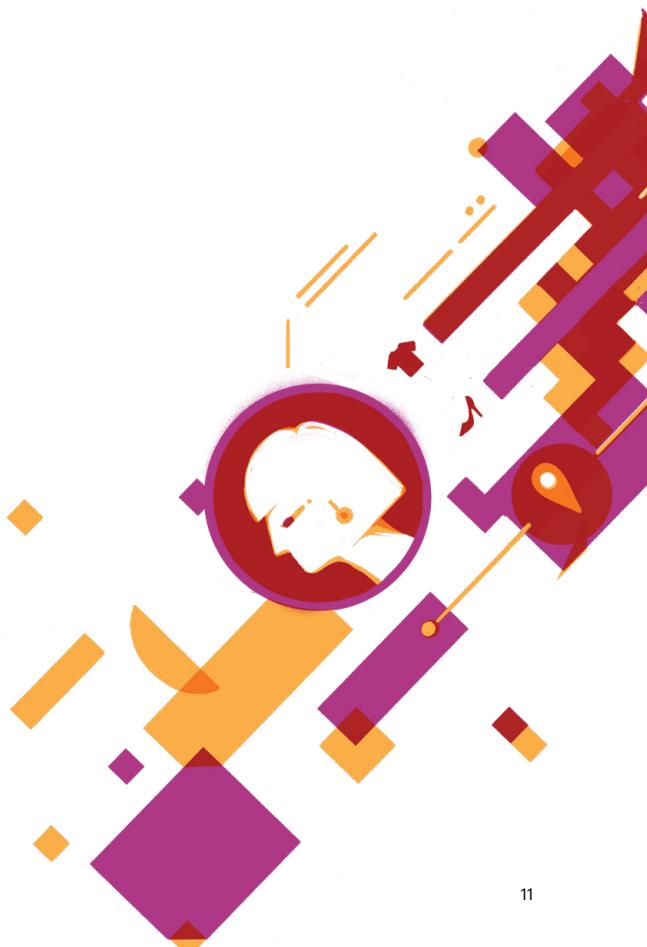
As fashion executives consider where to focus their attention and direct their resources, we explore five technology-driven imperatives for the industry in this report:

- **Metaverse Reality Check:** Virtual goods and extended reality
- **Hyper Personalisation:** Data- and AI-led marketing and e-commerce
- **Connected Stores:** In-store customer experience with mobile apps and micro-fulfilment
- **End-to-End Upgrade:** AI-powered value chain integration
- **Traceability First:** Blockchain and tracking technology for sustainability

Decision makers need to prioritise technology investments to seize these opportunities in ways that align with their business goals while preparing their organisations for a hyper-connected, fast-evolving era of the industry. But integrating new technology can be resource intensive, especially if it is not a good strategic fit or lacks useability and thus fails to be adopted by employees. Thus, technology investments need to be made wisely, and directed towards company change management as much as towards the core technologies themselves.

Whatever the investment approach, executives will need to understand their companies' appetite for change, creating an environment that enables a new digital culture, from factories to shop floors. For those that embrace change the competitive advantages are clear.

Technology in Fashion: A Quick Guide

As fashion and technology become ever more entwined, the lexicon of fashion is evolving rapidly. This quick guide introduces technologies influencing the industry today, which fashion professionals can deploy to develop use cases and strategies for adoption.

Applied artificial intelligence (AI) recognises patterns in data and interprets those patterns to produce insights. **Machine learning (ML)** is a subset of AI, giving computers the ability to "learn" without being explicitly programmed. **Deep learning (DL)** is an advancement of ML that analyses data using a logical structure called a neural network. AI, ML and DL can be applied across the fashion value chain, helping decision makers to analyse complex data sets, streamline operations and improve productivity.

Big Data refers to data sets that are too large and complex to be stored and processed using conventional methods, thereby requiring a strong data backbone or core network and bespoke architecture. In fashion, insights from Big Data enable companies to offer customers personalised communication and predict their preferences.

Blockchain is a type of **distributed ledger technology**. It is a decentralised, transparent system of records, validated with an irreversible signature and shared by multiple users. Once added to the blockchain, information cannot be amended. In fashion, blockchain technologies support rising demand for sustainability-driven traceability, supply chain transparency and product authentication at resale.

Cloud computing is the delivery of computing services over the internet, including servers, storage, databases, networking, software and analytics. In fashion, it can support flexible scaling, enabling companies to increase or decrease computer usage according to their needs. **Edge computing** is the practice of capturing and analysing data locally and in real time, significantly reducing latencies. This can help fashion companies accelerate production cycles and speed to market. Edge computing supports Internet of Things systems by enabling connectivity with devices such as mobile phones. **Quantum computing** harnesses quantum physics to represent and process information much faster than traditional computers. In fashion, it could be used to scale AI use cases, however the technology is in early development.

Computer-aided design (CAD) digitally produces product models and designs. In fashion, creatives can sketch and design in 3D CAD programmes, reducing the number of physical prototype and sample adjustments, increasing development speed, optimising costs and supporting sustainability by reducing or eliminating materials waste.

Computer vision, also known as image recognition, is a subset of AI that enables machines to derive information from images, videos and other visual inputs. In fashion, it allows users to scan visual data to identify patterns or styles. For example, a company can review e-commerce images to assess competitor products. The technology also automatically tags images uploaded to e-commerce sites with keywords to facilitate search for customers.

Digital workflows are a range of internal company processes that are converted to a digital format — for example, with enterprise resource planning software or internal communication platforms. Going digital can drive time and cost effectiveness. In fashion, digital workflows are being implemented across all parts of value chains.

Extended reality (XR) is an umbrella term that includes virtual reality (VR) and augmented reality (AR). **VR** immerses a person into an alternative world using hardware such as headsets, while **AR** adds a virtual layer to a person's view of the physical world, for example with a smartphone filter. In fashion, AR enables customers to virtually try on clothing and accessories, while VR supports the creation of digital fashion in virtual worlds and gaming as well as virtual showrooms and runway shows. XR spans digital and physical worlds, helping customers express their ideas and creativity in virtual spaces.

Internet of Things (IoT) describes networks of physical objects (hardware) connected to each other through built-in sensors and IoT applications (software). These increasingly available and affordable devices can connect with other devices and systems. IoT is enhanced by **5G (fifth generation mobile network)**, which offers faster data speeds and a lower cost of data transfer than previous generations. In fashion, IoT is associated with wearables (for example, smart watches and smart glasses) and sensors that are embedded in products. IoT sometimes uses RFID to enable the exchange of information about products such as materials, origins or maintenance.

Radio-frequency identification (RFID) uses radio waves to automatically identify and track objects with an RFID tag (a small transponder carrying information) and a reader (a device that receives signals from the tag). Similarly, but covering a smaller distance than RFID, **near-field communication (NFC)** transfers data wirelessly between devices such as smartphones and tablets containing NFC chips. In fashion, both technologies track products and orders in real time, helping companies address pain points like counterfeiting or improve recycling and inventory management.

Robots are autonomous machines that perform tasks without human intervention, while **cobots** (such as a robotic arm) collaborate with humans. In fashion, robots and cobots are used mainly in garment manufacturing and warehouse management. They handle precise, repetitive and sometimes dangerous tasks, such as sewing, managing textiles and spraying. **Automated guided vehicles (AGVs)** are mobile robots that follow sensors embedded in the ground or use vision, magnets or lasers to autonomously navigate themselves. Other robots and cobots can be mounted onto AGVs. In fashion, they are most often used in industrial applications, warehouses and dark stores. **Robotic process automation (RPA)** is software that programmes the execution of repetitive digital tasks, which in fashion can accelerate routine tasks across the value chain — for example, organising and structuring data, scheduling and assigning daily tasks, or creating high-quality design renders using a predefined set of rules.
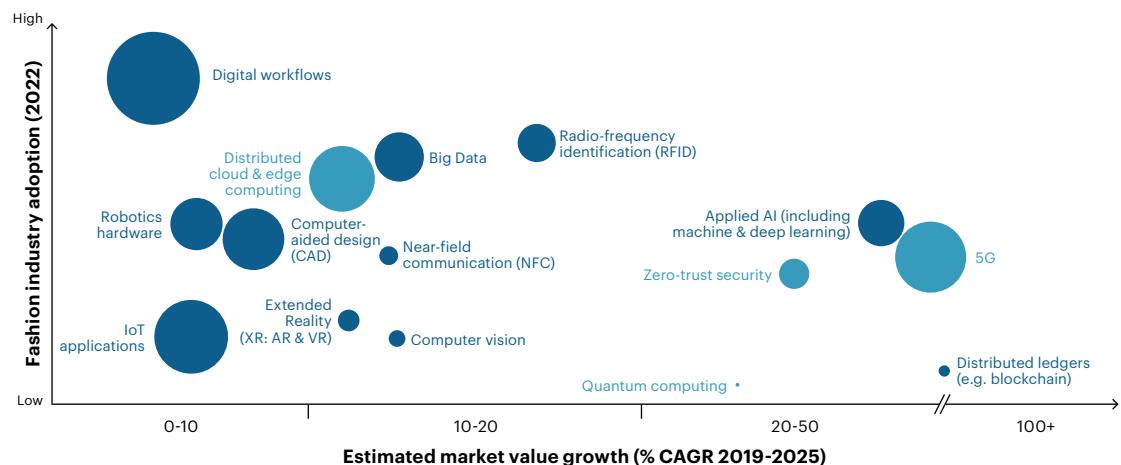
Zero trust security is an approach to IT security that requires every user or device trying to access a system to prove they are authorised to do so and are not hackers. The approach is useful in fashion due to the increases in remote working and cloud environments, volumes of sensitive customer and company data, and regulatory and customer expectations addressing data privacy and cyber risk.

Exhibit 1:

Key technologies for the fashion industry

● Core technologies deployed in the fashion industry

● Underlying technology enablers that will accelerate fashion industry use cases

Bubble size = Market size (2019-2020)

SOURCE: MCKINSEY EXPERT INTERVIEWS

The State of Fashion: Technology

Fashion players now have an opportunity to expand the breadth and depth of technology used throughout their businesses as tech advancements accelerate. Brands and retailers are leaning into technology not only to become more resilient to today's volatile operating environment, but also to become more responsible and sustainable. This report highlights five technology-driven imperatives to help fashion executives understand where to focus their investments to solve some of the industry's most pressing challenges.

Metaverse Reality Check

The marketing value of digital fashion and NFTs may now be clear, but fashion brands will need to separate hype from the concrete opportunities to generate sustainable revenue streams presented by growing consumer engagement with the metaverse.

>5%

Fashion companies focused on metaverse innovation and commercialisation could **generate more than 5 percent of revenues from virtual activities** over the next two to five years

Hyper Personalisation

Brands have access to a growing arsenal of personalisation tools and technologies to upgrade how they customise and personalise their customer relationships. The opportunity for executives now is to harness Big Data and AI to provide one-to-one experiences that build long-term loyalty.

71%

71 percent of global consumers want companies to deliver personalised communications and products, and 76 percent are unhappy when this is not offered

Connected Stores

The inexorable rise of e-commerce has forced fashion players to rethink the role of physical stores. Fashion executives can address consumer pain points by using in-store mobile apps to enhance the experience and micro-fulfilment technologies to leverage their physical retail networks for the quick-commerce era.

x4

Customers who engage with in-store technology **spend up to four times longer shopping** than those who do not

End-to-End Upgrade

Digital tools and analytics have transformed key parts of the fashion value chain, but these optimisations are often siloed within organisations, limiting the potential for cross-functional improvements. Brands should embark on end-to-end value chain integration to create more efficient and more profitable ways of operating.

>60%

More than 60 percent of fashion executives believe **creating integrated digital processes throughout their organisations** will be among their top-five areas for digitisation as they look ahead to 2025

Traceability First

Traceability systems powered by tracking software and Big Data will help fashion brands focusing on sustainability to reach far into their supply chains to understand the entire lifecycle of their products.

>50%

More than 50 percent of fashion decision makers say **traceability will be a top-five enabler to reduce emissions** in their supply chains

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METAVERSE REALITY CHECK

The marketing value of digital fashion and NFTs may now be clear, but fashion brands will need to separate hype from the concrete opportunities to generate sustainable revenue streams presented by growing consumer engagement with the metaverse.

KEY INSIGHTS

- Global spending on virtual goods reached an estimated $110 billion in 2021, more than doubling the total in 2015, with around 30 percent attributed to virtual fashion.
- Fashion companies focused on metaverse innovation and commercialisation could generate more than 5 percent of revenues from virtual activities over the next two to five years.
- Digital fashion and virtual skins in gaming environments are clear opportunities to generate sustainable revenues in the short-term. NFTs used for authentication or loyalty tokens are likely to be most relevant for fashion players in the future.

TECH ENABLERS

- **Blockchain** distributed ledgers to support NFTs and asset purchases through cryptocurrency on virtual platforms.
- **Extended reality (AR and VR**) to enable customers to alter images and virtually try on clothing.
- **NFTs** to serve as collectibles and customer-loyalty tokens and act as digital twins to store information and document authenticity.
- **Virtual fashion and skins** to change the appearance of avatars in gaming and online platforms.

EXECUTIVE PLAYBOOK

1 **Determine a position**

Decide whether the company will be a disruptor or follower in the metaverse adoption curve, based on the target customer and the role of digital in the overarching strategy.

2 **Decide where to engage**

Establish the appropriate level of engagement, ranging from developing one-off digital assets and new experiences in existing platforms to creating an entire virtual world.

3 **Prepare for the long term**

Depending on their revenue goals and vision for long-term investment, executives may opt to develop tech and talent capabilities internally, acquire existing disruptors or partner with relevant players and platforms.

Pioneers in the metaverse have shown there is a business case for fashion brands to invest in virtual worlds. Granted, a fully formed metaverse — comprising an interconnected, virtual ecosystem that overlaps with or offers an alternative to physical reality — is not yet possible given technology constraints. But brands' experiments with metaverse principles, such as virtual fashion, extended reality, gaming and non-fungible tokens (NFTs), demonstrate the impact that virtual activities can have as marketing and community-building tools for fashion. Global spending on virtual assets reached around $110 billion in 2021[19] and is expected to grow at roughly the same rate as the gaming market to be worth around $135 billion or higher by 2024.[20]

Over the next two to five years, fashion brands focused on metaverse innovation and commercialisation could generate more than 5 percent of revenues by investing in virtual activities today.

The next frontier for leading brands will be to translate unproven technologies into sustainable revenue streams, effectively separating hype from reality. Over the next two to five years, fashion brands focused on metaverse innovation and commercialisation could generate more than 5 percent of revenues by investing in virtual activities today.[21]

Looking beyond a five-year horizon, some bullish observers expect mass consumer adoption of virtual worlds, creating the biggest opportunity for the fashion industry since e-commerce. The bears predict that the hype around the metaverse will fade as technologies fail to meet expectations or users prove reluctant to use virtual spaces as extensively as some business plans are counting on.

While it is uncertain whether a meaningful number of consumers will develop fully fledged virtual lives and spend most of their time in the metaverse, significant revenue opportunities for fashion brands will emerge.

The pace of adoption will be driven by technological advancement, the interoperability between virtual environments and social acceptance. Tech players as well as fashion start-ups and brands need to develop technologies that help evolve today's unrefined virtual experiences into mature, immersive realities. Mass consumer adoption could be a significant hurdle — 78 percent of people who have already ventured into virtual worlds say they miss physical interaction when doing so.[22]

As a result, many players will likely hang back to see evidence of commercialised use cases and a tangible ROI before investing. For others that want to capture the commercial opportunity, the biggest short-term revenue potential lies with virtual assets that can be traded, transferred or used for payment. We identify two clear use cases for virtual assets that have long-term potential:

AR Fashion and Virtual Skins

In virtual spaces and on social media platforms, the appetite for creating and adapting online identities is high: approximately 70 percent of US consumers from Gen-Z to Gen-X rate their digital identity as "somewhat important" or "very important."[23] A similar appetite for virtual goods can be found in China, where 70 percent of luxury consumers have purchased or will consider purchasing virtual assets.[24]

Some companies are using augmented reality (AR), to enable users to alter photos and videos, and are creating digital skins to change the appearance of a user's avatar. For example, digital fashion start-up DressX, which sells virtual clothing that can be added to a photo and posted on social media, has partnered with brands such as H&M to launch digital collections.[25][26] Meanwhile, users on online gaming platforms such as Roblox update their avatars with new skins regularly,

even daily in some cases.[27] The potential revenue generation of in-game outfits and accessories can be significant. Gucci sold a virtual version of its Dionysus bag for the equivalent of $6 on Roblox, which later led to bids of more than $4,000 per bag when resold on the secondhand market.[28][29]

The multi-billion-dollar gaming market will continue to offer opportunities for fashion — the market for gaming skins could reach $70 billion by 2024, up from $40 billion in 2020.[30] Brands will need to turn to established gaming and platform partners to find inroads.

Still, as with any nascent technology, there are risks. For one, brands — particularly those in luxury — should be aware of selling "cheap" digital items that could weaken the exclusivity of their brand image. AR technology is at a relatively early phase of development, where glitchy or unwieldy applications can undermine the user experience.

Furthermore, if brands choose to partner with virtual platforms, in gaming or otherwise, the top-line opportunity may be dampened by high take rates, which could reach as high as 50 percent commission on revenues.[31]
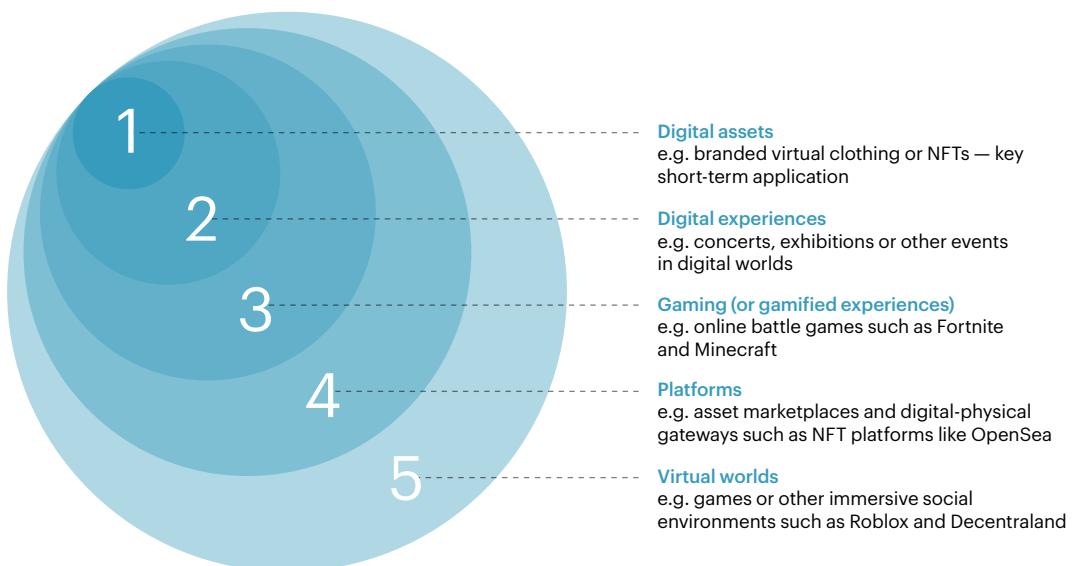
NFTs as Digital Twins and Loyalty Tokens

Much of the frenzy about blockchain-based NFTs has been centred around digital art collectibles, which are in some cases bought and traded for inordinate sums, driving news headlines as some observers scratch their heads. The compound annual growth rate of the value of the NFT market skyrocketed 750 percent between 2018 and 2021, from $41 million to $24.9 billion.[32]

But the rapid rate of growth in NFT sales is already starting to moderate. Indeed, the daily trading volume on NFT marketplace OpenSea fell by 80 percent between February and March 2022.[33]

Exhibit 2:

Brands can engage in the metaverse across five dimensions

1 Digital assets
e.g. branded virtual clothing or NFTs — key short-term application

2 Digital experiences
e.g. concerts, exhibitions or other events in digital worlds

3 Gaming (or gamified experiences)
e.g. online battle games such as Fortnite and Minecraft

4 Platforms
e.g. asset marketplaces and digital-physical gateways such as NFT platforms like OpenSea

5 Virtual worlds
e.g. games or other immersive social environments such as Roblox and Decentraland

SOURCE: MCKINSEY ANALYSIS

NFT sceptics suggest that this could indicate the bursting of a bubble in an unsustainable market with a limited number of active customers and rampant hoaxes and scams.

However, even as the hype subsides, use cases will emerge that address industry pain points and consumer desires with applications that support community building, product traceability and authenticity.
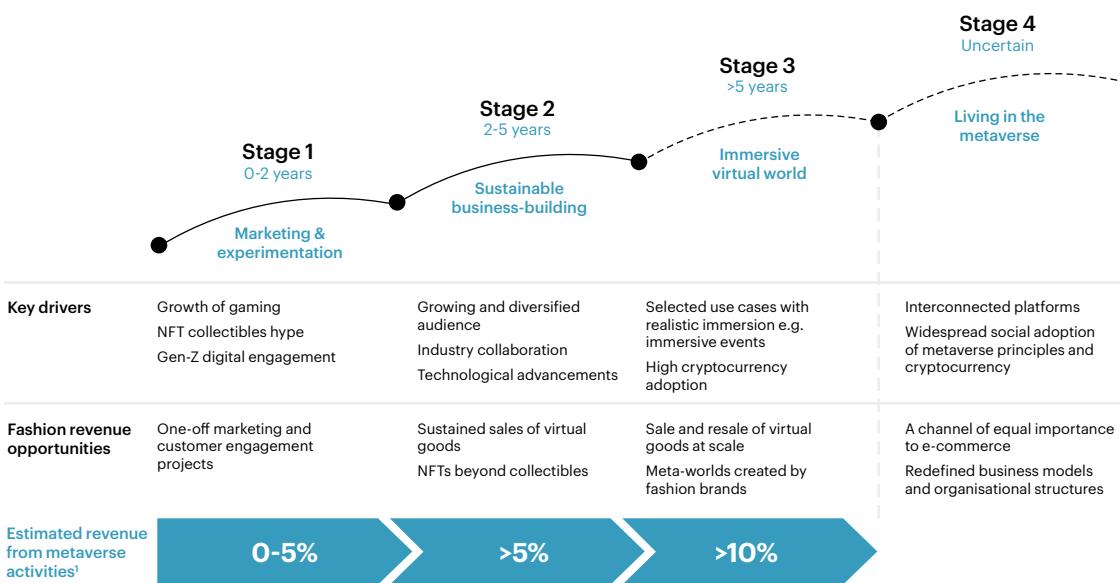
The long-term business opportunity for fashion brands to engage with NFTs will likely serve more pragmatic purposes by using NFTs as "loyalty tokens." Gucci, Adidas and The Hundreds, among others, have used NFTs to offer benefits like early access to new NFT drops and physical products, essentially serving as a membership programme.[34] In a sense, these NFTs are digital collectibles, since users cannot yet wear them in virtual worlds, though they could use them for social media profiles. Brands are starting to add more "utility" to collectible NFTs, which could make buying one more worthwhile to consumers and translate into a long-term opportunity for brands.

We see the most compelling use case for NFTs as digital twins that host information about a physical or digital product's history, authenticity and ownership — something that is especially beneficial to the luxury segment in its battle against counterfeiting. Twins enable products to be paired with a theoretically tamper-proof record and unlock the ability for brands to

Exhibit 3:

The metaverse can offer sustainable revenue streams even if achieving a fully alternative world is uncertain

	Stage 1 0-2 years Marketing & experimentation	Stage 2 2-5 years Sustainable business-building	Stage 3 >5 years Immersive virtual world	Stage 4 Uncertain Living in the metaverse
Key drivers	Growth of gaming NFT collectibles hype Gen-Z digital engagement	Growing and diversified audience Industry collaboration Technological advancements	Selected use cases with realistic immersion e.g. immersive events High cryptocurrency adoption	Interconnected platforms Widespread social adoption of metaverse principles and cryptocurrency
Fashion revenue opportunities	One-off marketing and customer engagement projects	Sustained sales of virtual goods NFTs beyond collectibles	Sale and resale of virtual goods at scale Meta-worlds created by fashion brands	A channel of equal importance to e-commerce Redefined business models and organisational structures
Estimated revenue from metaverse activities[1]	0-5%	>5%	>10%	

[1] For companies pursuing one or more metaverse-related activities, such as experiences and asset sales

SOURCE: MCKINSEY ANALYSIS

Sales of NFTs saw a paradigm shift in 2021

NFT SALES, USD

750%
CAGR
2018-2021

$24.9b

$41m $142m $338m

2018   2019   2020   2021

SOURCES: NONFUNGIBLE.COM (NON FUNGIBLE TOKENS YEARLY REPORT 2020), L'ATELIER BNP PARIBAS, DAPP RADAR

collect royalties from resale. A host of start-ups and industry initiatives such as Aura Blockchain Consortium, Lablaco and Arianee are aiming to make blockchain-based digital twins commonplace. Lablaco is working to link its digital IDs to virtual versions of garments, so that customers can engage in augmented reality experiences such as try-ons.

Partner, Build, Acquire

While a few disruptors, such as marketplaces for digital fashion, will solely focus on virtual goods, most tech-savvy, innovative brands will tap the opportunity to diversify revenue streams and target Gen-Z and Millennial consumers. Players that want to experiment in the metaverse but lack the requisite in-house capabilities can:

- Partner with gaming or tech companies, as Gucci did in its tie-up with Zepeto, a social network and avatar simulation app, to produce paid-for digital skins,[35] or as Burberry did when it partnered with Tencent to launch a

limited-edition scarf with the Chinese virtual influencer Ayayi.[36]

- Build their own capabilities by recruiting talent with tech-related skills alongside a deep-rooted understanding of the metaverse and its communities, as Balenciaga is doing by creating a "metaverse business unit" dedicated to metaverse marketing and commerce.[37]

- Make acquisitions, along the lines of Nike's deal to buy virtual fashion studio RTFKT in 2021.[38]

Like the early days of e-commerce, some metaverse-related ventures are likely to fail outright or need rapid iteration. However, fashion is well placed to capitalise on the engagement with virtual worlds and the metaverse, owing to its connection to self-expression, status and creativity. Executives should consider metaverse strategies based on their companies' digital ambitions and customer targets.

Where Fashion-Tech Investors Are Putting Their Money

Capital is flowing into technologies that make fashion commerce more nimble, more sustainable and more engaging to shoppers. And, of course, there's no escaping the metaverse.

by Marc Bain and Carlos Sanchez Altable

Customer uses smartphone to browse e-commerce website. Qi Yang/Getty Images.

Across the varied funding taking place in fashion tech, investors are emphasising technologies that make commerce more nimble, more sustainable and more engaging to shoppers, whether they're buying their goods new or used, in stores or online. Many are also making non-fungible token (NFT) and metaverse-related moves, but they're starting slowly in these areas and doing their research to determine what opportunities lie beyond NFTs as collectibles.

In 2021, the value of the top 50 investments in technology related to fashion grew 66 percent compared to 2019, reaching $16.2 billion, according to McKinsey analysis of data from Crunchbase, a business-information platform.[39] The investments considered in this analysis went towards either fashion retailers or businesses selling products and services to fashion firms, rather than fashion brands. E-commerce, having benefitted from the pandemic-driven surge in online shopping, received roughly 55 percent of the investment. The remainder largely comprised payment technologies, including "buy now pay later" firms, social commerce and resale, followed by supply chain and logistics companies and those working in NFTs or technologies like virtual reality.

Investors say e-commerce has room for further growth and innovation. For instance, new marketplace models that are "inventory light" and help individual creators and sellers have been one area of focus for Forerunner Ventures, a San Francisco-based fund.[40]

"On the back end — the commerce-enablement side, where we spend a lot of our time investing — there's been a tonne of innovation on the enabling tools and technologies powering anybody to be a seller, whether you are an incumbent brand or a creator or somebody just getting going," said Nicole Johnson, a partner at Forerunner. As an example, Johnson cited Canal, a distributed commerce platform that aims to let individuals and companies of any size sell products on the same channels where customers first encounter them, such as YouTube or Substack. Forerunner has been one of the lead backers of the Bay Area start-up, which went live in 2021.

Frederic Court, founder of London's Felix Capital, highlighted marketplaces as an area of interest as well, such as those that have their own strong point of view and emphasise a curated shopping experience. "In a world where there is so much choice, curation itself is a very important theme," he said.[41]

Consumer-facing fashion tech has drawn most of the investment in recent years, and that's still the case. Social commerce, for example, saw a jump in funding in 2021, driven largely by a $500-million raise by China's Xiaohongshu.[42]

At Swedish fast-fashion giant H&M, executives are looking to e-commerce innovations that allow it to blur the line between online and in-store experiences and offer customers the same level of personalisation across channels. Alan Ting, the company's head of M&A, described one potential idea where customers could log their purchases in a "digitised wardrobe," and then when visiting a store, the H&M app would guide them to products they might like based on past purchases. The company is also continuing its investments in analytics and AI to leverage its massive trove of customer data, he noted.[43]

> **In 2021, the value of the top 50 investments in technology related to fashion grew 66 percent compared to 2019.**

Supply chains and logistics continue to draw investor interest. In late 2020, Singapore-based Lyra Ventures participated in a funding round for Material Exchange, a centralised materials database company.[44] Reina Nakamura, a general partner at Lyra, said the database can help individual creators as well as brands competing against the likes of fast fashion juggernaut Shein to be nimbler in production.

Because of its digitised supply chain, Shein has visibility into the availability of materials that can be whipped into orders, making it more agile than brands relying on the traditional model of attending trade shows, exchanging physical

samples and producing fabrics to order, according to Nakamura.

"This has always become the bottleneck for any agile upstream supply chain to be built, and I think Shein has really changed the game here," she said.[45]

Similarly, in 2021, Forerunner co-led a funding round for Swyft, which connects shipping carriers with vendors to let them offer same-day delivery and compete against Amazon's logistics machine, Johnson said.

Resale is offering investors both a sustainability play and a growing market of shoppers, particularly younger ones. In recent consumer surveys from BoF Insights, 65 percent of respondents aged 18 to 24 said they have purchased secondhand fashion before.[46]

> Web3 and the metaverse are inescapable topics, and while capital is pouring into metaverse-related companies, investment on the fashion and retail side is just getting started.

H&M has said it will double its investments in 2022, focusing on areas such as tech and supply chain, renewable energy and sustainable materials. H&M's most significant investments in fashion tech, for instance, have focused on Sellpy, the secondhand site it acquired in 2019, Ting said. In 2021 it launched Sellpy in 20 additional countries, bringing its total number of markets to 24, and told Reuters it has invested more than €20 million ($24.4 million) in the business.[47]

Beyond H&M, resale companies including Vestiaire Collective, Grailed and Tradesy held funding rounds in 2021.[48] Etsy acquired the Gen-Z-focused secondhand marketplace Depop, and more brands now offer resale of their own goods.[49]

Pierre Denis, former chief executive of Jimmy Choo and now a fashion-tech investor based in London, pointed to the resale economy
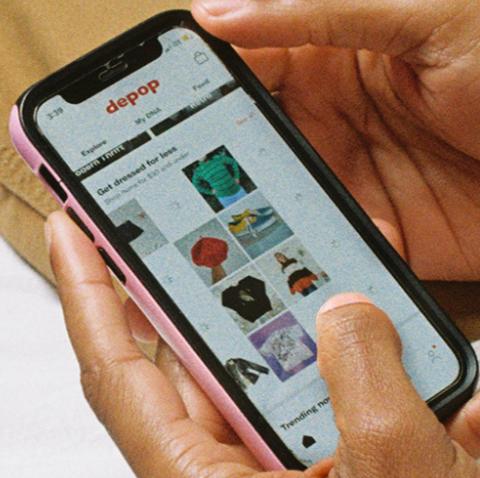
as one of several key investment targets, alongside data analytics and social commerce.[50] He joined a $2.7-million funding round for Reflaunt, a "resale-as-a-service" technology company that supplies the backend infrastructure allowing brands and retailers to plug into a network of secondhand marketplaces and launch their own resale businesses.[51]

Meanwhile, Lyra's Nakamura pointed to resale logistics companies, such as Lizee, a French start-up founded in 2019 focusing on logistics solutions for rental and resale brands — something she said traditional warehouse-management systems aren't designed to do. Lizee raised €1.3 million ($1.55 million) in a seed round in 2021.[52]

While many of these investments aim to solve current industry pain points, investors are also keeping an eye on the future. Web3 and the metaverse are inescapable topics, and while capital is pouring into metaverse-related companies, investment on the fashion and retail side is just getting started. Johnson, for instance, said Forerunner is "walking before we run and thinking about where the consumer utility is and the biggest opportunities for mass consumer adoption in those spaces."

But money is beginning to flow. Denis and Nakamura separately have backed Threedium, whose technology lets brands and retailers create 3D and augmented reality assets for use in e-commerce and a range of gaming environments. Nakamura described the company as a "backbone of everything 3D."

H&M launched its first virtual fashion collection at the start of 2022. The company is working to understand what competencies it needs to develop — or acquire — in the space, according to Ting. "For sure, we're going to need to offer our products in a digital fashion," he said.

A customer shopping for secondhand fashion on a smartphone. Depop.

02.
HYPER PERSONALISATION

Brands have access to a growing arsenal of personalisation tools and technologies to upgrade how they customise and personalise their customer relationships. The opportunity for executives now is to harness Big Data and AI to provide one-to-one experiences that build long-term loyalty.

KEY INSIGHTS

- Advanced personalisation techniques are playing out across industries, setting a high bar for fashion brands — 71 percent of consumers expect companies to deliver personalised interactions and a similar proportion say it is frustrating when this does not happen.

- Competition for customer attention is intensifying and conversion costs are rising amid new privacy restrictions and limits on third-party data collection.

- Players can drive customer lifetime value by pushing beyond basic segmentation and ad hoc targeting to hyper-personalised shopping experiences across all touchpoints.

TECH ENABLERS

- **Artificial intelligence** to analyse complex data sets, make predictions, create one-to-one experiences and maximise engagement.

- **Big Data** to fuel AI models with a continuous pipeline of real-time customer behavioural data.

- **Cloud computing** to enable real-time processing of customer data collected across channels.

- **Customer data platforms** to provide a single, coherent and complete view of the customer across channels.

- **Next-generation e-commerce platforms** and content delivery networks to personalise in real time and distribute thousands of unique landing and content pages.

EXECUTIVE PLAYBOOK

1 **Invest in first-party data collection**
Adopt first-party data enhancement mechanisms and capture further third-party data through external partnerships.

2 **Connect customer data with a unique ID**
Connect data across channels and data platforms to create a 360-degree understanding of the customer.

3 **Develop AI models**
Incorporate cross-channel behavioural and transactional data into personalisation engines to create a holistic view of customer profiles, and align models with the brand's vision.

4 **Deliver solutions at scale**
Deploy design and distribution tools across marketing and content delivery networks to deliver thousands of different versions of landing and content pages across channels, prioritising the touchpoints that are most relevant to the product and segment.

5 **Establish personalisation as a core capability**
Build a personalisation roadmap to align teams — from data science to marketing and e-commerce — around a central strategy.

It's no secret that fashion brands need to make highly personalised customer experience a cornerstone of their digital businesses. Their customers expect nothing less. Consumers have had their personalisation expectations redefined by the likes of Netflix, Spotify and Amazon. Shoppers expect brands to provide them with product choices and experiences that are tailored to their individual preferences. Indeed, 71 percent of global consumers want companies to deliver personalised communications and products, and 76 percent are unhappy when this is not offered.[53]

Not so long ago, a personalised experience in fashion was something only very high-end, luxury shoppers could receive. Luxury boutique associates would lavish attention on key customers, manually recording an individual's personal tastes and shopping habits in notebook after notebook to help them tailor their service. Building a long-lasting rapport with these shoppers was an exclusive, elaborate, not to mention inefficient, exercise.
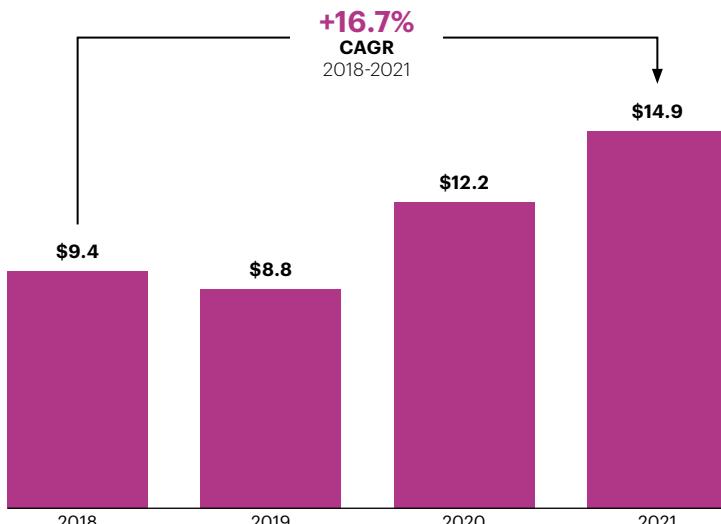
Shoppers expect brands to provide them with product choices and experiences that are tailored to their individual preferences.

Fast forward to today and brands are facing a convergence of factors that make personalisation a priority. Declining brand loyalty among customers and increased competition for attention from social media platforms, along with tightening regulations and moves by Apple and Google to modify access to third-party data, are all impacting
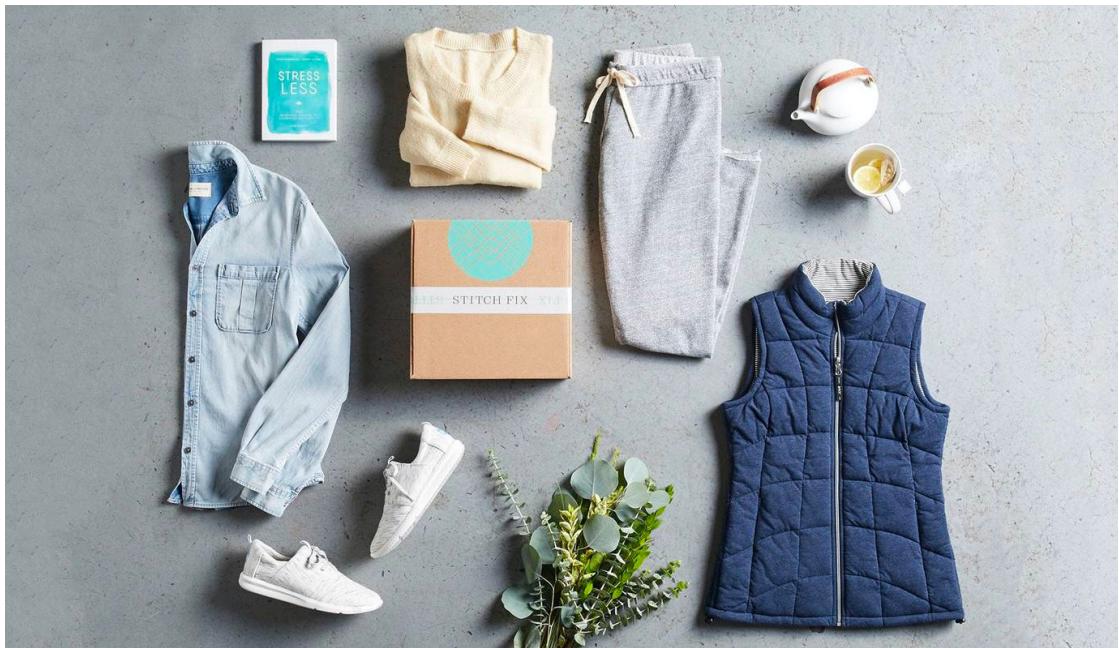
Exhibit 5:

Data privacy regulation has spurred advertising's efficiency to decrease and costs to increase

GLOBAL AVERAGE COST PER THOUSAND (CPM) ON FACEBOOK, USD

+16.7%
CAGR
2018-2021

- 2018: $9.4
- 2019: $8.8
- 2020: $12.2
- 2021: $14.9

SOURCES: ADSTAGE PAID MEDIA BENCHMARK REPORTS, REVEALBOT

the ability of brands to connect with customers online.[54] [55] [56] Now more than ever, personalisation can hold the key for brands to capture market share.

That said, the fashion industry today generally confines personalisation to marketing recommendations for customer sub-segments, based on past purchases or online browsing history, held back by talent and technology constraints. There's scope to go further. For the first time, businesses have tools that enable them to work with all types of data across channels in real time.

This is evident in e-commerce, where platforms powered by cloud-based technologies could run AI or machine learning algorithms to accelerate the processing and analysis of Big Data on customer behaviour.[57] The result of these analytical capabilities would mean brands are equipped to provide hyper-personalised, one-to-one experiences — similar to those of the sales associate in an exclusive boutique, but available to customers across all fashion segments, from high street to luxury.

Offering hyper personalisation will require companies to reimagine how e-commerce operates. Search-based shopping is likely to shift to the individualised discovery of products and styles offered in the right size and fit. All customers will have a curated experience on their own versions of brand websites and marketplaces, from landing page to payment, akin to their experience on social media feeds. With this, companies will use personalisation technology to build experiences that drive customer engagement and, ultimately, loyalty.

Fashion retailer Zalando has taken steps towards this vision. It uses data analytics to offer its customers millions of tailored "Zalando interfaces." By incorporating preferences into its algorithm, product displays are automatically tailored to each customer, from size to their favourite brands. The retailer is also exploring 3D body scanning technology to enhance size and fit selections.[58]

Another company embracing this opportunity is The Yes. The fashion marketplace has built an extensive product taxonomy while also

deploying machine learning and computer vision to synthesise hundreds of data points for each product. The algorithm then translates shopper preferences into a personalised exploration feed.[59]

Meanwhile, styling service Stitch Fix tailors products to customers' tastes and needs and uses a discovery tool called "style shuffle" to help users indicate designers they like.[60] Fast-fashion player Shein offers each customer a scrollable feed of products powered by a real-time recommendation algorithm informed by myriad data points across social media and other channels.[61]

Offering hyper personalisation will require companies to reimagine the way that fashion e-commerce operates across platforms — a potentially complex, fast-evolving challenge.

Looking ahead in the luxury segment, hyper personalisation is set to also play out in physical stores. Store associates can leverage first-party data to provide customers with a unique experience no matter which store they enter, taking in-store clienteling to the next level. What's more, as technologies advance, it is feasible that brands will be able to create digital wardrobes for each customer along with personalised styling recommendations.

Offering hyper personalisation will require companies to reimagine the way that fashion e-commerce operates across platforms — a potentially complex, fast-evolving challenge that can overwhelm brands. This can be managed by:

Accelerating first-party data collection
- Challenge: Changes to data privacy laws and restrictions on third-party data collection in various jurisdictions have rendered data

management platforms and third-party cookies less relevant.
- Solution: Brands need to maximise their first-party data collection to enable personalisation across platforms and channels. This can happen, for example, through loyalty programmes that help identify and link customer purchases online and offline. In-store apps can also track offline browsing behaviour, and brands can create campaigns that collect data in exchange for loyalty points or discounts. In these efforts, brands need to be mindful of adhereing to data privacy regulations (e.g. GDPR in Europe).

Creating a 360-degree customer view
- Challenge: When shopping for fashion, customers can generate a vast amount of data across channels and platforms — ranging from location data to website or app engagement time. This data tends to be unstructured, in multiple formats and scattered across different databases. In isolation, this provides little or no insight.
- Solution: Brands need to establish a complete customer profile connected to a unique ID across data sources and channels. A customer data platform is needed to host all data assets and consolidate the customer view, as are rigorous data standardisation and cleaning processes. The result is brands could create a single dataset that joins up customer preferences and behaviours at a granular level across platforms, channels and product categories. For retailers, this could also span data from different brands. Companies should consult current data legislation when creating these customer profiles.

Aligning the 'human touch' and AI
- Challenge: Fashion customer behaviour can be difficult to predict, not least because

of fashion's rapid trend cycles and the low levels of repeat purchasing among individual shoppers. Furthermore, a stand-alone personalised algorithm might not align with a brand's strategic priorities without human intervention.

- Solution: Players need to develop advanced AI models, such as those that display products and photo styles best suited to the individual customer, or models that use advanced size and fit algorithms. These models should incorporate behavioural data, such as login time and add-to-cart behaviours, along with nuances relating to the brand's market and segment positioning.

Scaling personalisation solutions
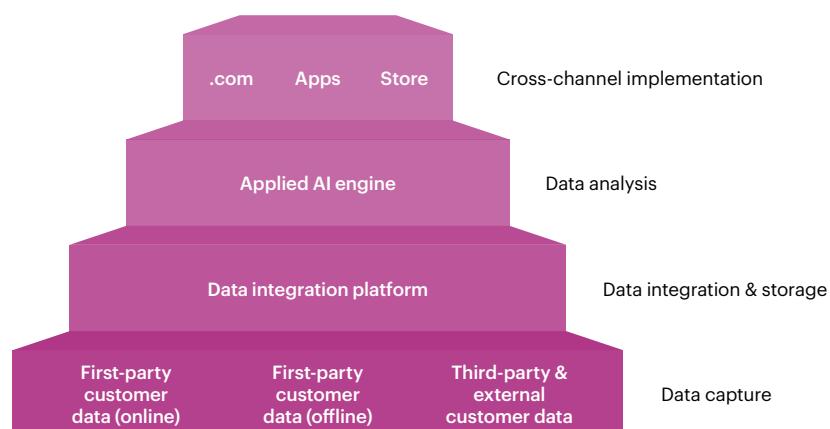
- Challenge: A significant platform upgrade is required to deliver sophisticated, hyper-personalised e-commerce content, which is informed by thousands of data points and delivered across multiple channels with ultra-fast loading times.

- Solution: A company's portfolio of design and distribution tools needs to include content management systems that can standardise, centralise and distribute digital elements to support marketing alongside content delivery networks that help deliver thousands of unique landing and content pages. Their portfolio should also include an e-commerce platform for their website and app, so that brands can deliver personalisation to every customer across all journeys.

A priority for executives should be to establish hyper personalisation as a core competency. Brands will need to invest strategically across all their data and analytics activations, from collection to cross-channel implementation. In many cases, this will mean setting up a dedicated cross-functional team, comprising product managers, marketing domain experts, software engineers and data scientists. Brands that set themselves up to win will hone their ability to deliver intelligent, targeted marketing and e-commerce solutions for every customer.

Companies need a full range of analytics capabilities for a new era of personalisation

.com	Apps	Store	Cross-channel implementation
Applied AI engine			Data analysis
Data integration platform			Data integration & storage
First-party customer data (online)	First-party customer data (offline)	Third-party & external customer data	Data capture

SOURCE: MCKINSEY ANALYSIS

Zalando: Bringing Data Science to the Art of Fashion Retail

by Marc Bain

Robert Gentz
Co-Founder & Co-Chief Executive, Zalando

AI and other technologies are critical to how the fashion giant matches millions of customers with the right product in the right fit, says co-founder and co-chief executive Robert Gentz, and now the company is looking to innovations like augmented reality as it seeks to capture more market share.

Zalando is Europe's largest online-only fashion retailer, but there's another way it often describes itself: Europe's most fashionable tech company. Technology has been central to how the company operates since its founding in 2008 in Berlin. Today it uses data to optimise everything from how it buys products from brand partners to how it delivers items to customers. It also leverages technologies, including AI, to deliver shoppers a more personalised experience on its site and app. The approach has worked: in its 2021 fiscal year, total merchandise volume on its platform rose 34 percent year on year to €14.3 billion ($15.7 billion), bringing in revenue of €10.4 billion.[62]

Robert Gentz, co-founder and co-chief executive, is helping to steer Zalando to its next goal: by 2025, it expects merchandise annual sales to top €30 billion as it aims to capture more than 10 percent of the European fashion market.[63] It's a lofty ambition, and far from guaranteed as competition grows online. If Zalando is to achieve it, it must continue to set itself apart, and technology will be vital in the effort.

Personalisation has been a major focus at Zalando for years and is a key part of the customer experience it offers. Why is it so important for the company?

On Zalando you have 1.4 million different items. It is a huge selection. And then you have 48 million customers. Using technology and data to bring the right customer to the merchandise, or the right merchandise to the customer, is important because, for these 1.4 million choices, how do you make sure that she finds one item? So we're trying to use technology to personalise it for customers as much as we can. It comes down to the matchmaking problem: how do you matchmake merchandise with customers?

Which technologies are you using for this task?

It's AI. There's one program that is running, an algorithmic fashion companion, which is based on items that you have bought in the past. The algorithm combines fitting items to [create] an outfit, which we have learned through how people combine [items]. When you look at click-through rates and buy-through rates, the outfits we're producing are hitting the mark of what customers want. So it's algorithms that are continuously improving with feedback loops from customer data as well as human feedback that we internally produce.

What are some of the ways a customer's experience on the site or app is tailored to them?

First of all, in onboarding you already have an opportunity to express brands you like, your sizes. That personalises the site already for you. In terms of the product and merchandise to the teasers that you see, it is customised so the Zalando shop looks different to every single customer once they actually have an interaction with us.

What metrics does Zalando look at to determine if these efforts are successful?

Sometimes the short-term metrics are not always the ones that lead to the right long-term answers. If you want to just optimise click-through rates, then the items that might be the most fancy ones have the highest click-through rates but are probably not the ones that create the right offering, the right experience in the long term. What we are mostly optimising is long-term customer lifetime value, and the long-term customer lifetime value is generated through complex algorithms that [factor] how much time you spent on site, how much are you browsing and what are you buying — it's

different sets of [key performance indicators].

Discovery of new products is one type of value a retailer can offer shoppers, but if shoppers are getting personalised recommendations based on past behaviour, does that limit their chances of discovering new items they might love but that aren't like what they've bought in the past? Does Zalando take any steps to account for this?

Just looking at the past does not always answer the question for the future. What we actually take a lot of inspiration from is how the music industry is trying to solve the problem. You cannot only do it by machines and past behaviours. You always have to mix in new and modern fashion elements. This is where the fashion people help the technology people.

So there's still old-fashioned human curation in the process?

Yeah. In the end it's all about emotion. Nobody wants to just shop in a big automated warehouse. It is about the art as much as it's about the science.

Determining the right size and fit of a product remains one of the biggest obstacles shoppers face when buying online. Zalando has invested heavily to help solve this issue. It acquired a virtual dressing room company in 2020,[64] has an an entire size and fit department, and is establishing a technology hub in Zurich dedicated to the task. How is Zalando using technology to solve or at least reduce these issues, and what solutions is it exploring?

What we're trying to achieve is by, probably 2030, you don't really need the physical changing room. You have the same experience everywhere. What we are doing at this stage is mostly based on data we get from our customers to help them make better choices. It's very much based on returns — why you return a certain item — and customer feedback.

We have many customers who order a very wide range of products and across brands. A customer returns an item, and another customer returns exactly the same item for the same reason, but kept a similar one. You get a data graph — a graph of fitting — and based on that we're able to make recommendations with existing customers with whom we have a deep relationship on whether items fit or not. We have already been able to reduce size-related returns by 10 percent. The next iteration of this will be when we move more towards whole-body measurements and experiment much more with 3D technology and body measurement technology.

Logistics is another complex area. How is Zalando using AI or other technologies to manage logistics?

One of the biggest tech teams we have is working on convenience and logistics. An interesting problem is where do you allocate an item with the [greatest] proximity to a customer across a warehouse network, which is very important to drive sustainability and delivery times by avoiding single-item shipments. Where you have size and brand and other items, it gets very granular. This is a very big data and algorithmic problem.

Are there features of Zalando's organisational structure that allow it to better integrate technology and data? Even companies that want to make the best use of technology aren't always set up for it. Departments might be siloed, for example, so they're not looking at the same data to make decisions.
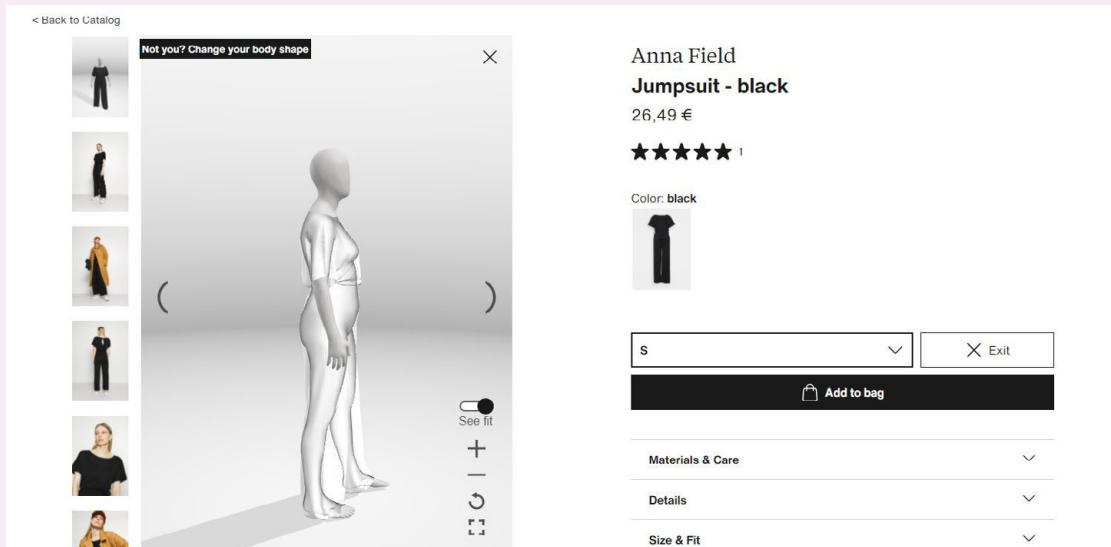
One of the big things that we at least try to do is to bring cross-functional teams together as much as we can. We have about 2,500 software engineers working at Zalando in various teams. When we have large-scale projects, we try to bring the different disciplines to the table and have them all looking at this problem.

One of the big challenges companies face is making sure all the data they're relying on is clean, and then they need to be able to derive valuable insights from it. How does Zalando tackle these challenges?

I wouldn't say we are perfect at this, but we're very focused on it. We set ownerships for specific amounts of data we produce in terms of who is responsible for it and have constant discussions about how we get better data. It's a culture of data cleanliness.

AR and VR have gained more attention as everyone talks about the metaverse. Are there emerging technologies or applications Zalando sees as being able to have a big impact in the future?

Coming back to the real-life problems of size and fit, this augmented reality space might be a good catalyst to produce real breakthroughs in terms of solving

the virtual try-on experience for customers and having definite answers if an item fits you personally or not, before you have it physically in your hand. It's something that we feel quite passionate about, that this part of the metaverse might actually help us to solve big problems on the size-and-fit and sustainability area. When it comes to a purely virtual world and to items that only live virtually, we're still exploring.

Even as e-commerce has grown, stores are still where most sales happen. In 2018, Zalando launched its Connected Retail platform to offer inventory from physical stores. How is Connected Retail progressing and how does technology enable that programme?

Throughout the pandemic obviously this scaled quite a lot, so there's now about 7,000 stores that are trading on Connected Retail. It's a big piece of the partner programme. How technology can help [is that] we actually provide [partners] with an interface. It doesn't require any integrations into a store. It requires a match of the inventory a store has with a database so that customers can order from it, and it requires a certain interface with regards to physical aspects of the logistics. In the future, where it gets much more interesting is when we are able to combine this with our local delivery efforts [to] enable customers who want to order inventory that is close by.

Zalando says it wants to have a net-positive impact — that is, running the company "in a way that gives back more to society and the environment than we take."[65] It's a big goal and something much of the fashion industry is thinking about. What role can technology play here?

I think a lot of the challenges in fashion with regards to sustainability — with regards to size and fit, overproduction, resource allocation, personalisation and so on — is fundamentally a data and collaboration problem. As fashion brands get more data-savvy in terms of their own supply chain — they don't need to be more tech-savvy but I think more data-savvy — and collaborative, we can all jointly produce a fashion ecosystem which makes more sense and is less resource-consuming.

What we're trying ourselves is to work with brands very early in the design process to make sense of how data can help the entire process. Less resources are consumed, at least for us in terms of delivery and returns. It creates more profit pools for everyone, and this can be reinvested. But generally what to me is very clear is, in the end, it's about data, it's about collaboration, data exchange. Many of the problems that we're seeing in terms of overproduction, in terms of wrong production, or not designing for circularity, can be solved in the long term.

This interview has been edited and condensed.

03.
CONNECTED STORES

The inexorable rise of e-commerce has forced fashion players to rethink the role of physical stores. Fashion executives can address consumer pain points by using in-store mobile apps to enhance the experience and micro-fulfilment technologies to leverage their physical retail networks for the quick-commerce era.

- Despite the acceleration of digital shopping habits, 60 percent of customers in Europe still want to shop in stores so they can browse and touch physical products before purchasing. In store, customers who engage with technology spend up to four times longer shopping than those who do not.

- Mobile apps provide a frictionless shopping journey for different types of shoppers, whether it's those seeking convenience or an engaging, social experience.

- Micro-fulfilment technologies enable brands to process orders efficiently from stores, reducing associated costs by up to 90 percent, and can help companies adapt to today's quick-commerce environment, thus leading to higher conversion and customer satisfaction rates.

TECH ENABLERS

- **Cloud computing** to support robotics and run advanced analytics in real time across store and distribution networks.

- **Last mile optimisation software** to boost the efficiency of order delivery.

- **Mobile applications** to optimise in-store service and customer experiences.

- **RFID** to track products and stock levels in real time.

- **Robotics** to automate order fulfilment.

- **Stock optimisation software** to automatically allocate inventory across store and distribution networks.

EXECUTIVE PLAYBOOK

1 **Assess customer needs**
Determine the different customer types the brand serves — convenience or experience shoppers — and tailor an in-store mobile app or in-store mode to optimise each customer journey.

2 **Understand pain points**
Engage with store associates to understand service pain points to develop an app dedicated to enhancing their interactions with customers. Use online and in-store engagement data to facilitate consistent, personalised service across locations and channels.

3 **Bridge online and offline**
Determine the level of investment in micro-fulfilment technologies after evaluating the volume of e-commerce orders using new omnichannel journeys (such as buy online, pick up in store (BOPIS) and buy online, ship from store (BOSFS)) in each physical retail location.

The rules of physical retail are changing. Pressure on the economics of operating stores has been mounting, particularly since more and more consumers began embracing the convenience — and safety — of e-commerce during the Covid-19 pandemic.

But physical retail is far from dead. A 2020 survey of European consumers showed that 60 percent of respondents wanted to see or touch products in-person before buying, while 50 percent shopped in stores so they can take items home immediately. As pandemic restrictions subside, the percentage of customers shopping online is expected to fall 3 percentage points from 2021 levels across key markets, including Europe, the US and China.[66] This presents an opportunity for players to reshape the role of stores in their overall retail mix.

Engagement with in-store technology can lead customers to spend up to four times longer shopping than customers who simply browse.[67] But what is the right mix of technologies to attract customers to stores, and keep them engaged when they arrive?

Experiments with in-store technologies such as magic mirrors, connected hangers and interactive holograms were once touted in the industry as a solution to declining footfall and store engagement. These have largely failed to make a meaningful impact on in-store conversion rates while requiring hefty installation costs.[68] Instead, fashion executives should direct investment towards in-store technologies that specifically address operational pain points and fit seamlessly into the customer journey.

For example, 20 percent of customers are dissatisfied with online delivery and returns.[69] Mobile-based technologies that tailor and streamline the in-store experience and micro-fulfilment technologies that incorporate stores into distribution networks could help address these challenges.

Mobile Apps for All

Brands can adapt mobile-based technology to the expectations of two distinct consumer profiles: the shopper seeking convenience and the shopper seeking experience.

For the convenience-driven shopper, mobile apps can combine digital and physical shopping experiences in an efficient end-to-end journey. Fast-fashion retailer Zara's customer app, for example, allows shoppers to book fitting rooms, see available stock, find products on the shop floor and join a virtual queue to complete a purchase.[70] The user experience of such apps needs to work seamlessly within the customer journey, and the technology can build on existing backend software, such as inventory management and point-of-sale software.

Fashion executives should direct investment towards in-store technologies that specifically address operational pain points and fit seamlessly into the customer journey.
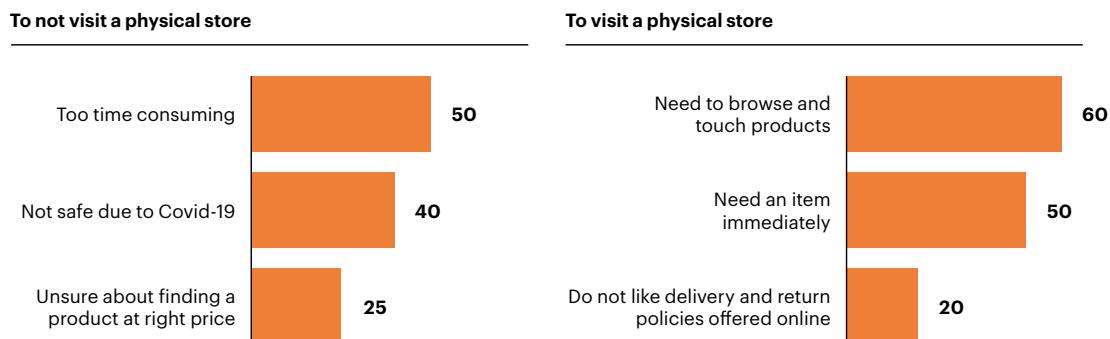
Meanwhile, for customers seeking experiences, social connections and entertainment from stores, mobile apps can help personalise visits. Nike's House of Innovation stores in New York, Shanghai and Paris aim to showcase the brand's storytelling. In New York, interactive AR challenges let customers surface animations and product information by scanning QR codes located on the shop floor.[71] The in-store experience is particularly attractive for luxury players whose customers expect brand immersion within stores. In its Shenzhen "social retail" store, Burberry encourages customers to interact on a WeChat mini-programme, post photos and access benefits such as "secret items" at the in-store café.[72]

These technologies also offer brands significant data insights into customers even if they

Technology can contribute to shoppers' reasons for visiting physical stores and address in-store pain points

TOP THREE REASONS TO VISIT, TO NOT VISIT A PHYSICAL STORE, % OF RESPONDENTS

To not visit a physical store

Reason	%
Too time consuming	50
Not safe due to Covid-19	40
Unsure about finding a product at right price	25

To visit a physical store

Reason	%
Need to browse and touch products	60
Need an item immediately	50
Do not like delivery and return policies offered online	20

SOURCE: MCKINSEY 2020 SURVEY OF EUROPEAN CUSTOMERS

do not make a purchase, through scanned product tags or tracking items taken into fitting rooms. Store associates can have apps designed for them, so that they can use this customer data and improve workflow management, such as requesting stock for a customer to be brought to the shop floor quickly.

How brands leverage available mobile technology depends on their strategic priorities. In the mass market, a high proportion of sales may already be generated through e-commerce apps. Here, a brand could develop an "in-store" mode to bolt onto an existing app. In the luxury segment, e-commerce apps commonly account for less than 10 percent of sales, which means it will be more challenging to encourage customers to adopt app-based behaviours.[73]

Improving Omnichannel Journeys

A customer's in-store experience is not the only aspect of shopping in a physical store that can benefit from a digital upgrade. Leading players are also adopting technologies that allow stores to become micro-fulfilment centres. By using

stores to fulfil online orders, brands can maintain appropriate stock levels across distribution and store networks and enable fast delivery. Conversion rates are around 50 percent higher with same-day delivery compared with two days.[74]

Some mass-market players such as Target are repurposing space within physical store networks to create micro-fulfilment centres, helping them to adapt to quick commerce and ultra-fast delivery expectations. This is often through buy online, pick up in store (BOPIS) models or buy online, ship from store (BOSFS), where the order is sent from a store where all items are in stock.[75] However, to date, most players have not gone digital. Typically, keeping track of stock is done manually and in-store stock is not integrated into overall e-commerce stock.

Stock optimisation technologies can help speed up and automate a store's value chain. For example, fast-fashion giant Inditex uses RFID product tags that feed into a single inventory system. This gives visibility into stock levels across channels, allowing for online order fulfilment

03. CONNECTED STORES

Exhibit 8:

Behind the Scenes

A Layout optimised for order fulfilment

B Robotic grids for picking and packing product

C Modular conveyors and shuttles

D Packing stations

E Optimised last-mile delivery

ILLUSTRATIVE CONNECTED STORE
SOURCE: MCKINSEY ANALYSIS
ILLUSTRATION BY JOE BOYD

from store stock. This visibility has reduced the time required for store associates to take a store inventory by 88 percent.[76]

Cloud computing is an increasingly viable enabler of micro-fulfilment centres. By running IT infrastructure in the cloud, brands can centralise their technology capabilities and collaboration, and run data analytics in real time across store networks, regardless of where they are located.

For mass-market executives looking to leverage these emerging technologies, we identify three types of fulfilment models:

- A back-office delivery centre, in which orders are fulfilled with very limited automation.
- A dedicated in-store floor section for e-commerce order fulfilment, with some degree of robotic automation.

- A "dark store," which is a physical store converted entirely into a distribution or fulfilment hub, which could be entirely automated with robotics.

The cost savings on shipping alone can be substantial with micro-fulfilment models. In 2019, Brian Cornell, chief executive of Target Corp, said that when one of its stores fulfils an online order, it costs around 40 percent less than shipping from a distribution centre to a customer. When customers order online and pick up in store, about 90 percent of the cost is saved.[77]

But without technology that can streamline the fulfilment process, from order allocation to packing, a brand will likely need either high-value orders or a boutique model with low levels of
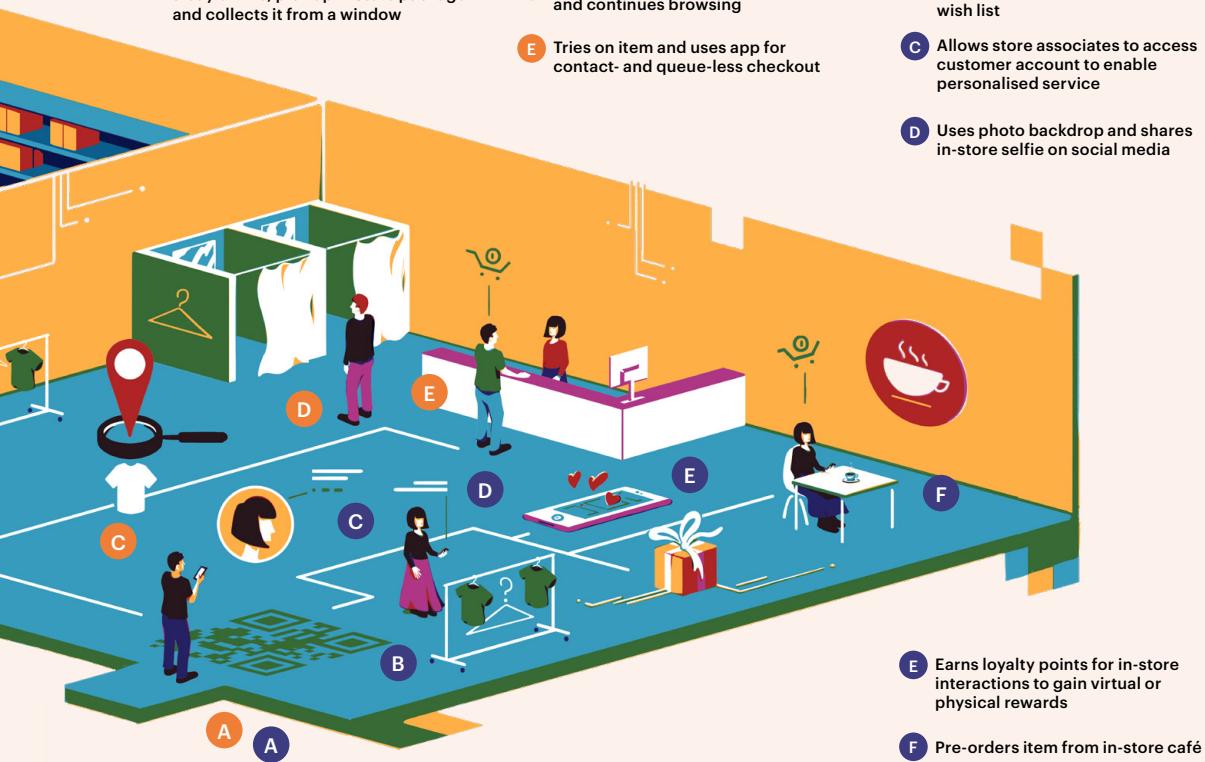
Convenience Shopper

A Switches to store mode on e-commerce app when prompted by location services

B Alerts store associate that they have a buy online, pick up in store package and collects it from a window

C Searches for a product's location and availability; places order if not in stock in store

D Joins virtual queue for fitting room and continues browsing

E Tries on item and uses app for contact- and queue-less checkout

Experience Shopper

A Scans QR code to check in to store

B Scans RFID tag to read product information, receive styling suggestions and add product to wish list

C Allows store associates to access customer account to enable personalised service

D Uses photo backdrop and shares in-store selfie on social media

E Earns loyalty points for in-store interactions to gain virtual or physical rewards

F Pre-orders item from in-store café

in-store traffic to justify manual in-store fulfilment.

Therefore, automation can play an important role across all types of fulfilment models to help brands maximise cost savings. Brands can use stock optimisation software, which incorporates all stock across their store and distribution networks; last mile optimisation software, which boosts the efficiency of allocating order delivery routes; employee task management solutions; and fully robotic set-ups that include robotic grids and arms for picking, packing and storing stock.

When deciding which stores to use for e-commerce fulfilment and what fulfilment model to pursue, executives should consider the brand's size, store density and e-commerce activity, as well as physical store locations and customer demand. For instance, luxury brands will probably not devote retail space exclusively to fulfilling orders because of the high costs of their stores' prime locations. Instead, they will focus on stock optimisation algorithms to predict the best location from which to fulfil an order and pick and pack manually — something mass-market players simply cannot afford to do. For mass-market brands, automated e-commerce order fulfilment can make financial sense if order volume is high enough and in a dense, urban area — even more so if customers are paying a premium for faster delivery.
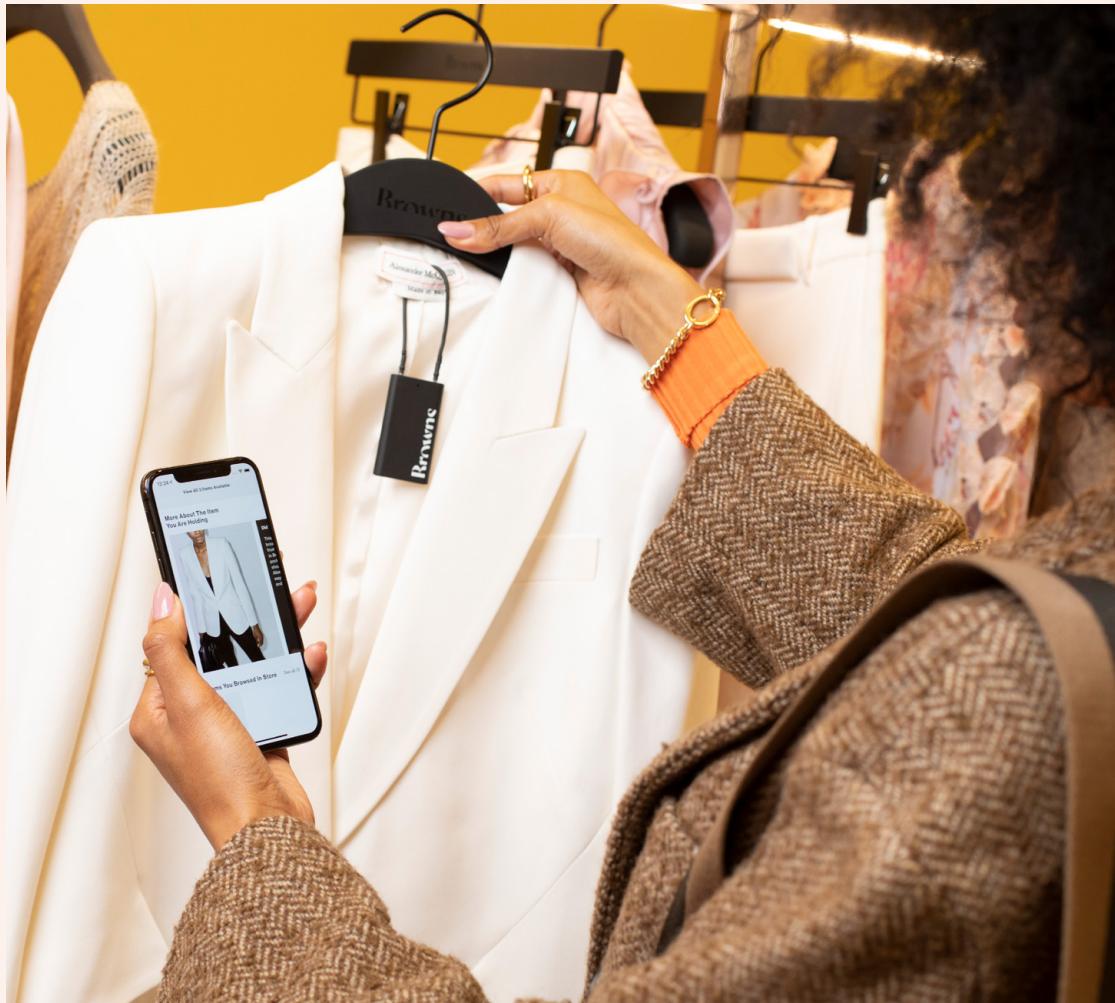
However, regardless of order volume, using inventory optimisation software to help predict the number of items returned to stores is a promising use case given that approximately 30 to 40 percent of e-commerce sales are returned.

How Luxury Brands Are Using Technology to Enhance the Customer Experience

Far from replacing the personal, face-to-face service at the heart of the luxury shopping experience, new technologies and digital channels are giving brands engaging and creative ways to enhance their customer relationships.

by Marc Bain

Farfetch-owned Browns' in-store app technology. Farfetch.

The digital tools and touchpoints that are becoming part of the luxury customer experience, ranging from apps to online channels to virtual reality, are no substitute for personal, face-to-face service in physical stores. Instead, they are enabling brands and retailers to enhance the experience.

Around 80 percent of luxury sales are influenced by digital touchpoints.[78] Even luxury fashion brands that do not sell core products such as clothing and leather goods online, such as Chanel, have websites, apps and social media accounts to connect with customers digitally. Meanwhile, brands that have historically leaned into new innovations are exploring emerging technology. For example, Gucci is using augmented reality (AR) for virtual try-on of sneakers and Burberry for uses like providing shoppers with a digital representation of its bags to better convey their shapes and sizes.[79]

> **Stores continue to be where the vast majority of sales happen, and store associates are at the centre of the luxury shopping experience.**

Still, stores continue to be where the vast majority of sales happen, and store associates are at the centre of the luxury shopping experience. Hero, Getbee, Kering's Luce and other clienteling apps designed for in-store associates to communicate with and sell to customers remotely were already on the rise before Covid-19 arrived in 2020 and became vital to many brands as the pandemic shuttered stores. Gucci, Balenciaga, Moncler and Burberry, among others, turned to clienteling as a way to stay connected with their customers. But as fashion businesses enter into post-pandemic recovery, apps are still important for enhancing the customer experience.

Clienteling 2.0

When Farfetch-owned Browns opened its new high-tech flagship in London in April 2021, it leveraged technology such as apps to connect customers directly with "what is most important in the store, [and that] is the sales associate," said Sandrine Deveaux, Farfetch executive vice president of future retail.

Browns associates use an app that provides the usual clienteling features as well as what Deveaux called a "connected retail layer." This layer allows associates to, for example, scan a QR code in the consumer-facing Browns app to connect to a shopper's account on the store's site.

Associates can then pull physical items appearing on a shopper's wishlist and recommend other relevant ones. They're also able to send a list of items the shopper showed interest in during the in-store visit to their Browns account; suggest products not in the store, since only some of Browns' extensive inventory is available on location; and provide a link so purchases can be made from their mobile phone.

"About 30 to 35 percent of the in-store sales are done from stock which is not in the store," Deveaux said. "Through that in-store app, the sales associate is really able to tell the story of this product and the consumers want to buy it even if they haven't tried it [on]."

Thom Browne, a Farfetch partner, is among those using Farfetch's technology. Its stores, which include locations in the US and Europe as well as several in China, South Korea and Japan, tend to be small and have limited space for stock so its associates use the tool to direct shoppers to its more expansive online catalogue.

Telling a Product Story

Chanel has introduced elements of Farfetch's technology at its Rue Cambon store in Paris and has been rolling it out to select locations. It is employing the tool not so much to sell products directly but to highlight the stories around them, Deveaux said. Chanel fitting rooms have RFID sensors that read tags on the items customers are trying on, allowing a connected mirror to show information such as videos and photos of items as they appeared on the runway.[80]

Meanwhile, LVMH Japan, in partnership

with investment company SoftBank, announced in February that it is accelerating efforts to allow customers at its stores to enter "virtual reality spaces" where they can communicate with artisans in real time and see manufacturing processes.[81]

Clienteling apps can play a role here as well, providing store associates with information about a collection which they can share with clients. In 2021, the Hero app also introduced a feature for associates to create short-form videos they can use to highlight specific products.

Of course, these are some of the more advanced examples of how luxury labels are using technology for the customer experience. Milton Pedraza, chief executive of research and consulting firm Luxury Institute, pointed out that few brands have yet to use clienteling apps as effectively as they could. One challenge is training staff on how to properly communicate with customers through these channels, he added.

> **E-commerce and social media are increasingly where shoppers now encounter products, a fact that has altered the relationship between brands and retailers.**

Many luxury brands are only in the early stages of collecting and deriving insights from data on customers to help them personalise their service across channels. Eventually, the aim would be to offer every shopper, or as many as possible at least, individualised service and communications, from recommending products based on their taste when they enter a store, to serving them the most relevant products when they open the brand's app to sending emails letting them know when items they might like have arrived at a store nearby.

These efforts show how brands are integrating technology and digital channels into the way they serve shoppers even in physical spaces.

LVMH Japan noted in its announcement that it is adapting "to an evolving environment which includes the expansion of online sales,

remote clienteling and support for a diversity of interests among new and younger customer segments." Burberry's "social retail" store in Shenzhen, which it created with Chinese tech giant Tencent, lets shoppers unlock content and experiences through a mini-programme in WeChat, the Tencent super app used widely in the country for messaging, payments and more.[82]

Digital Past and Present

Luxury's growing acknowledgement of the importance of digital channels is in sharp contrast to how much of the industry reacted in the early days of the internet and online shopping.

"You had to paint a picture of what the customer experience would be like," Natalie Massenet, who founded pioneering luxury e-commerce retailer Net-a-Porter in 2000, said of the challenge she faced convincing brands to sell online. It was hard for brands to believe customers would want to buy a product without having touched it. "I always used to explain to brands that that they were underestimating the fact that people were coming to make a purchase in their store already having decided to make a purchase, because they would've seen the products they wanted in fashion magazines," she added.

E-commerce and social media are increasingly where shoppers now encounter products, a fact that has altered the relationship between brands and retailers. Massenet noted that "wholesale distribution today is very much seen as a marketing function, because brands have the opportunity to go direct to consumers." Many luxury brands that do sell online are shifting to an e-concession model, where they manage the presentation and stock available through a retail partner, or they are cutting back on wholesale. Kering recently said it would cease online wholesale entirely.[83] While there are several reasons for these moves, such as better margins and control of inventory, a key motivation for brands is having a greater hold over the customer journey, before and after purchase.

Fashion businesses look set to continue to develop ways to blend digital and physical. In April,

Farfetch and Neiman Marcus Group struck a deal that will see Bergdorf Goodman's website and mobile app moved to Farfetch's backend technology platform. The companies said in a statement that Bergdorf Goodman's digital customer experience will be offered to shoppers globally and integrated seamlessly with its New York City flagship.[84]

Luxury brands also see a clear role for technology for connecting with customers beyond physical stores. The forays into virtual worlds and NFTs by several luxury players also illustrate the value they place on extending their brands online. Brands have also begun exploring how they can use technology to make customised items through small-batch production, ultimately helping their products become as personal as their service.

04.
END-TO-END UPGRADE

Digital tools and analytics have transformed key parts of the fashion value chain, but these optimisations are often siloed within organisations, limiting the potential for cross-functional improvements. Brands should embark on end-to-end value chain integration to create more efficient and more profitable ways of operating.

- More than 60 percent of fashion executives believe creating integrated digital processes throughout their organisations will be among their top-five areas for digitisation as they look ahead to 2025.

- There are very few off-the-shelf solutions that are designed to integrate the fashion value chain from end to end, meaning companies will need to build custom solutions or prioritise pain points.

- By adopting integrated, digitally enabled value chain solutions, brands could see up to a 50 percent increase in speed to market, up to 8 percent rise in full-price sell through and up to a 20 percent decline in manufacturing costs.

TECH ENABLERS

- **Artificial intelligence and machine learning** models to predict, execute or suggest business decisions along the value chain.

- **Big Data** to provide a data backbone or "common truth" across an organisation, to which other technologies are connected.

- **Cloud computing** to deliver the computing power that enables applications and data platforms to be scalable, cost effective and high performing.

- **Digital workflows** to simplify, standardise and automate internal processes.

EXECUTIVE PLAYBOOK

1 Calibrate instinct with analytics
Establish the right balance of data- and human-led decision making along value chains.

2 Prioritise journeys
Instead of developing narrow use cases, prioritise one or two "journeys" along the value chain that are most critical to business strategy and performance, including product performance, category performance, supply chain optimisation, stock management, and purchasing and demand forecasting.

3 Invest in four key enablers
Fund projects that focus on machine learning and AI models, cloud computing, digitised workflows and an overarching data backbone to unlock end-to-end integration.

4 Focus on change management
Invest in upskilling employees to support digitisation efforts — but be prepared to address potential resistance to working in a more connected way with other functions.

Fast-changing consumer demand and persistent supply chain disruptions are just a few of the factors adding to the complexity of operating a fashion brand today.

The industry needs a new digitised value chain model that unites multiple internal processes and data sources, from demand forecasting to pricing. Indeed, when it comes to digitisation, 61 percent of fashion executives believe end-to-end process management is among the most important investment areas for their organisations between 2021 and 2025.[85] The result will be more fortified, shock-resistant companies which are able to navigate today's volatile business landscape.

Many fashion companies have been improving individual value chain processes with digital technologies. But fully integrated backend systems and workflows are still a way off.

One reason is that relatively few off-the-shelf applications are designed to optimise the fashion value chain from end to end. While companies like Nextail,[86] Logility[87] and O9[88] offer solutions that address certain activities such as buying, first product allocation, replenishment and store transfers, no single solution covers the entire value chain. Brands thus need to identify solutions that address their pain points or custom build applications, which is resource intensive. At the same time, development costs remain high and companies face gaps in their technology stacks and talent pools.

Five critical workflow "journeys" in the fashion value chain lend themselves to end-to-end integration: product performance, category performance, supply chain optimisation, stock management, and purchasing and demand

Exhibit 9:

Capacity planning and end-to-end process management are executives' top digital investment priorities

EXPECTED DIGITISATION INVESTMENT PRIORITIES (2021-2025)
% OF RESPONDENTS

■ Ranked as investment priority 1
■ Ranked as investment priority 2-5

Category	Priority 1	Priority 2-5	Total
Capacity planning	5	61	66
End-to-end process management	24	37	61
Virtual sampling	24	34	58
Virtual fabric libraries	11	44	55
Supply chain transparency and traceability solutions	8	47	55
Supplier collaboration portal	3	34	37
Advanced intelligence for country and supplier selection	3	32	35

SOURCE: MCKINSEY APPAREL CPO SURVEY 2021
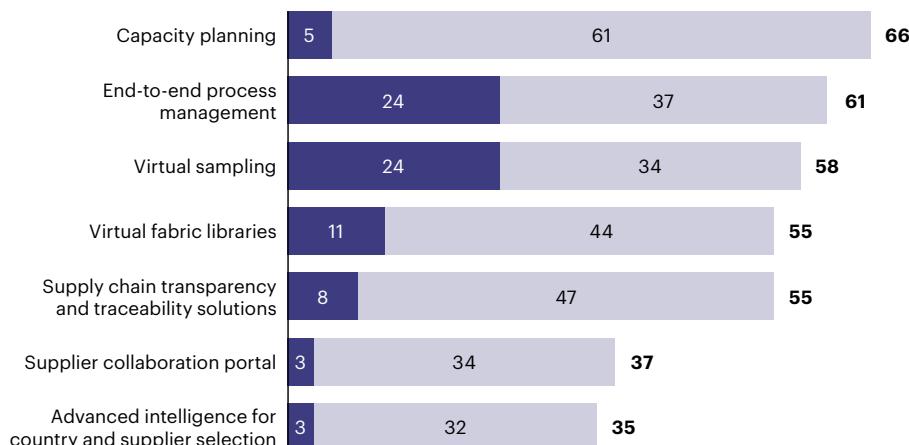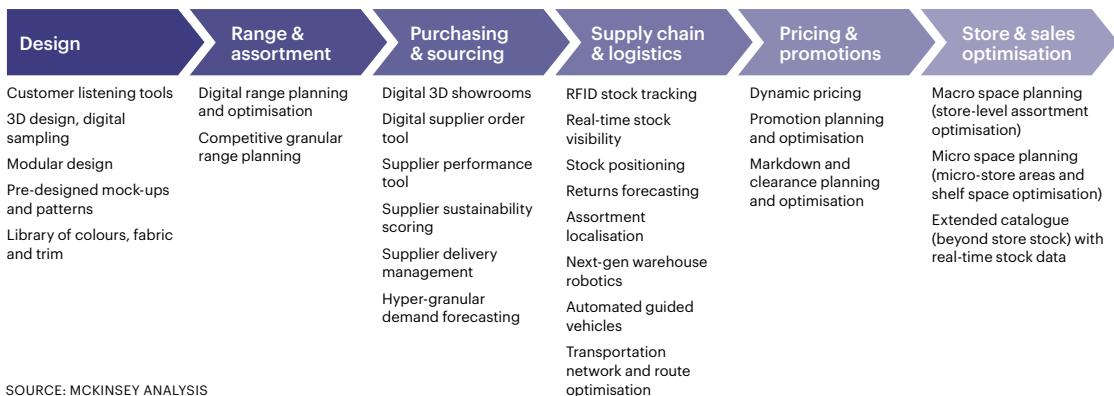
Digital applications need to be connected along the value chain

Design	Range & assortment	Purchasing & sourcing	Supply chain & logistics	Pricing & promotions	Store & sales optimisation
Customer listening tools	Digital range planning and optimisation	Digital 3D showrooms	RFID stock tracking	Dynamic pricing	Macro space planning (store-level assortment optimisation)
3D design, digital sampling	Competitive granular range planning	Digital supplier order tool	Real-time stock visibility	Promotion planning and optimisation	Micro space planning (micro-store areas and shelf space optimisation)
Modular design		Supplier performance tool	Stock positioning	Markdown and clearance planning and optimisation	Extended catalogue (beyond store stock) with real-time stock data
Pre-designed mock-ups and patterns		Supplier sustainability scoring	Returns forecasting		
Library of colours, fabric and trim		Supplier delivery management	Assortment localisation		
		Hyper-granular demand forecasting	Next-gen warehouse robotics		
			Automated guided vehicles		
			Transportation network and route optimisation		

SOURCE: MCKINSEY ANALYSIS

forecasting. Integrating key parts of a value chain journey could make speed to market up to 50 percent faster, full-price sell-through up to 8 percent higher and manufacturing up to 20 percent less costly.[89]

Integrating key parts of a value chain journey could make speed to market up to 50 percent faster.

Product performance, or assessment of which products are selling well — shows the impact of end-to-end integration in practice. A siloed pricing and promotions application might use AI and machine learning to determine a product's promotional price by analysing the current stock, in-season price, time in season and expected elasticity. By contrast, investing in end-to-end integration would expand the scope of the application to also consider similar products already in store or arriving soon, as well as expected returns or a competition range. Each of these data points impact expected sell-through and

thus the appropriate promotional pricing, which can ultimately boost gross margins.

At Levi's, company-wide machine learning combined with a cloud-based data repository containing internal and external sales and inventory information provide multiple processes with resources to make better decisions around everything from pricing to consumer marketing, according to chief strategy and AI officer, Katia Walsh. Data-driven knowledge-sharing also helps Levi's determine the best locations from which to ship its products, identifying the store or distribution centre that is the closest to the shipping address, helping it to control logistics costs and manage store inventory smoothly.[90]

Shein takes this even further. Not only has the ultra-fast fashion player integrated its internal processes, but it has also linked those internal processes with that of its suppliers. This enables a fast and efficient ordering and replenishment journey. Shein uses AI modelling to evaluate millions of social media posts across platforms to determine which products to produce, while advanced analytics help its design teams review

the performance of design attributes down to details like the zipper and fabric. With its vertically integrated supply chain using software from Singbada,[91] Shein's designs could reach customers within approximately three weeks after they are first conceived.[92]

Executives should be prepared to address potential resistance to working in a more connected way, one in which data, and knowledge, flow across processes seamlessly.
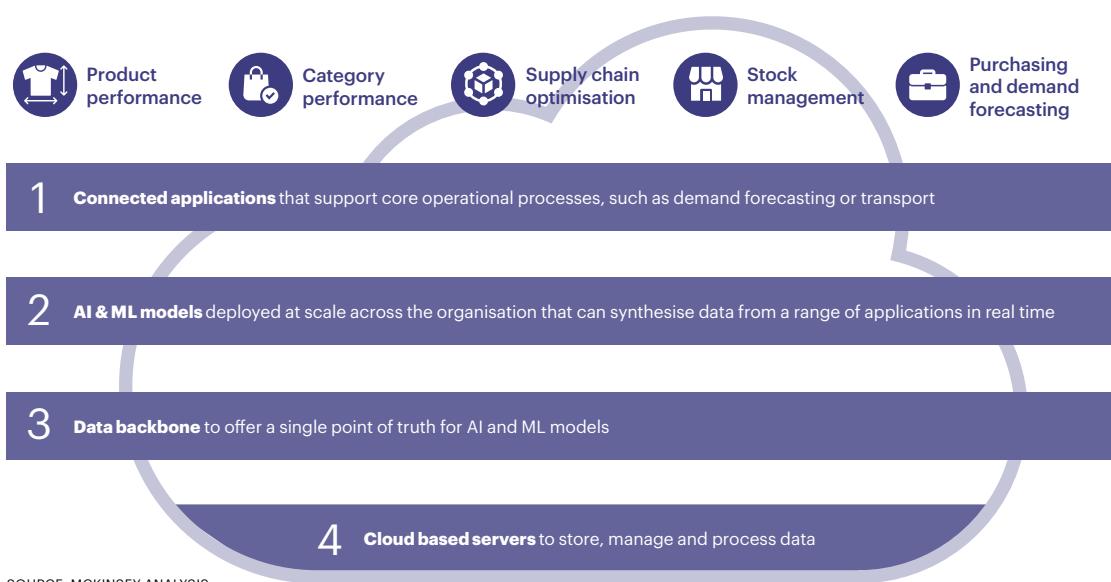
To be sure, fashion players' operating models will continue to require a finely tuned balance of art and science to not lose sight of the creative, experience-focused aspects of decision-making which are critical in fashion. Executives

should be prepared to address potential resistance to working in a more connected way, one in which data, and knowledge, flow across processes seamlessly. Embracing deep digital integration will require focusing on change management. Teams will need to be upskilled or reskilled, and tools will need to be designed with a user-centric mindset to ensure their adoption. For example, this may mean adopting "explainable AI" whereby AI predictions and outputs can be easily understood and managed by humans, unlike "black-box" models that are difficult to interpret, and therefore trust.

Ultimately, fashion companies — from mass market to luxury alike — will benefit from optimising their time to market, flexibility and product availability at a time when many companies are struggling to maintain margins. Value chain integration will prove to be a critical point of competitive differentiation.

Exhibit 11:

Value chain integration can be achieved by combining multiple layers of technology

- Product performance
- Category performance
- Supply chain optimisation
- Stock management
- Purchasing and demand forecasting

1 **Connected applications** that support core operational processes, such as demand forecasting or transport

2 **AI & ML models** deployed at scale across the organisation that can synthesise data from a range of applications in real time

3 **Data backbone** to offer a single point of truth for AI and ML models

4 **Cloud based servers** to store, manage and process data

SOURCE: MCKINSEY ANALYSIS

05.
TRACEABILITY FIRST

Traceability systems powered by tracking software and Big Data will help fashion brands focusing on sustainability reach far into their supply chains to understand the entire lifecycle of their products.

- More than 50 percent of fashion decision makers say traceability will be a top-five enabler to reduce emissions in their supply chains, but many brands at best currently only have visibility over their suppliers with whom they have direct relationships.

- Creating a centralised system for sustainability metric calculations, data collection and supply chain traceability is essential to make meaningful progress against social and environmental goals.

- To accelerate advancements in traceability, fashion companies should invest in emerging technologies like digital ledgers, be willing to open source their own solutions, and collaborate with start-ups and industry peers.

TECH ENABLERS

- **Big Data** to process large, complex supply chain-related data sets with AI and machine learning models.

- **Blockchain,** a form of digital ledger, to assign immutable, trackable digital product information.

- **Product passports** to host traceable sustainability and authenticity product data.

- **RFID tags and readers** to store product information and track products in real time.

EXECUTIVE PLAYBOOK

1 **Lay the foundations** Engage directly with suppliers and work with industry bodies, start-ups and peers to develop a standard for measuring sustainability performance, supported by a clear data framework.

2 **Prioritise impact areas** Adopt robust metrics to assess which areas of the supply chain or business practices have the biggest environmental and social impact, and support the monitoring of those metrics by developing or investing in tech solutions.

3 **Scale solutions** Adopt software and Big Data technologies to automate data gathering, regardless of how large, or how complex, the supply chain. Open source successful technologies to enable wider industry progress towards a common data standard or even a data platform.

More than ever, fashion brands are being held accountable for their environmental and social impact. In terms of greenhouse gas emissions alone, it is estimated that the industry is accountable for 2.1 billion tonnes (or 4 percent of the global total), a figure that it set to rise if action is not taken.[93]

Brands are largely ill-equipped to monitor and manage social and environmental practices across their supply chains, including greenhouse gas emissions, of which only 6 percent on average is generated from their direct operations. Fashion players are operating with very limited visibility of their supply chain beyond their tier one suppliers with whom they have direct relationships.[94]

Now, new legislation and the increased frequency of supply chain disruptions, alongside consumer and investor pressure, are forcing corporate action.

If fashion brands are to achieve sustainability objectives, ranging from better materials sourcing to improved regulatory compliance to emissions reduction, they will need to establish full line of sight into how their products are manufactured.

Currently, the industry's traceability efforts are hampered by manual processes and unreliable data.

Complete traceability entails brands identifying the history, location and distribution of product parts and materials throughout all stages of the supply chain — including contractors and subcontractors. More than 50 percent of fashion decision makers say traceability will be a top-five enabler to reduce emissions in their supply chain before 2025.[95] This visibility provides stakeholders with information that can inform sustainability-related decisions:[96] [97]

- **Regulatory compliance:** Traceability plays a critical role in helping companies proactively respond to the fast-evolving regulatory landscape, including in the US, where the Securities and Exchange Commission has proposed its Enhancement and Standardization of Climate-Related Disclosures for Investors. This new rule will require US-listed companies to disclose emissions from tiers one, two and three of their supply chains. Also on the horizon is the EU's proposed legislation as part of its Green Deal that will set mandatory minimum levels for recycled content in products and will require digital twins for products that contain sustainability information to combat misleading marketing, or "greenwashing."[98] [99]

- **Investors and the ESG imperative:** Similarly, companies need a greater grip on traceability to demonstrate to the financial community how they are meeting investment criteria relating to environmental, social and governance targets.[100]

- **Customer expectations:** Finally, customers are increasingly calling on brands to be better equipped to assess and disclose their sustainability claims. In China, 25 percent of customers rank sustainability as one of the top three factors that they considered when purchasing luxury products.[101] In Europe, 60 percent of fashion customers say transparency is important. While just 20 percent currently seek out this information when purchasing, the percentage of customers who are acting on these interests is starting to increase — particularly among younger generations.[102]

Currently, the industry's traceability efforts are hampered by manual processes and unreliable data. This is exacerbated by the lack of industry-wide standards, leaving both brands and their suppliers to struggle with tracking and aggregating data.

For traceability to operate successfully at scale, a common data language is essential. This will create the level of standardisation required for comparability and allow manufacturers and

suppliers to share data more easily with multiple brands, encouraging a higher level of buy-in across the value chain. To achieve a common language, brands will need to collaborate, both in terms of the types of data collected and the way in which key metrics like water usage and emissions are compiled and assigned on a product level.

The industry is showing promising initial signs of moving closer to this objective of great collaboration. Companies such as Kering, LVMH, Fast Retailing and Inditex have adopted the Taskforce on Climate-Related Financial Disclosures to align on how they assess and disclose climate risks and opportunities.[103] Some initiatives offer certification labels (such as Cradle to Cradle)[104] or self-assessment tools (like the Higg Index,[105] developed by the Sustainable Apparel Coalition, an industry-wide non-profit).[106]

There are concerns, voiced by players such as the Changing Markets Foundation, that the fragmented nature of these schemes makes comparability and a holistic and granular view of impact difficult.[107] As industry-wide labelling standards emerge (along with mechanisms to validate the data), consolidation of traceability and impact tracking standards will likely occur and will be an important enabler for the acceleration of traceability efforts given the network effects of such solutions.
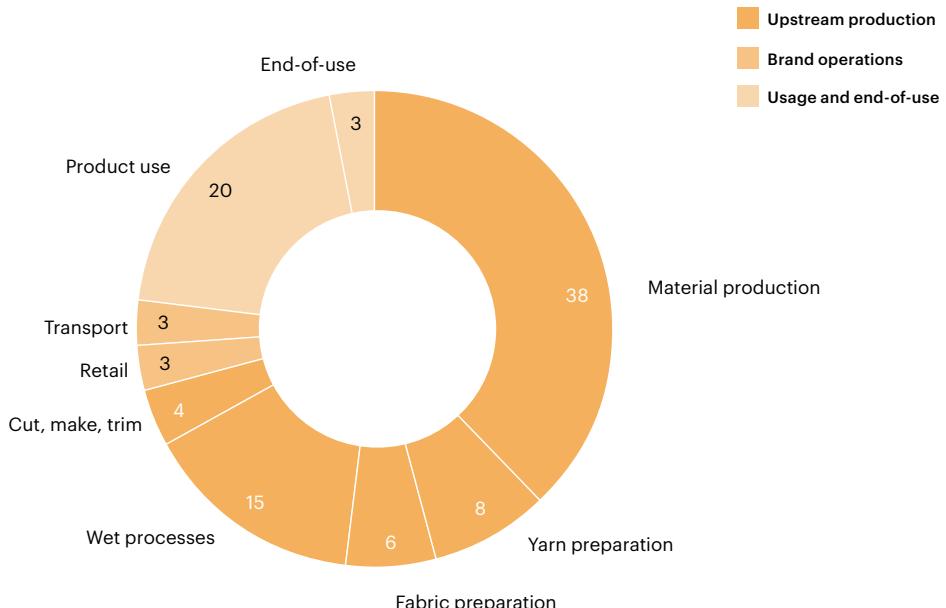
The Power of Data

Technology will be critical for the development and adoption of a common data language. Given the complexity and fragmentation of value

Traceability is a key to unlocking the sustainability challenge

APPAREL AND FOOTWEAR GREENHOUSE GAS EMISSIONS, %, 2018

Legend:
- Upstream production
- Brand operations
- Usage and end-of-use

End-of-use — 3
Product use — 20
Transport — 3
Retail — 3
Cut, make, trim — 4
Wet processes — 15
Fabric preparation — 6
Yarn preparation — 8
Material production — 38
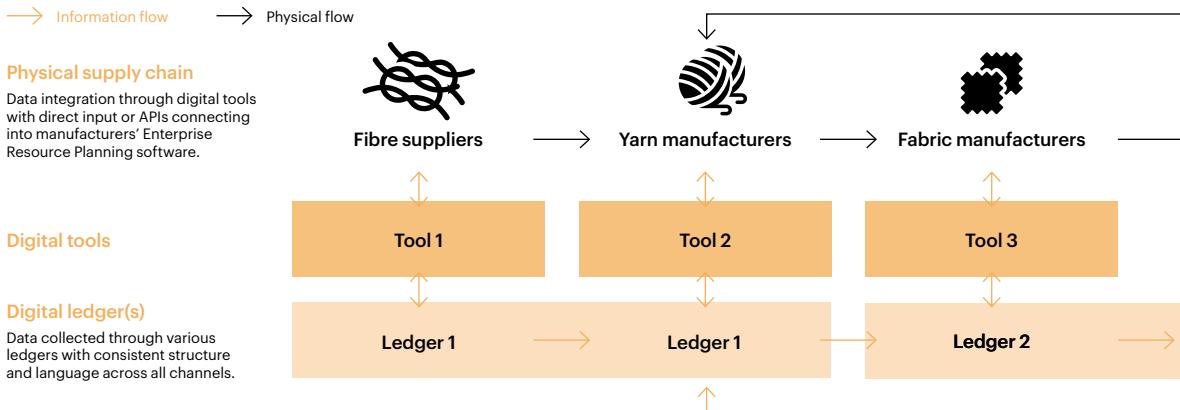
SOURCE: GLOBAL FASHION AGENDA AND MCKINSEY FASHION ON CLIMATE REPORT, 2020

Exhibit 13:

A standardised data format is necessary to scale traceability

ILLUSTRATIVE VALUE CHAIN

SOURCE: MCKINSEY ANALYSIS

chains, brands —particularly large ones — will require tracking software for data gathering and marshalling. Brands can look to establish a decentralised ledger (a peer-to-peer shared database with no central administrator) to efficiently collect and distribute data and ensure its reliability — the data within digital ledgers is immutable. These ledgers may be open source or owned by individual brands, or third-parties and start-ups could create data interfaces for specific segments of the value chain.
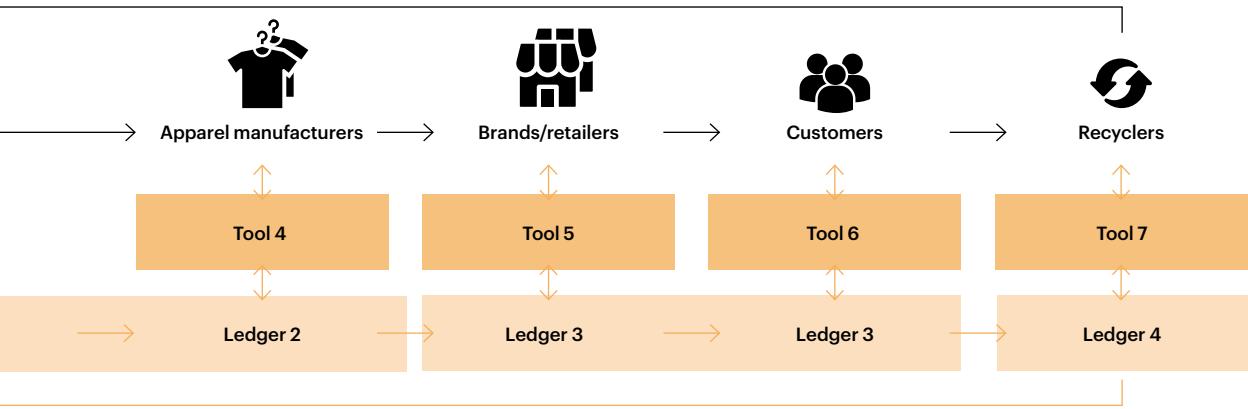
Such traceability systems — whereby each entity along the value chain inputs data — are far from a reality today. However, pilots are running to test platforms that enable brands to track garments through the supply chain, alongside implementations of off-the-shelf solutions connecting suppliers and brands' data systems. For example, TextileGenesis, which uses blockchain-based technology to assign a trackable digital token to recycled and organic fibres, has partnered with Fashion for Good, Lenzing and other organisations as well as retailers such as Bestseller, Kering, Zalando and H&M Group to use the technology to validate whether fibres originate from

sustainable sources.[108]

Meanwhile, TrusTrace offers a centralised database of certifications and other evidence to document the sustainability claims from retailers, manufacturers and suppliers, as well as third parties such as certification agencies. Adidas, which has targets to use only recycled polyester by 2024 and to make 90 percent of its products in a way that is more sustainable by 2025, will use TrusTrace's software to track all certified materials used in its products in the next two years.[109]

Owing to the complex and fragmented nature of the value chain, technology is the key enabler to achieving traceability.

In addition, companies such as Applied DNA Sciences are experimenting with physical (for example, RFID) and molecular trackers that can be applied to products at various stages of manufacturing and can store product information.[110] Thread manufacturer American & Efird has adopted molecular trackers to

Apparel manufacturers	Brands/retailers	Customers	Recyclers
Tool 4	Tool 5	Tool 6	Tool 7
Ledger 2	Ledger 3	Ledger 3	Ledger 4

authenticate some lines of recycled thread.[111] However, just 10 percent of senior fashion executives have invested in such physical "track and trace" solutions when seeking to address supply chain visibility and traceability.[112]

Knowledge Sharing

For traceability initiatives to have a meaningful impact, brands will need to be more open about proprietary knowledge about their supply chains. Collaboration is required to achieve a common good. This is happening in some parts of the industry. The Aura Blockchain Consortium has united LVMH, Prada and Richemont-owned Cartier on a shared platform to solve traceability challenges by developing blockchain-based "product passports" for luxury goods.[113] This would provide verified information relating to a product's entire lifecycle. In addition, H&M Group has launched an open-source B2B service called Treadler to grant industry peers access to its suppliers list. H&M vets suppliers using Higg data and shares information as a paid-for service to allow other brands to engage with H&M-vetted

suppliers without having to conduct their own assessment.[114]

The onus will be on big brands with the capital to invest — and, ultimately, the biggest footprints — to lead the charge. It is likely that over time a handful of data platforms will emerge as principal solutions, so there is a potential return on investment for brands who can help develop them.

Traceability will put the industry on track towards a more transparent, accountable future, ensuring that investors, consumers and regulators can interact with brands based on sustainability information they can trust. What's more, traceability will be critical in establishing a competitive business model. Owing to the complex and fragmented nature of the value chain, technology is the key enabler to achieving traceability. With this, brands need to embrace a new, collaborative mindset to enable information sharing, while extending tools and providing training and support to their suppliers so that they are also able to embrace a more traceable industry.

GLOSSARY

Avatar
A digital image or graphic representation of a real person used in virtual worlds such as computer games or social media.

Category performance
Measures the performance metrics of a product category – e.g. units sold, revenue, full-price sell through.

Clienteling apps
Apps used by store associates to guide consumers through their in-store shopping journey. These apps can enable associates to, for example, access customer loyalty data and inventory information or act as a point of sale.

Cryptocurrency
(e.g. Bitcoin, Ethereum, Solana) A type of digital asset built on the blockchain that represents encrypted currency, which can help prevent counterfeiting, among other uses. It can be "mined" (created) or purchased from special exchanges. No official authority or government produces, monitors or regulates cryptocurrency.

Customer listening tools
AI technology that tracks what customers say on social media in real time, capturing the "mood" or sentiment of posts.

Dark store
A physical retail facility that could be a conventional store but is not open to the public. Instead, it houses goods to fulfil online orders.

Data backbone or data lake
A centralised storage repository that holds large amounts of data in different formats (raw, curated, analytical, structured or unstructured) until analysed.

Digital twin
A virtual asset associated with a physical object or process. It can include coded information about an object or garment's full history from manufacturing (such as the type of dyeing production used) to transportation (such as the location of distribution facilities) and information about the purchase aftercare, repairs and resale.

First-party (1P) data
Data collected from customers via a brand or retailer's own channels (such as a website, app or in store), enabling businesses to use data in a privacy-complaint and cost-effective way.

Generation-Z (Gen-Z)
Demographic cohort born c. 1996–2012, following the Millennial generation.

Last mile optimisation software
Manages deliveries from the warehouse to customer, comprising route optimisation, advanced dispatching, customer alerts, proof of delivery and analytics that help reduce delivery frequency and minimise delivery time and distance.

Magic mirrors
Also referred to as smart or connected mirrors, magic mirrors feature Wi-Fi-connected displays behind the mirror, providing useful features such as additional lighting or sound.

Molecular trackers
Chemicals that are applied to yarn or fabric at various points in the supply chain that can be traced or scanned to understand a garment's materials. Some may even be paired with a digital twin to store further information on product origin, manufacturing and sustainability credentials.

Non-fungible token (NFT)
An entry on a blockchain recording a unique digital asset (e.g. images or videos) and its owner, enabling the documentation of any sale or transfer of the item. Often associated with the metaverse, NFTs are a building-block technology that will allow for true ownership of digital goods.

Product performance
Measures the performance metrics of a specific SKU – e.g. units sold, revenue, full-price sell through.

QR code
A matrix barcode that is readable by machines and, when scanned, can contain information about the item to which it is attached or associated.

Stock optimisation software
Allows businesses to manage inventory location and use. The software may use technology such as AI to provide real-time, adaptive stock visibility, allowing fashion players to fully utilise all stock.

Supply chain optimisation
Processes to improve supply chain operations, from manufacturing and transportation to distribution, often leveraging digital and AI tools.

Third-party (3P) data
Data that is purchased from external sources such as aggregators, which are not the original collectors of the data. The third parties purchase data from other sources across the web to aggregate, segment and resell.

Traceability
The ability to identify and monitor the history, distribution, location and application of materials, parts and finished goods to understand the sustainability of practices relating

to issues including human rights, health and safety and environmental impacts.

Virtual fashion and skins
The visual representation of fashion items created with technology and 3D software to be applied, for example, to social media images or to alter the appearance of avatars in games.

Virtual goods
Intangible objects traded in online communities or marketplaces, to be used either in virtual worlds or as collectibles.

Virtual sampling
A digitised, three-dimensional product development process, enabling designers to create virtual samples simulating movement, stretch and use.

Web3
The next phase of the internet using a decentralised, peer-to-peer model powered by blockchain technology on which apps and platforms would be built.

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INFOGRAPHICS

1. Metaverse Reality Check
Source: McKinsey expert analysis

2. Hyper Personalisation
Source: Nidhi Arora, Wei Wei Liu,
Kelsey Robinson et al., "The value
of getting Personalisation right, or
wrong, is multiplying," McKinsey &
Company, November 12, 2021

3. Connected Stores
Source: McKinsey & Company
Modern Retail Collective

4. End-to-End Upgrade
Source: McKinsey Apparel CPO
Survey 2021

5. Traceability First
Source: McKinsey Apparel CPO
Survey 2021

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