

E-Commerce Study Using AR/VR and Ethical Convergence of Commerce

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Abstract

The landscape of E-commerce is undergoing a fundamental transformation, shifting from a platform-centric model of transactional exchange to an immersive, ecosystem-driven experience. This analysis examines the critical trends and disruptive forces that define the immediate and long-term trajectory of digital commerce. The study identifies three foundational pillars driving future growth: Hyper-Personalization via Generative AI, Spatial Commerce (AR/VR Integration), and Sustainable Supply Chain Resilience. Future E-commerce will be characterized by the disappearance of the traditional "checkout line" in favor of an ambient shopping experience where predictive algorithms anticipate consumer needs long before a search query is initiated. Generative AI will revolutionize content creation, customer service, and dynamic pricing models, while the rise of the Metaverse and sophisticated AR tools will blur the physical and digital divide, enabling virtual product trials and collaborative shopping environments. Crucially, the analysis posits that the primary strategic challenge for businesses will not be technological adoption, but the ethical convergence of efficiency and transparency, balancing data-driven scaling with radical environmental and consumer privacy demands. The future of E-commerce is not merely faster transactions, but the creation of intelligent, responsible, and perpetually adaptive retail entities.

Keywords: E-Commerce, augmented reality (AR), virtual reality (VR), ethical convergence, digital marketplace

INTRODUCTION

The digital marketplace is no longer a nascent frontier; it is the bustling metropolises of modern commerce. E-commerce, once a niche convenience, has irrevocably reshaped how we shop, sell, and even conceive of ownership. But clinging to yesterday's digital storefronts is a recipe for obsolescence. The future of e-commerce is not just about online transactions; it is about intelligent, immersive, and deeply personalized experiences that blur the lines between the physical and digital.

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The bedrock of this evolution is data, refined and democratized. Gone are the days of broad demographic targeting. The future belongs to hyper-personalization, driven by sophisticated AI and machine learning that can anticipate needs before they are even articulated. Imagine a virtual stylist curating your entire wardrobe based on your upcoming events, weather patterns, and even your mood, or a grocery platform suggesting recipes based on the contents of your digital pantry. This is not science fiction; it is the inevitable trajectory of e-commerce, moving from reactive suggestions to proactive fulfillment [1]. This personalization will extend beyond product recommendations to frictionless, integrated shopping journeys. The

concept of separate websites and apps will fade. Instead, we will see a seamless continuum from social media discovery to in-app purchases, voice commands to augmented reality try-ons. Think of a TikTok influencer showcasing a new piece of furniture, allowing viewers to tap a button and virtually place it in their living room via AR, then complete the purchase within the same platform. Conversational commerce, powered by chatbots and virtual assistants, will evolve beyond basic FAQs to become sophisticated shopping companions, guiding users through complex decisions and facilitating instant transactions [2].

Beyond the screen, physical retail will undergo a digital metamorphosis. The "omnichannel" buzzword is quickly becoming a fundamental operating principle. Future physical stores will be less about inventory and more about experience. Think "showrooms" where customers can touch, feel, and try products, with everything else handled by a seamless digital backend for immediate home delivery or click-and-collect. This blended approach leverages the strengths of both worlds, offering tactile engagement alongside the convenience and vast selection of the online realm. Dark stores and micro-fulfillment centers, strategically located in urban areas, will become the silent engines powering lightning-fast local deliveries, further blurring the lines for consumers who expect instant gratification.

The very definition of "product" is also expanding. The rise of subscriptions and services over single purchases is a significant trend. Consumers are increasingly valuing access over ownership, opting for curated boxes of goods, streaming entertainment, or on-demand services delivered directly to their door. This recurring revenue model provides stability for businesses and predictable convenience for customers, fostering deeper relationships and loyalty.

Furthermore, sustainability and ethical sourcing are no longer niche concerns but powerful purchasing drivers. Future e-commerce platforms will need to be transparent about their supply chains, carbon footprints, and labor practices. Consumers will actively seek out brands committed to eco-friendly packaging, ethical manufacturing, and circular economy principles, driving innovation in sustainable logistics and product design [3].

However, this future is not without its challenges. Concerns around data privacy and security will intensify, demanding robust ethical frameworks and transparent data handling practices. The increasing reliance on AI will necessitate careful consideration of algorithmic bias to ensure equitable experiences for all consumers. And the environmental impact of increased shipping and return volumes will require innovative solutions in packaging, logistics, and waste reduction.

The e-commerce landscape of tomorrow will be a dynamic ecosystem, driven by innovation and shaped by evolving consumer expectations. It will be a world where personalization is paramount, convenience is instantaneous, and ethical considerations are woven into the fabric of every transaction. For businesses to thrive, they must embrace this fluid reality, constantly adapting, experimenting, and prioritizing the creation of seamless, intelligent, and ultimately human-centered digital experiences. The future of shopping is not just online; it is wherever the customer is, and it is evolving at the speed of a click [4].

ETHICAL CONVERGENCE OF COMMERCE

For centuries, ethics and commerce often stood as uneasy bedfellows, essential to society, yet frequently perceived to operate on divergent principles. Profit, swift transactions, and market dominance were the currency of commerce, while ethics concerned themselves with fairness, transparency, and human well-being. But in the lightning-fast, borderless realm of e-commerce, this traditional tension is not merely being examined; it is undergoing a profound convergence, where ethical considerations are no longer an afterthought but an intrinsic, often indispensable, component of commercial success [5].

This "ethical convergence" is not simply about adding ethical checkboxes to a business model; it is about a fundamental shift in the DNA of digital commerce. It suggests that the most successful and

resilient e-commerce enterprises of tomorrow will be those that seamlessly integrate ethical principles into their core operations, product design, marketing, and customer engagement.

Several Powerful Forces Are Driving This Convergence:

- *The hyper-empowered consumer:* The digital age has birthed the "conscious consumer". Armed with information, social media platforms, and a global megaphone, today's shoppers demand more than just competitive pricing. They want to know where products come from, how they are made, the environmental footprint, and whether the companies they support align with their values. Ethical lapses, once easily swept under the rug, now spread virally, inflicting irreparable damage to brand reputation and market share.
- *Regulatory scrutiny and data governance:* The sheer scale of data collection in e-commerce has led to a global awakening around privacy. Regulations like GDPR, CCPA, and an expanding web of consumer protection laws are forcing companies to adopt ethical data practices by design, not by default. The cost of non-compliance, in both fines and lost trust, makes ethical data handling a core commercial imperative.
- *Technological enablers of transparency:* Paradoxically, technology itself is facilitating this ethical convergence. Blockchain can offer immutable ledgers for supply chain transparency, allowing consumers to trace a product's journey from raw material to doorstep. AI, while posing its own ethical dilemmas, can also be leveraged to audit for bias, identify unethical labor practices in complex supply chains, or personalize ethical choices for consumers.
- *Brand value and talent acquisition:* In a crowded digital marketplace, ethical practice is becoming a potent differentiator. Companies known for their integrity, sustainability, and fair dealings cultivate fierce customer loyalty. Moreover, attracting and retaining top talent increasingly depends on demonstrating a commitment to purpose beyond profit. Employees, especially younger generations, seek employers whose values mirror their own.

This Ethical Convergence Plays Out Across Multiple Facets of E-Commerce:

- *Data ethics:* Moving beyond mere compliance, ethical data usage involves explicit consent, anonymization, secure storage, and transparency about how data shapes personalized experiences and advertising. It means rejecting "dark patterns" that trick users into revealing more than intended.
- *Algorithmic fairness:* E-commerce relies heavily on algorithms for recommendations, pricing, and search results. Ethical convergence demands these algorithms are free from bias, do not exploit vulnerabilities, and offer a level playing field for both consumers and sellers. Transparency about algorithmic decision-making, where possible, builds trust.
- *Supply chain responsibility:* The global nature of e-commerce often obscures the human and environmental costs embedded in production. Ethical convergence calls for rigorous auditing, fair labor practices, sustainable sourcing, and a commitment to reducing the environmental impact of manufacturing and shipping.
- *Environmental stewardship:* From packaging waste to energy consumption of data centers, e-commerce has a significant ecological footprint. Ethical convergence means investing in sustainable logistics, offering eco-friendly product lines, carbon offsetting, and promoting a circular economy.
- *Digital inclusion and accessibility:* For e-commerce to be truly ethical, it must be accessible to all. This means designing platforms that are user-friendly for people with disabilities, bridging the digital divide, and ensuring fair access regardless of socio-economic status.

The ethical convergence of commerce in e-commerce is not a fleeting trend or a niche concern for a few enlightened businesses. It is the inexorable evolution of a rapidly maturing industry. Those who embrace it will not only secure a more sustainable competitive advantage but will also contribute to a more just and responsible digital economy. It is the challenge and the promise of our age: to prove that profit and principle can, and indeed must, thrive together in the ever-expanding universe of online trade.

The future of e-commerce belongs to those who build bridges between conscience and code, creating value that extends far beyond the bottom line [6–8].

AR/VR IN E-COMMERCE

Imagine standing in your living room, phone in hand, not just browsing for a new sofa, but seeing it there, life-sized, sunlight glinting off its virtual fabric, perfectly complementing your rug. Or perhaps you are slipping on a digital pair of glasses, watching them conform to your face in real-time, before a single physical frame is ever shipped. This is not science fiction; it is the nascent, exhilarating reality of AR/VR integration in e-commerce, a transformative wave poised to redefine how we discover, interact with, and ultimately purchase goods [9, 10].

For years, e-commerce has been a double-edged sword: boundless convenience paired with a persistent, tactile void. The inability to touch, feel, or truly visualize a product beyond a static image or a 360-degree spin has been the industry's Achilles' heel, contributing to high return rates and a lingering sense of buyer's remorse. Enter Augmented and Virtual Reality, the digital architects ready to bridge this physical-digital chasm, rendering the limitations of the flat screen obsolete.

Augmented Reality (AR) leads the charge with its immediate accessibility, leveraging the ubiquitous smartphone. Brands are already deploying AR which allows customers to project 3D models of products into their real-world environment. Think IKEA Place, which lets you "try on" furniture in your home before buying, or Sephora's Virtual Artist, allowing users to experiment with makeup shades in real-time. This is not just a novelty; it is a powerful decision-making tool that reduces guesswork, boosts buyer confidence, and significantly cuts down on costly returns. For fashion, AR-powered virtual try-on apps are evolving beyond simple overlays, using advanced tracking to simulate fabric drape and fit, creating a personalized dressing room wherever the customer may be.

Virtual Reality (VR), while requiring more specialized hardware, promises an even deeper dive into immersive retail. Picture a luxury car showroom, meticulously recreated in VR. You can "walk" around the vehicle, open doors, sit inside, customize features, and even take a virtual test drive, all from the comfort of your home. High-end fashion houses are experimenting with VR "boutiques" that transcend geographical barriers, offering an exclusive, curated shopping experience. For complex products like industrial machinery or specialized electronics, VR can provide interactive demonstrations and detailed explorations of internal components, fostering a level of understanding impossible through traditional online catalogs. The nascent metaverse vision further amplifies this, envisioning interconnected virtual shopping districts where avatars browse, socialize, and make purchases in entirely new digital economies.

The benefits extend far beyond individual transactions. For brands, AR/VR offers unparalleled opportunities for differentiation and engagement. It transforms passive browsing into an interactive, memorable experience, fostering stronger emotional connections with products and cultivating brand loyalty. Data gathered from these interactions: what products customers linger over, what customizations they gravitate towards, can provide invaluable insights for product development and personalized marketing. Moreover, it democratizes access to luxury and specialized retail, allowing a global audience to experience offerings that were once limited by physical location.

However, the integration is not without its hurdles. The creation of high-quality 3D assets for thousands of products is a significant investment. Ensuring seamless user experience across a myriad of devices, addressing potential "digital fatigue" or motion sickness in VR, and establishing robust data privacy protocols are critical challenges. The accessibility of high-end VR headsets is still a barrier for mass adoption, though advancements in standalone devices and "pass-through" AR are rapidly lowering this threshold.

Despite these challenges, the trajectory is clear. As AR/VR technology matures, becomes more affordable, and further integrates with AI-driven personalization, its presence in e-commerce will shift from novelty to necessity. We are moving towards a future where shopping is no longer just about acquiring goods, but about experiencing them in a rich, interactive, and deeply personal way, blurring the lines between the digital and the tangible. The flat screen is giving way to a holographic fabric of reality, and e-commerce is shedding its two-dimensional skin to embrace a truly immersive dimension of retail. The future of shopping is not just online; it is all around us.

THE SPATIAL REVOLUTION OF E-COMMERCE USING AR/VR

E-commerce solved the problem of distance. But for decades, it has suffered from the tyranny of the flat screen. It demands that consumers make high-stakes purchasing decisions based on two-dimensional images and static descriptions, leaving the crucial sensory gap, the ability to touch, measure, and experience, unfilled. This fundamental lack of spatial context fuels consumer uncertainty, leading to high abandonment rates and, critically, the staggering logistics costs associated with millions of preventable returns. Enter Augmented Reality (AR) and Virtual Reality (VR). These immersive technologies are not mere novelties; they are the essential next layer of digital retail, translating products from abstract pixels into tangible, reliable experiences. This is the dawn of Spatial Commerce.

Augmented Reality: Bridging the Digital-Physical Divide

AR is the technology of the immediate future for e-commerce because it requires no specialized headset and integrates directly into the smartphone, the primary shopping tool. AR works by overlaying 3D digital content onto the user's real-world environment, allowing for friction-free purchasing confidence.

The Power of "Try Before You Buy"

The most transformative impact of AR lies in mitigating returns. By allowing consumers to realistically gauge size, fit, and aesthetic compatibility, AR turns the living room or face into a personalized digital showroom:

- *Furniture and home goods:* Platforms like IKEA Place and Lowe's utilize AR to let users drop accurately scaled 3D models of sofas, lamps, or paint colors into their homes. This eliminates the agonizing guesswork of whether a product will fit or clash with existing decor.
- *Apparel and beauty:* The shift from simple filters to accurate volumetric simulations is changing fashion. AR apps allow users to virtually "try on" cosmetics, eyeglasses (Warby Parker), and even sneakers, ensuring the color saturation and fit are accurate before the package even ships.
- *The confidence multiplier:* When a shopper uses AR, they move past guesswork. Studies show that AR integration can reduce return rates by as much as 25% and significantly boost conversion rates, often yielding higher Average Order Values (AOV) because the consumer feels more secure in purchasing premium items.

In essence, AR transforms the digital transaction from a hope-and-pray scenario into an informed, contextualized decision.

Virtual Reality: The Immersive Destination

While AR enhances the existing physical environment, VR transports the shopper entirely. VR implementation, currently reliant on headsets (Meta Quest, Apple Vision Pro), offers the promise of experiential retail, a way to recreate the brand intimacy and social discovery of physical shopping without the distance barrier.

The Rise of V-Commerce and Virtual Flagships

VR is used to build sophisticated, branded environments that could not exist in the physical world:

- *Virtual flagship stores:* Instead of browsing a static product grid, consumers can "walk into" a hyper-realistic virtual store designed by a brand. They can navigate aisles, view interactive displays, and inspect products in 360°, just as they would in a physical location.

- *Social shopping and commemoration*: VR allows groups of friends to meet up as avatars and shop together, recreating the social ritual lost in solo browsing. This communal experience drives engagement and is particularly potent for luxury and high-consideration purchases.
- *Product storytelling*: VR environments are perfect for immersive narrative. A retailer selling sustainable coffee could allow the user to "visit" the virtual farm where the beans were harvested, building profound brand loyalty and transparency that a 2D video could never match.

VR shifts the e-commerce proposition from being purely transactional to deeply experiential. It creates destinations that are entertaining to visit, driving repeat engagement even when the shopper has no immediate need to buy.

The Operational Hurdles: From Pixels to Poly-Counts

The promise of spatial commerce is compelling, but widespread adoption faces significant operational and technological challenges.

The Content Creation Bottleneck

The biggest barrier to entry is not the software, but the content. Moving from standard photographic assets (JPEGs) to high-fidelity, dimensionally accurate 3D models (a process known as volumetric capture or photogrammetry) is expensive and time-consuming.

An e-commerce giant might have millions of SKUs, but modeling each one in 3D requires dedicated studios and constant maintenance to reflect product changes. Standardization of 3D file formats among manufacturers is essential for scaling.

User Adoption and Accessibility

While AR is highly accessible via smartphones, VR is still constrained by hardware affordability and user comfort. Until lightweight, reasonably priced mixed-reality devices become commonplace (a transition expected within the next 3–5 years), VR's audience will remain niche.

Data and Personalization

Spatial commerce generates a treasure trove of new data:

- How long did a customer look at an item's texture in VR?
- Where exactly did they place the virtual chair in their living room?

Leveraging this dimensional data to personalize future recommendations and refine virtual store layouts is a complex but crucial task for future AI-driven retail.

The implementation of AR and VR in e-commerce is not optional; it is the necessary evolution required to move past the limitations of the original internet framework. E-commerce is transitioning from a database of static images to a portfolio of interactive, measurable experiences.

Retailers who invest now in 3D asset pipelines, offering contextual viewing through AR, and experimenting with branded VR experiences are positioning themselves to dominate the next decade of digital consumption. The friction is being removed, the guesswork eliminated, and the experience amplified. In the future of e-commerce, we will no longer browse products; we will inhabit them.

CONCLUSION

The evolution of E-commerce is not a linear progression of improved websites, but a radical restructuring of global retail characterized by intelligent autonomy and immersive integration. The research confirms that the era of simplistic, two-dimensional online shopping is receding, giving way to an intricate digital ecosystem powered by autonomous logistics, predictive intelligence, and multi-sensory brand engagement.

To thrive in the coming decade, businesses must move beyond optimization and embrace holistic transformation across three critical areas:

1. *Immersive integration*: Investing in infrastructure that supports Spatial Commerce will be mandatory. The ability for consumers to interact with products in augmented or virtual realities will transition from a novelty feature to a fundamental expectation, requiring robust investments in 3D modeling and shared digital environments.
2. *AI-Driven intelligence*: AI must be leveraged not only for predictive analytics but as a mechanism for creating genuinely unique, one-to-one shopping experiences. This requires a shift toward ‘ambient commerce’, where the shopping process is continuous and deeply embedded in a customer’s digital and physical life.
3. *Ethical responsibility*: The critical determinant of lasting success will be the demonstrable commitment to sustainability and data ethics. Future consumers will prioritize brands capable of proving circular economy compliance and guaranteed data sovereignty. The transparency afforded by technologies like blockchain in the supply chain will become a non-negotiable requirement for consumer trust.

In summation, the future of E-commerce is intrinsically linked to its ability to create seamless, intelligent, and ethical value chains. Success will belong to the enterprises that treat commerce not as a separate digital channel, but as an ever-adapting, highly personalized service layer woven into the very fabric of human life, a dynamic, responsible, and contextually aware digital marketplace defined by continuous reinvention.

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