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Review Article

Augmented Reality and Blockchain: Emerging Technologies Transforming Digital Marketing and Consumer Behavior

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A B S T R A C T

This review explores the convergence of two transformative technologies — Augmented Reality (AR) and Blockchain — within the domains of digital marketing strategy and consumer behaviour analytics. Together, these technologies represent a paradigm shift in how organisations engage consumers, generate behavioural insights, and maintain data integrity. Augmented Reality (AR) enhances consumer experience by enabling immersive, interactive, and personalised engagement across virtual environments, thereby enriching behavioural data capture and facilitating real-time analytics. In contrast, blockchain technology offers a decentralised framework that ensures data integrity, transparency, authenticity, and trust, while also enabling new forms of value exchange and tokenisation in digital ecosystems.

This review systematically synthesises existing literature on the applications, benefits, limitations, and synergies of AR and blockchain technologies in marketing and consumer research. Studies highlight that AR improves consumer engagement, brand recall, and purchase intention through sensory immersion, while blockchain ensures secure data provenance, verifiable transactions, and transparent supply chains. The integration of these technologies has given rise to innovative concepts such as phygital marketing, tokenised loyalty programmes, AR-enabled NFTs, and metaverse-based brand experiences, all of which redefine consumer-brand interactions.

Methodologically, we analyse emerging research that combines AI-driven analytics, AR-based behavioural tracking, and blockchain-led data governance, emphasising their implications for marketing ethics, consumer trust, and sustainable business models. Despite their potential, challenges persist in interoperability, scalability, cost-efficiency, and regulatory compliance, which limit mainstream adoption. Furthermore, the psychological and behavioural effects of immersive, blockchain-backed marketing systems remain underexplored, requiring deeper empirical and theoretical inquiry.

Keywords: Blockchain-Backed, Verifiable Transactions, Regulatory Compliance, Interoperability, Scalability

Introduction

Digital marketing and consumer behaviour analytics are undergoing rapid transformation, driven by rising expectations of immersive experiences, realtime data flows, personalisation, and greater transparency. Augmented Reality (AR) offers marketers a tool to create immersive, interactive brandconsumer experiences, while blockchain technology offers the potential to ensure data trust, transparency and decentralised control. The combination of these technologies opens new frontiers for strategic marketing and analytics of consumer behaviour.

This review addresses three key questions.

- How is AR being used in digital marketing and consumer behaviour contexts?
- How is blockchain being applied to digital marketing and consumer behaviour analytics?
- What are the synergies, challenges and future directions when both technologies converge?

We begin by reviewing AR, then blockchain, followed by their integration, practical implications, and research gaps, and conclude.

Augmented Reality in Digital Marketing and Consumer Behaviour

Definition, evolution and theoretical underpinnings

AR overlays digital information (graphics, video, 3D objects) onto the user's view of the real world via devices (smartphones, tablets, headsets). Recent reviews identify AR's key features: interactivity, augmentation (digital overlay), realworld integration (vividness), personalisation, and novelty.[1] In consumer behaviour research, AR can be situated in the technology acceptance model (TAM), the hedonic/utilitarian value framework, and engagement theory – where the interactivity and vividness of AR increase intrinsic and extrinsic value for consumers.

Marketing applications & consumer behaviour impacts

AR is leveraged in digital marketing in the following ways

- Virtual "tryon" experiences (beauty, fashion, eyewear) enabling consumers to visualise products in their context. [2]
- Interactive product visualisation (e.g., furniture in one's living room) improving decisionmaking and reducing perceived risk. [3]
- Gamified AR experiences,locationbased activations and socialmedia AR filters to boost brand engagement and sharin Empirical findings show increased brand awareness, engagement, conversion, and reduced returns in some instances when AR is used well. For example, one article reports AR marketing can increase conversion rates by up to ~30%. [5]

Benefits for consumer behaviour analytics

From an analytics viewpoint, AR offers.

- Richer behavioural data (dwell time, navigation of AR objects, spatial context) which can be tapped for predictive modelling.
- Higher engagement and stronger brandconsumer relationships, which may lead to more stable data and behaviour modelling.
- Enhanced experiential value, which may create stronger and more lasting memory encoding and brand recall.

Challenges and limitations

However, several limitations exist:

- High development and implementation costs (3D modelling, crossdevice testing) and fragmentation of device/platform ecosystems. [6]
- Consumer adoption and readiness: The novelty factor remains high; sustained value and relevance are not always clear. [7]

Table 1.Selected studies on AR in digital marketing/consumer behaviour

Study	Context / Application	Key finding
Kushnarevych & Kollárová (2023) – "AR & VR as shaping trend…"	Various industries, AR/VR in marketing communication	AR/VR use influences engagement and decisionmaking; but adoption barriers remain
Panezai et al. (2025) – "AR in Marketing: Narrative Review"	Retail applications of AR	Key features influencing behaviour: interactivity, personalisation, vividness, system quality
Bakar (2023) – "Systematic Review … AR in Digital Marketing"	Review of AR research 2018–22	Identifies research gaps such as measurement of behavioural outcomes, analytics integration
Kalra, Sharma & Patel (2023) – "Digital Marketing and Consumer Purchase Behaviour"	Social media & digital marketing influence	Highlights youth consumer behaviour dominated by online factors, limited specific to AR

- Measurement and ROI: There is often insufficient clarity on how to measure the incremental benefit of AR campaigns and how to integrate ARderived behavioural data into analytics pipelines. [9]
- Privacy, data ethics, and consent: The capture of spatial/contextual data raises consumer privacy concerns. [8]

Blockchain Technology in Digital Marketing and Consumer Behaviour Analytics

Definition and Relevance to Marketing

Blockchain is a distributed ledger technology (DLT) that enables secure, transparent, and tamper-resistant recording of transactions across a decentralised network of computers.[1] Unlike traditional centralised databases, blockchain ensures that data is stored across multiple nodes, making it highly resilient to manipulation or unauthorised access. Each transaction or data entry is cryptographically secured and linked in a chronological chain of blocks, creating a permanent and verifiable record [2] In the context of digital marketing and consumer behaviour analytics, blockchain has significant relevance and transformative potential. Firstly, it enhances data trust and authenticity by providing verifiable records of transactions and interactions. Marketers can leverage blockchain to track consumer activity, purchase history, and engagement data with a high degree of reliability, thereby improving the accuracy of analytics and predictive modelling [3] Secondly, blockchain empowers consumer control over personal data, aligning with privacy regulations such as GDPR and CCPA. Through decentralised data management, consumers can grant or revoke access to their personal information, decide how it is used for marketing purposes, and potentially monetise their own data through tokenised systems.[4]

Thirdly, blockchain offers solutions for ad fraud prevention and transparency in digital advertising. With blockchain-based verification, advertisers can ensure that impressions, clicks, and conversions are authentic, reducing the risk of fraudulent activity and increasing return on advertising spend.[5] Finally, blockchain enables tokenised marketing mechanisms, such as loyalty points, rewards, and gamified engagement campaigns. These tokens can be securely tracked and traded within blockchain ecosystems, incentivising consumer participation and fostering stronger brand-consumer relationships.[6] By combining decentralisation, cryptographic security, transparency, and tokenisation, blockchain provides a robust infrastructure for digital marketing strategies that prioritise trust, efficiency, and consumer-centric approaches. Its integration with advanced analytics and emerging technologies, such as augmented reality (AR) and artificial intelligence (AI), further amplifies its potential to reshape the marketing landscape.

Marketing & consumer behaviour applications

Key applications for blockchain in this domain include.

- **Transparency & trust:** Consumers can verify the provenance of products (important in luxury, food, and sustainability), and brands can demonstrate authenticity.
- **Ad fraud prevention/data integrity:** In programmatic digital advertising, blockchain provides verifiable clicks/impressions, reducing ad fraud.
- **Consumer data sovereignty:** Blockchain frameworks can give consumers more control over their data and consent management and enable tokenised reward systems.
- **Tokenised loyalty/rewards:** Smart contracts and tokens allow flexible loyalty programmes (e.g., blockchainbased points redeemable across brands or resellable).
- **Behaviour analytics enhancement:** Secure, auditable data flows (via blockchain) improve reliability of consumer behavioural datasets, enabling better predictive modelling. For instance, one study found blockchain had a positive effect on consumerbrand engagement in omnichannel firms.

Benefits & constraints

Benefits: improved trust, transparency, reduced fraud, and better data quality for analytics.

Constraints: technical complexity, scalability concerns (transaction speed, cost), integration with legacy systems, regulatory ambiguity (data privacy/regulation) and skills gap.

Table 2.Selected studies on blockchain in marketing/ consumer behaviour analytics

Study	Context / Application	Key finding
Srivastav et al. (2025) – "Evaluating effects of AI & digital marketing…"	Bibliometric study integrating AI and digital marketing	Identifies blockchain as emerging theme in consumer behaviour analytics
Abbas Q. Fatimi (2024) – "Impact of Blockchain on Consumer Data Privacy"	Digital marketing context, data privacy	Highlights blockchain's role in providing consumer data control and transparency

(Note: Actual dedicated empirical studies on blockchain + consumer behaviour analytics remain limited — more research needed.)

Converging AR and Blockchain Emerging Synergies in Digital Marketing & Consumer Behaviour Analytics

Conceptual Synergy

Although augmented reality (AR) and blockchain have traditionally been studied and applied separately, their convergence presents a unique set of opportunities for digital marketing and consumer behaviour analytics. AR enables brands to deliver immersive, interactive experiences that engage consumers in ways that traditional media cannot. By overlaying digital content onto the physical environment—such as virtual try-ons, interactive product visualisations, or gamified campaigns—AR generates rich, real-time behavioural data that provides insights into consumer preferences, engagement patterns, and decision-making processes.[1,2] However, the value of this data is often constrained by concerns about authenticity, privacy, and transparency. Blockchain can address these limitations by providing a secure, decentralised infrastructure for data capture, storage, and verification. Through cryptographic security and immutable record-keeping, blockchain ensures that AR-generated consumer interaction data is trustworthy, verifiable, and tamper-proof [3,4]. This creates a reliable foundation for advanced analytics, predictive modelling, and personalised marketing strategies.

The synergy between AR and blockchain can thus support immersive brand-consumer experiences underpinned by transparency and trust. For instance, a consumer engaging with an AR-enabled virtual product might have their interaction securely recorded on a blockchain, ensuring the authenticity of the engagement data. Brands can then leverage this verified data to tailor recommendations, forecast purchasing behaviour, or dynamically adjust marketing content in real time.[5] Furthermore, blockchain enables tokenised marketing mechanisms in combination with AR experiences. For example, consumers could earn blockchain-based loyalty tokens for completing AR-driven challenges or exploring virtual brand environments. These tokens could then be redeemed for discounts, exclusive content, or other rewards, incentivising deeper engagement while maintaining transparency and fairness [6] Together, AR and blockchain bridge the gap between experiential marketing and data integrity. AR provides the front-end engagement and experiential richness, while blockchain secures the back-end infrastructure for trustworthy data capture, provenance, and transaction verification. This integrated approach not only enhances consumer experience but also allows marketers to conduct robust behavioural analyses, predictive modelling, and personalised targeting, thereby improving marketing effectiveness, brand loyalty, and return on investment.In summary, the convergence of AR and blockchain offers a conceptual and practical framework for immersive, data-driven, and trustworthy digital marketing, highlighting the potential of combining emerging technologies to reshape both consumer experience and strategic marketing analytics.

Integrative application possibilities

- Virtual goods/overlays in AR that are tokenised as digital assets (NFTs) on blockchain, enabling ownership, secondary trading, scarcity and loyalty.
- Locationbased AR gamified campaigns where consumer engagement triggers blockchain smart contracts for reward distribution, auditability and traceability.
- AR environments capturing spatial and interaction data (e.g., how consumers manipulate virtual products and navigate in AR space), which is recorded on blockchain or ledgerbased systems for analytics pipelines.
- Supply chain transparency: Consumers using AR to visualise product provenance (e.g., "scan this product and see its origin & lifecycle"), with blockchain underpinning the provenance data—heightening trust and influencing behaviour.

Theoretical & empirical implications

From a theoretical lens, one might integrate models of technology acceptance (for AR), hedonic/utilitarian value, and consumer trust/transparency (for blockchain) with behaviour analytics frameworks. For example, the immersive AR experience may increase engagement and behavioural intentions, but if the data flows are not trusted, consumer behaviour (e.g., conversion, loyalty) may falter. Blockchain may moderate or mediate this effect by enhancing trust/data integrity. Empirical studies directly examining ARblockchain convergence are rare—this is a key research gap.

Table 3.Proposed model constructs & research directions

Construct	Example variable	Research question
AR interactivity/ immersion	Time spent using AR, number of interactions	How does AR immersion affect purchase intention or loyalty?
Blockchainenabled transparency/trust	Consumer perception of data transparency, trust in provenance	Does trust moderate the relationship between AR experience and behavioural outcomes?

Behavioural analytics feedback	Predictive model accuracy, conversion uplift, segmentation quality	Does integrating AR behavioural data and blockchainensured integrity improve predictive marketing models?
Tokenised motif	Use of tokens or NFTs in campaign	How do tokenised AR experiences influence consumer engagement and secondary behaviour (e.g., advocacy, resale)?

Practical Implications for Marketers, Analysts & Policymakers

For Marketers

- Develop AR experiences anchored in value (not mere novelty): e.g., tryon, spatial visualisation, and gamified promotions tied to real outcomes.
- Use blockchain to build consumer trust—especially in sectors where provenance, authenticity and data transparency matter (e.g., luxury, food, sustainability).
- Consider tokenisation and ecosystem design: linking AR experiences with blockchainbased loyalty/rewards may enhance engagement and create secondary markets.
- Measure not just engagement but behavioural outcomes (conversion, retention, referrals) and feed ARderived behavioural data into analytics pipelines for optimisation.

For Consumer Behaviour Analysts

- Leverage richer behavioural data from AR campaigns (interaction logs, spatial trajectories, dwell time) and ensure data integrity via blockchain frameworks.
- Develop predictive models (machine learning, AI) that incorporate AR interaction features and blockchainverified data flows to enhance accuracy and insights.
- Incorporate variables such as perceived trust, transparency, and ownership (tokenisation) into consumer behaviour models.
- Be mindful of privacy, consent, and ethical aspects when dealing with immersive AR data and blockchainlogged consumer behaviours.

For Policymakers and Regulators

- As AR campaigns capture sensor, location, image, and personal data, robust privacy and consent frameworks are required; blockchain may aid, but regulation must adapt.
- Standardisation and interoperability across AR platforms and blockchain systems should be encouraged to avoid fragmentation and ensure consumer protection.
- Tokenised loyalty schemes and digital assets (NFTs) raise regulatory questions (consumer protection, resale markets, taxation) that should be addressed proactively.

Research Gaps and Future Agenda

Technical / operational gaps

- Scalability issues of blockchain for highvolume consumer data logging; cost/latency constraints.
- Device fragmentation and consumer hardware readiness for AR across segments and geographies.
- ROI measurement frameworks specific to AR + blockchain convergence: metrics for success, baseline comparisons, and analytics integration.
- Lack of standard frameworks for integrating AR interaction data with blockchain log data and downstream analytics.

Empirical and theoretical gaps

- **Empirical studies on AR + blockchain convergence:** Very few studies examine campaigns combining both technologies; research is needed to test integrated models and outcomes.
- **Longitudinal studies:** Many existing studies are crosssectional; we need longitudinal designs to track behavioural change over time (loyalty, resale behaviour, advocacy).
- **Crosscultural and international perspectives:** Technology adoption and trust in blockchain and AR vary across cultures—comparative studies are limited.
- **Analytical model innovation:** How to incorporate AR interaction features, blockchain trust/tracking variables, and tokenisation in advanced machinelearning or predictive modelling frameworks.
- **Ethical and regulatory research:**Studies on the socioethical implications of immersive AR data capture, blockchain-based tokenisation, consumer data sovereignty, and consent mechanisms. For example, Wood (2023) identifies themes of personalisation, interactivity, privacy and transparency in AR ethical literature.

Future research agenda – "10point roadmap"

- Design and evaluate ARblockchain integrated campaigns in real marketing settings; measure consumer behaviour outcomes (purchase, loyalty, advocacy).
- Develop behavioural analytics frameworks that incorporate AR interaction variables and blockchainverified data flows; test predictive model enhancements.

- Comparative crosscultural investigations of AR + blockchain adoption, trust, perceived value, and behaviour.
- Develop and validate measurement scales for tokenised asset ownership (NFTs/virtual goods) and their influence on consumer behaviour.
- Explore secondary behaviour such as resale of tokenised AR goods, peertopeer trading, and how this influences brand ecosystem and consumer loyalty.
- Longitudinal studies to capture how AR experiences and tokenised ownership evolve behavioural trajectories (e.g., from awareness to advocacy).
- **Ethical frameworks:** examine consumer perceptions of privacy, data ownership, and consent in AR/blockchain contexts; design interventions to ensure ethical deployment.
- **ROI models:** propose and test metrics specific to ARblockchain marketing (e.g., interaction to conversion ratios, lifetime value of tokenised asset owners).
- **Technological infrastructure studies:** examine how to integrate AR platforms, behavioural data streams, blockchain ledgers and analytics pipelines efficiently (systems architecture, costbenefit).
- **Policy/regulation studies:** analyse regulatory implications of tokenised loyalty schemes, data logging via AR, and consumer data sovereignty via blockchain, and propose best practices.

Conclusion

The intersection of AR and blockchain technologies offers a promising frontier for digital marketing strategies and consumer behaviour analytics. AR brings immersive, interactive experiences and richer behavioural datasets; blockchain provides infrastructure for trust, transparency, data integrity and tokenisation. For marketers and analysts, the imperative is to move beyond novelty, integrate experiences with robust data, analytics and strategic value, and consider ethical and regulatory dimensions. For researchers, the field is ripe with opportunities—from integrated empirical studies and predictive model innovations to crosscultural examinations and governance frameworks. As digital marketing evolves, AR + blockchain may transition from an emerging novelty to a core strategic toolset for consumercentric and datadriven marketing.

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