From Blocks to Insights: Transforming Ethereum On-chain Data into Marketing Insights

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Abstract:

This study examines how blockchain and Web3 enable marketers to use transparent on-chain data to understand consumer behaviour and develop innovative strategies. Applying the 10Vs big data framework (volume, value, velocity, veracity, viscosity, variability, volatility, viability, validity, and variety), it analyses Ethereum Virtual Machine (EVM) components: account state, transaction, and block. The research identifies value enhancers and value detractors in Web3 marketing, linking blockchain data to marketing theory. It offers a systematic approach for extracting actionable insights with practical implications for segmentation and loyalty programs. It also enhances understanding of organisational information processing by showing how integrating on-chain data into strategies improves firms' adaptability in evolving EVM-compatible blockchain environments.

Keywords: *Web3, blockchain, on-chain data, marketing analytics, value, EVM, Ethereum Virtual Machine*

Track: Digital Marketing and Social Media

1. Introduction

The rise of blockchain technology and cryptocurrencies creates new opportunities for marketers to understand consumer behaviours and design advanced strategies (Rejeb et al., 2020). As blockchain, especially Ethereum, continues to expand, growing on-chain data provides rich marketing insights. On-chain metrics, derived directly from blockchain activity, reveal transaction volumes, address behaviour, token flows, and smart-contract interactions, offering extensive analytical value (Eberhardt & Tai, 2017). This emerging field of on-chain data analysis is becoming increasingly essential for organisations seeking to leverage blockchain for strategic marketing.

This conceptual paper proposes a framework for using on-chain data and blockchain technology in marketing, with a focus on Ethereum. Core blockchain attributes such as decentralisation, transparency, immutability, and peer-to-peer trust offer significant potential for marketing applications (Tapscott & Tapscott, 2017). As a decentralised, open-source platform, Ethereum enables tokenisation and smart contracts (Eyong, 2019), and its public ledger offers rich access to transaction and smart-contract data helpful in analysing consumer behaviour. Additionally, blockchain supports new models for customer engagement, loyalty programs, and brand interaction (Rejeb et al., 2020).

This paper examines how marketers can use on-chain data from Ethereum and other blockchain networks to generate actionable insights. It first evaluates blockchain data using the 10 Vs of big data: value, volume, variety, velocity, veracity, validity, viscosity, volatility, viability, and variability. It introduces a framework that connects specific on-chain data fields to marketing applications and use cases. It then outlines key considerations and challenges in applying blockchain data in marketing, along with future research and implementation directions. The proposed framework equips marketers to leverage blockchain technology to strengthen marketing strategies, deepen customer relationships, and enhance business value. As blockchain continues to evolve, it offers significant potential to transform marketing by enabling new forms of consumer engagement and insight.

2. Theoretical background

2.1 Blockchain and marketing

Blockchain offers key marketing advantages in trust, transparency, and security (Tan & Saraniemi, 2023). It supports tokenised loyalty programmes that boost engagement via real-time reward tracking (Tan et al., 2024) and improve data security through decentralised storage and smart contracts, which automate tasks and enhance consumer data control (Tan & Salo, 2023). For instance, smart contract-based loyalty systems securely manage points and enable transparent campaigns, while blockchain's immutability ensures reliable metrics such as clicks, conversions, and impressions (Rejeb et al., 2020). However, research has yet to fully connect on-chain data with marketing uses (Tan & Saraniemi, 2023). This study underscores the value of on-chain EVM data for supporting marketers' decisions. Yet public blockchain data, though accessible, is often difficult to retrieve and analyse, and its security-focused design limits efficient querying, complicating tasks such as segmenting users by behaviour or purchases.

2.2 Attributes of data for marketing insights

Kapil et al. (2016) identified multiple big data attributes, such as volume, value, velocity, etc., which can enhance marketing decisions and customer experience through real-time analytics (Akter & Wamba, 2020). Together, the Vs illustrate how big data has evolved into a multidimensional concept that encompasses scale and speed, usefulness, reliability, stability, and analytical purpose. Building on this literature, this study applies a 10Vs framework, i.e. value, volume, variety, velocity, veracity, validity, viscosity, volatility, viability, and variability, to blockchain marketing in Web3, grouping them into value enhancers that strengthen the utility of on-chain data and value detractors that constrain its marketing relevance. (See Table 1) As Wedel & Kannan (2016) note, marketing analytics progresses from descriptive and diagnostic to predictive and prescriptive stages, with advanced practice combining multiple data sources and models to generate actionable decisions. Marketers must therefore balance these dimensions; for instance, higher data volumes can lower statistical variance, whereas greater variety can increase computational demands.

Data attributes	**Data explanation**	**Description**
Value Enhancer		
Value	Usefulness of data	The relevance and usefulness of data for decision-making processes or business goals (Wedel & Kannan, 2016; Khan et al., 2018)
Volume	Size of data	The size or amount of data generated (Wedel and Kannan, 2016; Kapil et al., 2013 Khan et al., 2018)

Data attributes	Data explanation	Description
Variety	Type of data	The different types or formats of data available for analysis (Akter & Wamba, 2020; Khan et al., 2018)
Velocity	Speed of data	The speed at which data is generated, processed, and transmitted (Akter & Wamba, 2020; Khan et al., 2018)
Veracity	Quality of data	The accuracy, trustworthiness, and quality of the data (Akter & Wamba, 2020; Khan et al, 2018
Validity	Authenticity of data	The authenticity of the data, ensuring integrity throughout the data lifecycle (Khan et al., 2018)
Value Detractor		
Viscosity	Time lag in processing	The delay or lag in processing data can hinder real-time analytics (Kapil et al., 2016; Khan et al, 2018)
Volatility	Duration of usefulness	The time span for which data remains relevant and useful (Kapil et al., 2016; Khan et al., 2018)
Viability	Sustainability of the system	The system's or data source's sustainability and continued usefulness over time, ensuring that the data remains active and valuable (Khan et al, 2018)
Variability	Differentiation of data and sources	The differences in data sources and formats require advanced processing and standardisation to gain accurate insights (Khan et al., 2018; Rejeb et al., 2020)

Table 1. The 10Vs of marketing data analytics (authors' own creation)

3. The EVM on-chain data structure

The EVM's architecture, which underpins blockchain-based marketing analytics, consists of three interconnected components: 1) *Account State* includes balances, nonces, storage roots, and contract code, which provides the foundation for identifying active wallets and segmenting users; 2) *Transactions*, which drive all state changes such as value transfers, represent individual user actions like redeeming loyalty Non-fungible Tokens (NFTs) or participating in token campaigns. Two key subdivisions enhance marketing insights: a) the *Transaction Receipts Trie*, recording execution success, gas use, and triggered events for evaluating conversions and smart-contract reliability; and b) the *Log Fields*, which capture specific contract-emitted events (e.g., "voucher redeemed"), enabling precise attribution, filtering, and retargeting; 3) *Block* component is a broader component that organises these transactions into validated, time-stamped batches, offering temporal snapshots of network activity. Its subfields, such as Block Body Fields, Attestations, Execution Payload Headers and Fields, and Withdrawal Fields, reflect validator agreement, execution metadata, and stake movements, which signal network conditions, liquidity, and overall confidence, all of which influence campaign timing, cost forecasting, and user experience in blockchain-based marketing. (See Table 2)

EVM Data Fields	**Definition**
1 Account State	Stores account-specific data, including nonce, balance, and codeHash, which are essential for transaction validation and execution.
2 Transaction	A signed data package that encodes a message to be sent from one account to another, potentially triggering contract execution.
2.1 Transaction Receipts Trie	Contains the outcome of a transaction, including its success or failure, gas used, and logs generated during execution.
2.2 Log Fields	Details events triggered by smart contracts during transactions, used for filtering and listening for specific contract activities.
3 Block	A container for batches of transactions and related proof that transactions occurred and were validated by the network.
3.1 Block Body Fields	Includes data like the randao reveal, eth1 data, and more, which are part of the block structure and influence validator activities.
3.2 Attestations Fields	Comprises a list of validators' attestations, indicating agreement with the block's data as viewed by the network.
3.3 Data in the Attestation	Holds details about specific attestations, such as which validators participated and the related beacon block data.
3.4 Execution Payload Header Fields	Pre-execution state, including important transaction-related details like gas limits and block transactions roots.
3.5 Execution Payload Fields	Consists of transactions that the block will execute along with details such as gas usage and transaction outcomes.
3.6 Withdrawal Fields	Details of withdrawal operations from validators, crucial for understanding shifts in validator stakes and system exits.

Table 2. An illustration of selected EVM data fields and definitions (Wood, 2014)

Conceptually, the EVM is a global computer operating on thousands of nodes, enabling dynamic state updates through transactions aggregated into blocks. Each block represents a verifiable set of state transitions, secured by a Merkle root hash summarising all transactions. This ensures consistent, accurate updates and underpins Ethereum's ability to support value transfers and decentralised applications (Wood, 2014; Eyong, 2019). For marketing, the EVM's strength lies in its transparency, automation, and immutability. Unlike traditional systems, where data may be isolated or lost, EVM on-chain records create a permanent, tamper-proof ledger of every customer interaction. Each *Transaction*, from first contact to the latest activity, can inform future marketing initiatives and enhance marketing decisions. This enables stronger customer trust, automated reward systems, and data-driven strategies built on complete, accurate histories (Tan et al., 2024). Automated smart contracts further reduce overhead and ensure consistent delivery of commitments, from loyalty rewards to exclusive access.

4. The connection between 10-Vs, EVM data fields, and marketing implications

Table 3 links each value in the 10-Vs framework to its relevant EVM data fields and marketing implications for Web3. *Value enhancers*, i.e., value, volume, variety, velocity, veracity, and validity. These attributes improve the utility, reliability, and effectiveness of on-chain data for strategic decision-making. Conversely, *value detractors*, i.e., viscosity, volatility, viability, and variability, introduce challenges that affect data processing speed, insight stability, practical use, and consistency (See Table 3). Recognising both capabilities and constraints highlights the complex nature of blockchain data in the EVM, underscoring its potential for advanced marketing alongside the need to manage inherent limitations.

10-Vs	Related EVM data fields	Marketing implications on Web3
Value enhancer (Positive)		
Value	2.1 Transaction Receipts Trie, 2.2 Log Fields	Enhances decision-making capabilities with reliable, timely data, appealing to sectors that require precision.
Volume	3 Block, 2 Transaction	Showcases scalability and robust processing capacity, making it attractive to enterprises that need high-volume transaction handling.
Variety	2 Transaction, 2.2 Log Fields, 3.4 Execution Payload Header Fields, 3.5 Execution Payload Fields	Highlights the system's adaptability and comprehensive data handling, making it suited for complex business solutions.
Velocity	3 Block, 2 Transaction	Emphasises real-time data processing speed, which is attractive in environments that demand quick transaction turnaround.
Veracity	1 Account State, 2.1 Transaction Receipts Trie	Promotes data integrity and accuracy, crucial for businesses that rely on trustworthy transactions.

Validity	1 Account State, 2 Transaction	Ensures secure, verified transactions, which are vital for operations in regulated industries.
Value detractor (Negative)		
Viscosity	2 Transaction	Points to efficient network performance under high loads, which is important for performance-sensitive operations.
Volatility	2.1 Transaction Receipts Trie, 3 Block	Indicates data longevity and relevance, key for long-term strategic planning and investment.
Viability	3 Block, 2 Transaction	Underlines system sustainability and reliability, securing long-term customer trust and investment.
Variability	2.2 Log Fields, 3.5 Execution Payload Fields	Reflects data standardisation and accuracy in reporting, crucial for analytics-driven marketing strategies.

Table 3. The connection between 10-Vs, EVM data fields, and marketing implications

The *Transaction Receipts Trie* and *Log Fields* record precise execution outcomes and contract events, ensuring accurate verification of each transaction's status. By providing comprehensive and reliable data, they enhance the *value* of blockchain information for compliance, real-time monitoring, and historical analysis, enabling marketers to make trustworthy, timely, and credible data-driven decisions. The EVM's *Block* and *Transaction* structures enable efficient recording and confirmation of high transaction *volumes*, demonstrating real-time scalability and processing capacity. These attributes allow marketers to quickly interpret behaviour, manage campaigns, and adjust strategies to capture emerging trends. Furthermore, the EVM's *veracity* attribute enables rapid processing and integration of *Transactions* into *Blocks* without delay. By efficiently compiling transactions and maintaining low latency, it enables real-time campaign tracking, instant performance feedback, and rapid strategy optimisation. This high-*velocity* responsiveness enables brands to react immediately to market shifts and keep their messaging timely, relevant, and competitive.

EVM can handle a wide *variety* of data inputs and outputs, including Transactions, Log Fields, Execution Payload Header Fields, and Execution Payload Fields. These structures manage execution details, record events for compliance, and prepare the chain for new activity, enabling accurate, comprehensive data flows. This *versatility* enables marketers to segment audiences more precisely and tailor offerings to drive stronger engagement and higher conversion rates. The EVM ensures *veracity* through the combined functioning of the *Account State* and the *Transaction Receipts Trie*, which maintain data integrity by recording balances, nonces, and verifiable execution outcomes. Their consistency and traceability help eliminate errors that could lead to financial or reputational risks. At the same time, the EVM upholds *validity* through strict management of the *Account State* and the validation of each *Transaction* against current blockchain rules, preventing double-spending, replay attacks, and other unauthorised actions. This robust security framework is essential for strengthening user trust in decentralised environments where authenticity is commonly established without intermediaries.

5. Discussions

5.1 Theoretical implications

This research makes three key contributions. First, this paper strengthens the theoretical foundation for blockchain-based marketing analytics by integrating the 10-Vs data attributes (Wedel & Kannan, 2016; Akter & Wamba, 2020) with blockchain architecture, illustrating how on-chain data generates both value enhancers and detractors in Web3 environments. The proposed framework shows how Ethereum data, such as token transfers, contract executions, and real-time transaction flows, can be leveraged to generate customer insights, optimise campaigns, and design loyalty programs. It highlights the importance of agility, interoperability, and adaptive strategies to manage diverse data types, network congestion, and market volatility, enabling marketers to maintain relevance in decentralised ecosystems. Second, the study provides an in-depth analysis of the EVM data structure (Wood, 2014), clarifying the marketing implications of its three core components: Account State, Transaction (Transaction Receipts Trie and Log Fields), and Block (including Execution Payloads and Attestations). Understanding these elements enables marketers to design data-driven campaigns that respond to real-time blockchain activity. Third, while blockchain adoption offers new opportunities, challenges remain, particularly in integrating on-chain and off-chain data and managing the lack of cross-chain standardisation (Jabbar et al., 2021). This paper is the first to link the EVM data structure with data-attribute literature, offering a roadmap for organisational learning and real-time decision-making in decentralised markets.

5.2 Managerial implications

This paper identifies four main managerial implications. First, analysing transactional behaviour on the blockchain reveals user engagement, preferences, and spending patterns, enabling segmentation by transaction frequency, volume, and timing. For example, tracking flows between addresses helps identify high-value users or “whales” for targeted campaigns, influencer strategies, and tailored messaging across DeFi, NFT, and dApp activities. Second, monitoring interactions with smart contracts and dApps provides insight into product adoption and market trends, allowing firms to identify popular services, guide product development, and deliver educational content aligned with user sophistication. Third, blockchain’s immutability supports detailed user histories for predictive analytics, Customer Lifetime Value (CLV) estimation, and timely interventions, enabling marketers to anticipate behaviour and personalise campaigns, such as responding to rising NFT activity. Lastly, analysing wallet holdings and asset flows uncovers user interests and investment behaviours, informing personalised campaigns, product launches, and events. Shifts in token or NFT holdings signal sentiment changes that help marketers time initiatives, enhance retention, and identify new opportunities in decentralised ecosystems.

6. Limitations and future research

This study has several limitations that warrant further research. First, existing marketing metrics are not designed for blockchain environments. Traditional Key Performance Indicators (KPIs), such as click-through rates and customer lifetime value, overlook blockchain-specific metrics, including token flows, gas fees, and smart contract interactions. Future work should develop KPIs tailored to blockchain campaigns and comparable to traditional measures. Second, the study focuses only on the EVM and its data fields. Examining other virtual machines, such as Solana, may reveal additional marketing uses and clarify whether EVM-based metrics transfer across architectures. Third, cross-chain analytics are still limited; without integration, insights cannot be combined into unified user profiles. Research should explore interoperability protocols, oracles, and machine-learning models to support multi-chain tracking and segmentation. Finally, privacy concerns restrict on-chain marketing, as blockchain transparency can expose behavioural patterns despite pseudonymity. Future studies should investigate privacy-preserving tools, such as zero-knowledge proofs and standardised protocols, to maintain anonymity while preserving data utility.

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