DECENTRALIZED INNOVATION PLATFORMS: INSIGHTS FROM THE ETHEREUM CASE

Giacomo Vella, Valeria Portale, Daniel Trabucchi, Luca Gastaldi

School of Management, Politecnico di Milano, Milan, Italy

giacomo.vella@polimi.it

ABSTRACT

This study investigates how blockchain-based platforms redefine traditional innovation platform models by analyzing Ethereum as a paradigmatic case. While classical platforms are characterized by centralized governance and selective openness, Ethereum introduces a decentralized architecture that structurally embeds openness, composability, and permissionless participation into its protocol. Drawing on a qualitative single-case study based on over 100 secondary sources, this research explores three dimensions: governance and orchestration, complementor engagement, and architectural modularity. Findings highlight that Ethereum operates through multi-actor orchestration, where governance is distributed among core developers, the Ethereum Foundation, decentralized autonomous organizations, and community contributors. Complementors engage directly with the platform, leveraging smart contracts and token-based incentives to build interoperable applications without the need for approval from a central authority. Moreover, Ethereum extends composability beyond core-periphery dynamics, enabling peer-level recombination of complements through public, reusable smart contracts. A comparative analysis with traditional platforms and open-source ecosystems positions Ethereum as a novel archetype of innovation platform, blending open-source governance with blockchain-enabled modularity and decentralized economic coordination. The study advances platform theory by proposing new conceptualizations of openness, modularity, and governance in decentralized digital ecosystems.

Keywords*: Innovation platforms, Blockchain, Decentralized governance, Ethereum*

1. INTRODUCTION

The emergence of digital platforms over the last two decades marks one of the most significant structural transformations in the modern economy (Trabucchi et al., 2019). The shift brought by platform is not merely technological but deeply organizational, strategic, and institutional. The rise of platform firms coincides with a broader structural transformation in how economic value is created. Platforms no longer need to own production means but act as facilitators of distributed capabilities (Zeng et al., 2021). In this orchestration-centric logic, the platform's primary role shifts from production to facilitation.

Innovation platforms exemplify this transformation: they serve as foundational infrastructures upon which external developers, known as complementors, can build complementary products or services, thereby fostering innovation and generating a virtuous cycle of value creation (Gawer & Cusumano, 2014). Typical examples of innovation platforms are operating systems, such as iOS and Windows, as well as videogame consoles, emblematic business models to enable external innovation through the development of applications and games. Several factors have supported the rise of digital platforms: digitization has reduced transaction costs, enabling scalable and

efficient market making(Gawer, 2021); digital data feedback loops allow continuous service improvement and user retention (Trabucchi et al., 2017; Trabucchi & Buganza, 2019); and modular innovation facilitates seamless integration by third-party developers, creating layered innovation ecosystems (Tiwana, 2014).

More recently, blockchain technology has shown potential to further enhance innovation platform capabilities, particularly in relation to modular innovation. Its decentralized and programmable architecture supports the creation of interoperable modules, automated via smart contracts, that can be integrated into digital ecosystems in a transparent and secure manner (Leiponen et al., 2022). In addition to increasing innovation potential, blockchain introduces other changes. Traditionally, platforms have positioned the platform leader in a central role, concentrating authority and control within a single entity (Chen et al., 2021). In contrast, blockchain, based on decentralization and transparency, enables new forms of decentralized platforms (Chen & Bellavitis, 2020). These challenge the conventional centralization of power and the economic dependence of third-party actors on dominant platform leaders (Adner & Kapoor, 2010; Boudreau & Hagiu, 2009; Gastaldi et al., 2024; Jacobides et al., 2024).
Among blockchain platforms, Ethereum stands out as a paradigmatic case of innovation platform, widely recognized for enabling external developers to build and deploy smart contracts and decentralized applications (Dapps) on top of its infrastructure (Leiponen et al., 2022). Introduced in 2013, Ethereum pioneered programmable blockchains via smart contracts and Dapps. Today, Ethereum is the leading blockchain platform for decentralized applications development. Its popularity among developers stems from the robustness of its ecosystem, the wide breadth of available tools, and its native modular and composable architecture, which allows developers to reuse and build on each other's products. Thanks to its composable and permissionless architecture, Ethereum functions as a form of public digital infrastructure for innovation, allowing anyone to build, deploy, and interact with applications, thus fostering a decentralized, community-driven environment conducive to continuous innovation.

Although recent literature has shifted attention toward decentralized platforms, limited understanding exists regarding the interactions between blockchain platforms, and the Dapps built upon them (Chen et al., 2021). This research explores the evolving relationship between platform business models and blockchain technology. Focusing on Ethereum as an innovation platform, it aims to examine how blockchain reshapes platform ecosystems, governance structures, and innovation dynamics. In particular, it investigates how complementor roles evolve in a decentralized context, revealing new pathways for innovation less reliant on centralized control. By analyzing these shifts, the study contributes to understanding how blockchain challenges dominant platform paradigms and proposes an alternative model for organizing platform ecosystems.

Accordingly, this research addresses the following research question: *How does blockchain-based decentralization, exemplified by Ethereum, challenge and extend established conceptualizations of innovation platforms?*

2. THEORETICAL BACKGROUND

2.1 INNOVATION PLATFORMS AND COMPLEMENTOR DYNAMICS

Innovation platforms represent a foundational mechanism for fostering and orchestrating external innovation within digital ecosystems. Defined as "products, services, or

technologies that act as a foundation upon which external innovators, organized as an innovative business ecosystem, can develop their own complementary products, technologies, or services" (Gawer & Cusumano, 2014), these platforms are purposefully designed to enable complementors, external developers or firms, to create additional value atop a core technological architecture. Examples such as iOS, Windows, and videogame consoles exemplify this model, where the success of the platform is inherently linked to the richness and diversity of the complementary innovations developed by third-party actors (Gawer, 2021; Jacobides et al., 2024). Through the coordination of inter-organizational value creation, innovation platforms generate layered innovation ecosystems in which complementors play a central role in extending the platform's functionalities and enhancing user experience (Frandsen, 2017).

However, the relationship between platform providers and complementors in traditional innovation platforms is marked by inherent power asymmetries. The platform leader, also referred to as the orchestrator or keystone firm (Iansiti & Levien, 2004), controls the core technological architecture and establishes the governance framework that dictates how complementors can engage with the platform (Gawer & Cusumano, 2002; Jacobides et al., 2024). This control is exercised through boundary resources such as APIs and SDKs, which determine the technical and contractual interfaces available to third-party developers (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013). While this governance structure enables efficient coordination, it also consolidates decision-making power in the hands of the platform leader, shaping the trajectory of innovation and influencing which complementary products are allowed or promoted (Gawer, 2021).

Scholars are divided on whether platform leaders should compete with their complementors. Some argue that competition undermines trust and discourages innovation by third-party actors (Gawer & Henderson, 2005; Lan et al., 2019; Wen & Zhu, 2019). Others suggest that platform-led entry into complementary spaces can stimulate innovation by increasing consumer attention and market size (Cennamo, 2018; Foerderer et al., 2018). Despite these debates, it is clear that the governance of traditional platforms often results in significant power imbalances, with platform owners acting both as regulators and competitors within their ecosystems (Gillespie, 2018; Jacobides et al., 2018; Thomas & Autio, 2020).

2.2 Innovation Platforms in Decentralized Contexts: Blockchain and Open Source

From this perspective, blockchain exhibits several features that make it comparable to an innovation platform. Originally designed as infrastructure for decentralized, peer-to-peer monetary exchange (Miau & Yang, 2018), it has evolved into a foundational technology enabling the development of applications far beyond cryptocurrencies (Catalini & Gans, 2016; Zamani & Giaglis, 2018). With the introduction of smart contracts, blockchain became a programmable architecture with growing relevance across non-financial sectors, including supply chains, healthcare, public administration, and creative industries (Buterin, 2014). Traditionally, platform providers, often known as platform leaders (Gawer & Cusumano, 2002), retain control over the core technological infrastructure. However, blockchain has emerged as a technological paradigm that challenges the traditional assumptions of innovation platforms (Trabucchi et al., 2020). It is now considered as a potential foundation for decentralized platforms, where governance and decision-making are distributed across community contributors rather than concentrated in a single firm (Chen et al., 2021).

From this perspective, blockchain platforms share strong affinities with the open-source movement, which predates blockchain but similarly emphasizes decentralization and community governance (Izquierdo & Cabot, 2018). Innovation platforms in decentralized contexts, such as blockchain and open-source projects, exhibit several commonalities in governance models. Both types of platforms emphasize active community participation and decentralization, mitigating the traditional centralization of power (Chen et al., 2021; Tiwana, 2014). Open-source projects are typically governed through distributed community-driven efforts rather than proprietary control, enhancing credibility and transparency. These two decentralized models, blockchain platforms and open-source projects, also share another key feature in how complementors drive innovation. In particular, modularity and composability, two structural characteristics that enable complementors to interoperate and build on each other's work, are present in both domains. They have been identified as central to the success of projects like GNU/Linux distributions (Keil et al., 2018) and are a key, intrinsic feature of smart contracts (Sun et al., 2024). Starting from the recognition of the parallel between innovation platforms and blockchain platforms, this study investigates the extent to which blockchain can be interpreted as an innovation platform, and how it differs from more traditional models.

3. METHODOLOGY

The methodology adopted in this research aims to provide an in-depth understanding of Ethereum as a decentralized innovation platform. A qualitative single-case study approach was selected for its suitability in exploring under-researched areas and addressing complex "how" questions (Edmondson & Mcmanus, 2007; Yin, 2013). Ethereum was chosen as a revelatory and representative case due to its pioneering role in blockchain programmability and its influence on subsequent decentralized ecosystems (Yin, 2013).
Ethereum represents a particularly relevant case because of its explicit positioning as a programmable blockchain, enabling a detailed examination of governance mechanisms, complementor dynamics, and innovation processes in a decentralized setting. Its robust ecosystem, active developer community, and status as a reference point for other blockchain platforms further justify this selection.

The study relies exclusively on secondary data sources to comprehensively analyze Ethereum's evolving ecosystem. This choice aligns with the project's nature, characterized by extensive publicly available documentation, community-generated content, and continuous updates from core contributors and affiliated organizations.
The dataset comprises over 100 secondary sources, including the official Ethereum whitepapers, Ethereum Foundation reports, technical documentation, and blog posts from core developers. Additionally, industry media such as *CoinDesk* and *Cointelegraph*, as well as analytical platforms like Etherscan and DappRadar, were systematically reviewed. This corpus is complemented by academic literature on platforms and blockchain governance, ensuring triangulation and enhancing construct validity (Yin, 2013).

A comparative analytical approach is also employed to benchmark Ethereum against established innovation platforms, including traditional operating systems (iOS, macOS, Android, Windows) and open-source projects (GNU/Linux OS, Apache HTTP Server, Arduino). This comparison highlights similarities and differences in governance

structures, complementor openness, and innovation dynamics, situating Ethereum within the broader innovation platform literature.

This methodological approach, combining single-case analysis with comparative insights, enables a comprehensive exploration of Ethereum's unique characteristics as a decentralized innovation platform. The findings contribute to both theoretical advancements in platform and blockchain studies and practical insights for organizations and entrepreneurs navigating decentralized ecosystems.

4. FINDINGS

This section presents the main findings of the study, structured around the three analytical dimensions identified in the methodology: governance and orchestration, complementor engagement, and architectural modularity and composability. Additionally, Ethereum is compared with traditional operating systems and open-source ecosystems to identify convergences, divergences, and the emergence of a new archetype of innovation platform.

4.1 GOVERNANCE AND ORCHESTRATION IN ETHEREUM

Ethereum's governance model constitutes a significant departure from the hierarchical orchestration mechanisms typically observed in traditional platform ecosystems. Unlike conventional innovation platforms, where a single firm exercises centralized control over the technological core and dictates the evolution of the ecosystem, Ethereum adopts a multi-actor governance structure. At the center of this configuration stands the Ethereum Foundation (EF), a Swiss non-profit organization established in 2014 following Ethereum's initial coin offering. The Foundation operates not as a dominant orchestrator but as an ecosystem steward, assuming a facilitative role aimed at sustaining long-term development, maintaining protocol integrity, and promoting the core values of decentralization and neutrality.

The Ethereum Foundation's approach is informed by a philosophy of subtraction, a deliberate strategy to minimize its visibility and centrality in the governance process. Rather than concentrating decision-making authority, the EF actively fosters a collaborative environment where independent contributors, developers, and organizations participate in shaping the platform's future. This organizational choice reflects an intentional divergence from platform business models where control over boundary resources and application development pipelines is closely guarded.

Central to Ethereum's governance is the Ethereum Improvement Proposal (EIP) framework. Established in 2015, the EIP system provides a structured yet open mechanism for proposing, reviewing, and implementing changes to the Ethereum protocol. Any member of the Ethereum community can submit an EIP, which then undergoes public scrutiny through community discussions, technical reviews, and iterative refinement. Decisions about EIP adoption are not made unilaterally by the EF but emerge through broad-based consensus among core developers, node operators, and community stakeholders. This process exemplifies a bottom-up, participatory model of governance that contrasts with the top-down decision-making typically employed by platform providers such as Apple or Google in managing iOS or Android ecosystems.

Complementing the EIP process are community-driven initiatives and events designed to foster collective decision-making and knowledge exchange. Devcon and Devconnect, for example, are annual global gatherings that bring together developers, researchers, and users to discuss the strategic trajectory of the platform and collaboratively address

technical challenges. The Fellowship of Ethereum Magicians, a self-organized community forum, further reinforces this decentralized governance model by providing a space for technical deliberation and the development of ecosystem-wide standards outside formal institutional control.

Through these mechanisms, Ethereum implements a governance structure that prioritizes inclusivity, transparency, and distributed participation. The EF's role is thus reframed from that of an authoritative platform owner to that of a facilitator and enabler of decentralized innovation.

4.2 COMPLEMENTOR ENGAGEMENT AND ECOSYSTEM DYNAMICS

Ethereum's architecture is explicitly designed to promote third-party innovation, positioning complementors, primarily developers of smart contracts and Dapps, as fundamental contributors to its ecosystem. Unlike traditional platforms, where complementor participation is mediated by boundary resources and subject to approval by the platform owner, Ethereum adopts a fully permissionless model. Any developer, regardless of affiliation or location, can build and deploy smart contracts directly onto the Ethereum blockchain, without needing to secure authorization from a central entity.
As of June 2025, over 5,000 Dapps are actively deployed on the protocol[1], and the network has surpassed 320 million unique wallet addresses[2], reflecting its broad adoption and extensive network effects. This decentralized participation generates a virtuous cycle: the more developers and applications that operate on Ethereum, the more valuable the platform becomes for new users and complementors, reinforcing growth through positive feedback loops.

The Ethereum Virtual Machine (EVM) serves as the technical core of this ecosystem. It provides a Turing-complete execution environment that allows developers to encode any computable logic into smart contracts. Together with programming languages such as Solidity and development tools like Truffle, Hardhat, and Remix, the EVM facilitates rapid prototyping, testing, and deployment of decentralized applications. Complementors also benefit from extensive documentation, public repositories, and access to testnets, which collectively lower barriers to entry and support iterative development.
Beyond the technical stack, Ethereum integrates innovative economic incentives to attract and retain complementors. Developers can issue native tokens to fund their projects, incentivize user participation, and govern decentralized applications. This practice aligns the interests of developers and users, fostering sustainable innovation models without centralized oversight. Token-based governance mechanisms, such as those employed by Decentralized Autonomous Organizations (DAOs), enable developers to retain control over the evolution of their applications while distributing decision-making authority among stakeholders. This model effectively replaces traditional revenue-sharing schemes with decentralized financial architectures that empower developers to directly capture and distribute value within their communities.

Overall, Ethereum reconfigures the relationship between platform providers and complementors by removing conventional entry barriers and enabling a decentralized, incentive-aligned innovation ecosystem. This model fosters rapid experimentation,

[1] (Source: https://dappradar.com/, accessed June 17, 2025)
[2] (Source: https://etherscan.io/, accessed June 17, 2025)

ecosystem growth, and a shift in the locus of innovation from the platform core to its periphery, empowering a global developer network to co-create the platform's future.

4.3 Architectural Modularity and Composability

A defining characteristic of Ethereum's infrastructure is its native support for modularity and composability, which operates at a level of openness and interoperability that surpasses traditional platform architectures. While conventional platforms typically control modular innovation through APIs and SDKs, limiting how complementors can interact with core functionalities, Ethereum enables complementors to interoperate directly and without centralized approval at the smart contract level. This structural feature transforms Ethereum from a monolithic platform into a decentralized, modular innovation environment.

Smart contracts on Ethereum are inherently public and reusable. They function analogously to open-source software libraries but are deployed on-chain and can be invoked by any other contract or application without the need for prior agreements or licensing. This dynamic creates what industry commentators describe as composability by default, where developers can seamlessly build upon each other's code to create new applications and services. As a result, innovation in Ethereum is not only cumulative but also horizontally distributed, with new Dapps routinely integrating existing components into novel configurations.

Three distinct forms of composability emerge from the analysis of Ethereum's ecosystem. Syntactic composability refers to the direct integration of existing smart contracts into new applications, enabling the reuse of core logic across multiple projects. For instance, PoolTogether leverages decentralized finance protocols such as Compound and Chainlink to provide a gamified savings platform, combining financial primitives with randomization services. Atomic composability enables multiple smart contract operations to be bundled into a single transaction, ensuring that either all operations are executed or none are—thus maintaining system integrity. This mechanism is central to the functioning of complex DeFi strategies, such as flash loans, where multiple market actions are conducted simultaneously without collateral. Morphological composability involves the interoperability of token standards, particularly ERC-20 and ERC-721, allowing digital assets to circulate freely across different Dapps. The widespread use of DAI, a stablecoin developed by MakerDAO, exemplifies this form of composability, as it is seamlessly integrated into exchanges, lending platforms, and payment systems.

Through permissionless composability, Ethereum redefines the platform-complementor relationship. Rather than operating through a controlled core-periphery model, the platform supports a fluid and dynamic ecosystem in which complementors build directly upon each other's outputs, driving a continuous cycle of innovation and experimentation. This architectural feature not only differentiates Ethereum from traditional operating systems and proprietary platforms but also positions it as a foundational layer for the broader Web3 paradigm, where openness and interoperability are structural principles rather than strategic choices.

4.4 Comparative analysis

To contextualize the findings from the Ethereum case study, a comparative analysis was conducted involving seven reference platforms, selected to represent both traditional operating systems and open-source projects. This analytical juxtaposition highlights the

distinctive features of Ethereum while situating it within the broader landscape of innovation platforms.

The comparison reveals that Ethereum shares several characteristics with open-source ecosystems, particularly in terms of governance decentralization, community-driven development, and the absence of centralized control over complementor engagement. Similar to projects such as GNU/Linux, Arduino, and the Apache HTTP Server, Ethereum fosters an environment where contributors act autonomously, building modular components that are openly shared and collectively improved. However, Ethereum extends this model by embedding economic incentives and programmable coordination directly into the protocol, enabling a form of decentralized innovation that is both technical and financial in nature.

In contrast to traditional operating systems, such as iOS, macOS, Android, and Windows, Ethereum eliminates the role of the platform owner as gatekeeper. Whereas firms like Apple, Google, and Microsoft maintain control over application distribution channels, boundary resources, and monetization pathways, Ethereum enables permissionless participation at the infrastructural level. Developers do not require approval to deploy applications, nor are they subject to centralized revenue extraction mechanisms such as app store commissions or licensing fees. This structural openness redefines the relationship between the platform and its complementors, shifting from orchestrated collaboration to autonomous, peer-to-peer innovation.

Furthermore, Ethereum introduces a unique form of complement-level composability, which was not observed in the comparative cases. While traditional platforms support modularity primarily at the interface between the platform core and third-party applications, Ethereum fosters horizontal interoperability among complements themselves. This allows for the dynamic recombination of smart contracts across multiple Dapps, creating a continuous feedback loop of innovation that transcends platform boundaries. Table 1 summarizes the findings from the comparative analysis, highlighting Ethereum's distinctive positioning relative to both traditional and open-source innovation platforms.

Cases	**Supply-Side Openness**		**Modularity and Composability**		**Platform Provider**	
Ethereum	Yes	Open-source and structurally permissionless by protocol design	Smart contracts and Dapps level	Permissionless	Ethereum Foundation	EF acts as a facilitator and coordinator of the ecosystem, empowering developers and advocating for Ethereum
iOS	No	Defined by the platform owner's control over application distribution channels	Mainly libraries level	Permissioned	Apple	Apple exerts strong control via APIs, SDKs, and App Store (mandatory gateway). It develops proprietary complements
macOS	Yes	Defined by the platform owner's control over application	Mainly libraries level	Permissioned	Apple	Apple controls APIs and SDKs, but App Store is optional; it

		distribution channels				develops internal complements
Android	Yes	Defined by the platform owner's control over application distribution channels	Mainly libraries level	Permissioned	Google	Google controls APIs, SDKs, and AOSP release; however, it allows multiple distribution channels. Some complements are developed internally
Windows	Yes	Defined by the platform owner's control over application distribution channels	Mainly libraries level	Permissioned	Microsoft	Microsoft controls APIs and Microsoft Store, despite it allows alternative distributions. It develops in-house complements—e.g., Microsoft Office
Apache HTTP Server	Yes	Embedded in the open-source nature and guided by democratization purpose	Mods level	Permissioned	Apache Software Foundation	ASF acts as ecosystem steward; it does not control complementors. Widely adopted modules may be integrated into official releases
Arduino	Yes	Embedded in the open-source nature and guided by democratization purpose	Sketches and shields level	Permissioned	Arduino AG	Collaborative relationship, with no control over complementors or their output
GNU/Linux OS	Yes	Embedded in the open-source nature and guided by democratization purpose	Distributions level	Permissioned	Linux Foundation and Free Software Foundation	LF and FSF operate as promoters and facilitators. Complementors act independently

Table 1 - Comparative Analysis

This comparison positions Ethereum as a novel archetype of innovation platform—one that synthesizes elements of open-source governance with blockchain-enabled modularity and permissionless participation. By blending these characteristics, Ethereum not only challenges the assumptions underpinning traditional platform models but also offers a blueprint for decentralized, community-driven ecosystems in the emerging Web3 landscape.

5. DISCUSSION

This section interprets the findings in relation to theories on innovation platforms, digital ecosystems, and blockchain governance. Based on the Ethereum case study and comparative analysis, it shows how Ethereum challenges and extends traditional views

of platform dynamics. Whereas prior research highlights the role of platform leaders in managing complementor engagement, modular architectures, and openness(Baldwin & Woodard, 2009; Eaton et al., 2015; Gawer & Cusumano, 2014), Ethereum adopts a different model. Its architecture and governance enable new configurations of openness, modularity, and coordination, positioning blockchain-based platforms as a new archetype in the platform economy. The next sections outline these contributions, with implications for theory, practice, and future research.

5.1 Redefining Platform Openness: From Governance Choice to Protocol Design

A key insight from this study is the redefinition of platform openness. In traditional digital platforms, openness is a strategic variable managed by the platform owner through boundary resources like APIs, SDKs, and app stores, determining who can participate and under what conditions (Cusumano et al., 2019; Eaton et al., 2015). This approach treats openness as a managerial lever to balance innovation with control (Gawer, 2021; Jacobides et al., 2024). Ethereum inverts this logic. Here, openness is not a strategic choice but a structural feature embedded in the protocol. Developers build on Ethereum without permission, using public smart contract standards and tools. Complementor participation is protocol-native rather than orchestrator-mediated, contrasting with the selective, provider-controlled access typical of platform governance models (Pereira et al., 2019; Vella & Gastaldi, 2025).

This transformation has two key implications for theory. First, it challenges the assumption that platform success depends on the platform owner's capacity to regulate openness and selectively onboard complementors. In Ethereum, the absence of gatekeeping has not hindered ecosystem growth but has instead catalyzed expansive innovation. Second, it calls for a reconceptualization of openness as a design feature rather than a governance lever. The Ethereum case demonstrates that openness can be programmed into the platform's foundational rules, shifting control over participation from the provider to the ecosystem itself.

This paradigm shift requires expanding platform theory to account for infrastructures where complementor access is not managed by policy or strategic intent but enabled structurally through technological affordances. Ethereum illustrates how protocol-level openness fosters decentralized innovation without compromising system coherence, suggesting new directions for both theoretical inquiry and platform design practice.

5.2 Extending Modularity and Composability: From Core-Periphery to Complement-Level Interoperability

A second key contribution of this study is the extension of modularity and composability in platform ecosystems. Traditional platform literature conceptualizes modularity as a stable core with a variable periphery, where the platform owner controls interfaces for third-party development(Baldwin & Woodard, 2009; Gawer, 2014). Complementors interact with the core via standardized APIs, but their innovations typically remain isolated, limiting direct interoperability. Ethereum transcends this model by embedding complement-to-complement composability into its smart contract architecture. Innovation occurs not only through core-periphery interactions but also via horizontal recombination among complements. Developers build new Dapps by assembling existing smart contracts, creating a library of reusable components that accelerates development and lowers entry barriers. Unlike traditional platforms, where composability is

constrained to technical modularity at the interface level, Ethereum enables permissionless composability directly among complements.

This model has significant implications for platform theory. It challenges the view of modularity as a one-directional interface and introduces a configuration where complements are both autonomous and interdependent. Peer-level composability enhances innovation speed, fosters experimentation, and enables complex service ecosystems without centralized coordination. By shifting the locus of modularity from core-periphery to complement-complement interactions, Ethereum exemplifies a decentralized and collaborative mode of innovation that extends existing platform theories.

5.3 Introducing Multi-Actor Orchestration as a Governance Archetype

The third contribution of this study concerns platform governance. Traditional platforms rely on centralized orchestration, where the owner controls engagement rules, boundary resources, and value capture, often resulting in power asymmetries (Gawer & Cusumano, 2014; Jacobides et al., 2018). Ethereum proposes an alternative model: multi-actor orchestration. Here, governance is distributed across actors such as the Ethereum Foundation, core developers, Dapp creators, token holders, and DAOs. The Foundation acts as facilitator, offering resources and guidance while avoiding direct control. This reflects a philosophy of subtraction and neutrality, empowering the community rather than dictating outcomes.

The Ethereum Improvement Proposal (EIP) process exemplifies this model, allowing any participant to propose protocol changes through open, iterative consensus (Chen et al., 2021; Buterin, 2014). Beyond code, governance extends to community forums like the Fellowship of Ethereum Magicians and events such as Devcon and Devconnect, fostering participatory decision-making. DAOs further decentralize orchestration, using token-based mechanisms for project governance (Sun et al., 2024). This model challenges the assumption that centralized orchestration is required for ecosystem coherence(Adner & Kapoor, 2010; Boudreau & Hagiu, 2009). Ethereum shows that coordination can emerge from technological protocols (e.g., EIPs, smart contracts), social structures (e.g., forums), and economic incentives (e.g., tokenomics). This reduces risks of envelopment, limits extractive practices, and sustains community engagement.

Multi-actor orchestration thus represents a new archetype in platform governance, blending open-source collaboration with blockchain's programmable, incentive-aligned frameworks. It calls for an expanded platform theory that accounts for decentralized and resilient governance models where strategic direction emerges organically.

5.4 Managerial Implications

This study provides several insights for practitioners in platform design, entrepreneurship, and ecosystem management. Ethereum shows that decentralized governance, composable architectures, and permissionless participation are not theoretical ideals but viable mechanisms for large-scale innovation.

First, for platform designers and entrepreneurs, Ethereum demonstrates that openness can be structurally embedded rather than selectively managed. Unlike traditional models that control access through APIs or SDKs, Ethereum's protocol-level openness lowers gatekeeping costs, accelerates third-party development, and fosters broader innovation.

Managers may consider integrating openness directly into technical architectures to achieve similar outcomes.

Second, Ethereum's complement-level composability offers a model for rapid innovation. Developers can reuse and combine components freely, reducing costs and development time while promoting cumulative innovation. For technology leaders, fostering peer-level interoperability—beyond core–periphery modularity—can expand ecosystem creativity. However, this approach also requires careful management of security risks and technical debt due to increased interdependencies.

Third, Ethereum's governance model provides lessons in decentralized ecosystem management. Its multi-actor orchestration distributes decision-making across diverse stakeholders, achieving coherence without central control. Managers of digital platforms, open-source projects, or decentralized initiatives may benefit from shifting toward facilitative stewardship, enabling community-led decision-making while providing infrastructure and support.

Finally, for policymakers, Ethereum raises questions about regulation in decentralized environments. Traditional oversight assumes identifiable intermediaries, but Ethereum's dispersed orchestration challenges this model, highlighting the need for new regulatory approaches that address decentralized coordination while ensuring accountability.

6. Limitations and Future Research

This study has several limitations. First, it adopts a single-case design focused on Ethereum. While Ethereum is a paradigmatic case, its unique features—such as early-mover advantage, community scale, and specific governance ethos—may limit generalizability. Future research could extend this analysis through multi-case studies of other blockchain platforms (e.g., Solana, Polkadot, Cosmos) to compare configurations of governance, openness, and modularity.

Second, the study relies solely on secondary data, potentially overlooking tacit knowledge, informal practices, or behind-the-scenes negotiations. Primary data collection, such as interviews with developers, Foundation members, and Dapp creators, could provide deeper insights into governance dynamics and ecosystem evolution.

Third, the analysis emphasizes Ethereum's strengths but does not fully address potential risks. Issues such as security vulnerabilities, cascading failures from smart contract interdependencies, and the risk of governance capture merit further investigation. The influence of core developers or well-funded actors may lead to forms of de facto centralization that require longitudinal analysis.

Finally, future research should examine the institutional and regulatory implications of multi-actor orchestration. Key questions include how decentralized governance interacts with legal systems and what accountability mechanisms are needed in ecosystems without clear ownership. These issues are critical for understanding the evolution of digital platforms in the Web3.

References

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. Strategic Management Journal, 31(3), 306–333. https://doi.org/10.1002/smj.821

Baldwin, C. Y., & Woodard, C. J. (2009). The architecture of platforms: A unified view. In Platforms, Markets and Innovation (pp. 19–44). Scopus.

Boudreau, K. J., & Hagiu, A. (2009). Platform Rules: Multi-Sided Platforms as Regulators. Chapters. https://ideas.repec.org//h/elg/eechap/13257_7.html

Catalini, C., & Gans, J. S. (2016). Some Simple Economics of the Blockchain. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2874598

Cennamo, C. (2018). Building the Value of Next-Generation Platforms: The Paradox of Diminishing Returns. Journal of Management, 44(8), 3038–3069. https://doi.org/10.1177/0149206316658350

Chen, Y., & Bellavitis, C. (2020). Blockchain disruption and decentralized finance: The rise of decentralized business models. Journal of Business Venturing Insights, 13. https://doi.org/10.1016/j.jbvi.2019.e00151

Chen, Y., Richter, J. I., & Patel, P. C. (2021). Decentralized Governance of Digital Platforms. Journal of Management, 47(5), 1305–1337. https://doi.org/10.1177/0149206320916755

Cusumano, M. A., Gawer, A., & Yoffie, D. B. (2019). The Business of Platforms: Strategy in the Age of Digital Competition, Innovation, and Power (Illustrated edition). HarperBus.

Eaton, B., Elaluf-Calderwood, S., Sørensen, C., & Yoo, Y. (2015). Distributed Tuning of Boundary Resources: The Case of Apple's iOS Service System. MIS Quarterly, 39(1), 217–244. https://doi.org/10.25300/MISQ/2015/39.1.10

Edmondson, A. C., & Mcmanus, S. E. (2007). Methodological fit in management field research. Academy of Management Review, 32(4), 1246–1264. https://doi.org/10.5465/amr.2007.26586086

Foerderer, J., Kude, T., Mithas, S., & Heinzl, A. (2018). Does Platform Owner's Entry Crowd Out Innovation? Evidence from Google Photos. Information Systems Research, 29(2), 444–460. https://doi.org/10.1287/isre.2018.0787

Frandsen, T. (2017). Evolution of modularity literature: A 25-year bibliometric analysis. International Journal of Operations & Production Management, 37(6), 703–747. https://doi.org/10.1108/ijopm-06-2015-0366

Gastaldi, L., Appio, F. P., Trabucchi, D., Buganza, T., & Corso, M. (2024). From mutualism to commensalism: Assessing the evolving relationship between complementors and digital platforms. Information Systems Journal. https://doi.org/10.1111/isj.12491

Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. Research Policy, 43(7), 1239–1249. https://doi.org/10.1016/j.respol.2014.03.006

Gawer, A. (2021). Digital platforms and ecosystems: Remarks on the dominant organizational forms of the digital age. Innovation, 1–15. https://doi.org/10.1080/14479338.2021.1965888

Gawer, A., & Cusumano, M. A. (2002). Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation. Harvard Business School Press.

Gawer, A., & Cusumano, M. A. (2014). Industry Platforms and Ecosystem Innovation. Journal of Product Innovation Management, 31(3), 417–433. https://doi.org/10.1111/jpim.12105

Gawer, A., & Henderson, R. M. (2005). Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel (SSRN Scholarly Paper 872715). Social Science Research Network. https://papers.ssrn.com/abstract=872715

Ghazawneh, A., & Henfridsson, O. (2013). Balancing platform control and external contribution in third-party development: The boundary resources model. Information Systems Journal, 23(2), 173–192. https://doi.org/10.1111/j.1365-2575.2012.00406.x

Gillespie, T. (2018). Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media. Yale University Press. https://doi.org/10.12987/9780300235029

Iansiti, M., & Levien, R. (2004). The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability. Harvard Business Press.

Izquierdo, J. L. C., & Cabot, J. (2018). The role of foundations in open source projects. Proceedings of the 40th International Conference on Software Engineering: Software Engineering in Society, 3–12. https://doi.org/10.1145/3183428.3183438

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. Strategic Management Journal, 39(8), 2255–2276. https://doi.org/10.1002/smj.2904

Jacobides, M. G., Cennamo, C., & Gawer, A. (2024). Externalities and complementarities in platforms and ecosystems: From structural solutions to endogenous failures. Research Policy, 53(1), 104906. https://doi.org/10.1016/j.respol.2023.104906

Keil, P., MacDonald, A. A. M., Ramirez, K. S., Bennett, J. M., García-Peña, G. E., Yguel, B., Bourgeois, B., & Meyer, C. (2018). Macroecological and macroevolutionary patterns emerge in the universe of GNU/Linux operating systems. Ecography, 41(11), 1788–1800. https://doi.org/10.1111/ecog.03424

Lan, S., Liu, K., & Dong, Y. (2019). Dancing with wolves: How value creation and value capture dynamics affect complementor participation in industry platforms. Industry and Innovation, 26(8), 943–963. https://doi.org/10.1080/13662716.2019.1598339

Leiponen, A., Thomas, L. D. W., & Wang, Q. (2022). The dApp economy: A new platform for distributed innovation? Innovation, 24(1), 125–143. https://doi.org/10.1080/14479338.2021.1965887

Miau, S., & Yang, J.-M. (2018). Bibliometrics-based evaluation of the Blockchain research trend: 2008 – March 2017. Technology Analysis & Strategic Management, 30(9), 1029–1045. https://doi.org/10.1080/09537325.2018.1434138

Pereira, J., Tavalaei, M. M., & Ozalp, H. (2019). Blockchain-based platforms: Decentralized infrastructures and its boundary conditions. Technological Forecasting and Social Change, 146, 94–102. https://doi.org/10.1016/j.techfore.2019.04.030

Sun, J., Saddik, A. E., & Cai, W. (2024). Smart Contract as a Service: A Paradigm of Reusing Smart Contract in Web3 Ecosystem. IEEE Consumer Electronics Magazine, 14(1), 46–55. https://doi.org/10.1109/MCE.2024.3353178

Thomas, L. D. W., & Autio, E. (2020). Innovation Ecosystems in Management: An Organizing Typology. In Oxford Research Encyclopedia of Business and Management. https://doi.org/10.1093/acrefore/9780190224851.013.203

Tiwana, A. (2014). Evolving a Platform. Platform Ecosystems, 201–246. https://doi.org/10.1016/b978-0-12-408066-9.00010-2

Trabucchi, D., & Buganza, T. (2019). Data-driven innovation: Switching the perspective on Big Data. European Journal of Innovation Management, 22(1), 23–40. https://doi.org/10.1108/ejim-01-2018-0017

Trabucchi, D., Buganza, T., & Pellizzoni, E. (2017). Give Away Your Digital Services: Leveraging Big Data to Capture ValueNew models that capture the value embedded in the data generated by digital services may make it viable for companies to offer those services for free. Research-Technology Management, 60(2), 43–52. https://doi.org/10.1080/08956308.2017.1276390

Trabucchi, D., Moretto, A., Buganza, T., & MacCormack, A. (2020). Disrupting the Disruptors or Enhancing Them? How Blockchain Reshapes Two-Sided Platforms. Journal of Product Innovation Management, 37(6), 552–574. https://doi.org/10.1111/jpim.12557

Trabucchi, D., Talenti, L., & Buganza, T. (2019). How do Big Bang Disruptors look like? A Business Model perspective. Technological Forecasting and Social Change, 141, 330–340. https://doi.org/10.1016/j.techfore.2019.01.009

Vella, G., & Gastaldi, L. (2025). Creating a blockchain platform: An empirical analysis in the Italian banking sector. Creativity and Innovation Management, 34(2), 393–413. https://doi.org/10.1111/caim.12645

Vitalik Buterin. (2014). A Next Generation Smart Contract & Decentralized Application Platform. https://ethereum.org/en/whitepaper/

Wen, W., & Zhu, F. (2019). Threat of platform-owner entry and complementor responses: Evidence from the mobile app market. Strategic Management Journal, 40(9), 1336–1367. https://doi.org/10.1002/smj.3031

Yin, R. K. (2013). Case Study Research: Design and Methods (5° edizione). Sage Pubns.

Zamani, E. D., & Giaglis, G. M. (2018). With a little help from the miners: Distributed ledger technology and market disintermediation. Industrial Management & Data Systems, 118(3), 637–652. https://doi.org/10.1108/IMDS-05-2017-0231

Zeng, J., Mahdi Tavalaei, M., & Khan, Z. (2021). Sharing economy platform firms and their resource orchestration approaches. Journal of Business Research, 136, 451–465. https://doi.org/10.1016/j.jbusres.2021.07.054