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Rethinking Firm Boundaries in the Platform Economy: How Digital Intermediation Redefines Organizational Scope, Market Participation, and Competitive Strategy

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Abstract

The platform economy has fundamentally altered how firms define their organizational boundaries, shifting from traditional internalization logic toward permeable, digitally mediated structures. This theory-development article synthesizes recent scholarship on digital intermediation to propose a novel framework that explains how platform-based coordination reconfigures firm scope, market participation, and competitive strategy. Drawing on peer-reviewed studies, we argue that digital intermediation enables boundary permeability by reducing transaction costs, facilitating complementor integration, and enabling indirect governance without full ownership. We contrast platform participation with classical internalization, highlighting ecosystem governance mechanisms that expand organizational scope while preserving strategic autonomy. Five formal propositions articulate the causal pathways: digital interfaces increase boundary permeability; complementor orchestration substitutes for vertical integration; ecosystem participation redefines market entry modes; platform-mediated coordination lowers coordination costs across firm boundaries; and strategic repositioning in multi-sided markets enhances competitive advantage through selective boundary management. The resulting theory advances boundary theory by integrating digital intermediation as a core mechanism of scope transformation. Contributions include a dynamic model of ecosystem boundary dynamics and implications for managerial decision-making in platform environments. This conceptual work lays the foundation for future empirical validation in digitally mediated markets.

Keywords Platform economy, Digital intermediation, Firm boundaries, Organizational scope, Ecosystem participation, Market participation

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Introduction

The platform economy and the role of digital intermediation

Digital platforms have emerged as dominant organizational forms that challenge conventional understandings of firm boundaries [1]. Unlike traditional hierarchies, platforms operate through digital intermediation that connects multiple sides of the market—users, complementors, and

producers—without owning all assets. This intermediation relies on interfaces, algorithms, and data flows that enable coordination at scale while maintaining organizational flexibility [2–6]. Recent scholarship underscores that such mechanisms fundamentally alter how firms delineate their scope and participate in markets [7–9].

Traditional firm boundary theories reexamined in digital contexts

Classical theories of the firm, rooted in transaction-cost economics and resource-based views, emphasized internalization to minimize opportunism and protect core competencies [7, 10]. In platform economies, however, digital intermediation reduces the need for full internalization by creating permeable boundaries that allow selective access to external resources [1]. Studies reveal that firms increasingly outsource non-core activities to ecosystem participants while retaining control through platform governance [8, 11–18]. This shift demands a rethinking of organizational scope beyond static make-or-buy decisions [15, 16].

Market participation through ecosystem integration

Platform participation replaces traditional market entry with ecosystem-based strategies, in which firms act as orchestrators or complementors [9, 19]. Digital intermediation facilitates indirect integration, enabling firms to expand market reach without heavy capital investment. Complementors gain access to shared infrastructures, while platform owners benefit from network effects that amplify value creation [20–22]. This dynamic participation blurs the distinction between inside and outside the firm, requiring new governance approaches [2, 23].

Strategic challenges to organizational scope in platform markets

The expansion of organizational scope via digital platforms introduces tensions between openness and control [11, 24–27]. Firms must balance boundary permeability to encourage innovation with mechanisms that prevent rivals from appropriating value [12, 25]. Literature on servitization and digital transformation illustrates how scope reconfiguration occurs through ecosystem positioning rather than hierarchical expansion [4, 6]. Competitive strategy thus pivots from resource ownership to ecosystem orchestration [3, 15].

Competitive strategy and boundary permeability in digitally mediated markets

Strategic positioning in platform economies hinges on the ability to manage boundary permeability strategically [1, 21]. Digital intermediation allows firms to participate in multiple ecosystems simultaneously, redefining competitive

advantage through network centrality rather than standalone capabilities [16, 20]. This article builds on these insights to develop a cohesive theory that explains how digital intermediation drives the observed transformations.

Theoretical Foundations and Literature Synthesis

Platform economies and the erosion of traditional firm boundaries

Platform economies erode classical firm boundaries by substituting digital coordination for hierarchical control [1, 27]. Gawer's analysis of platform interfaces demonstrates how digital layers create permeable structures that integrate external actors without ownership [1]. Complementary work on transaction costs shows that capabilities and digital tools jointly reduce the incentives for internalization [7, 10]. In multi-sided platforms, boundary decisions become dynamic, driven by network effects and governance choices rather than asset specificity alone [18, 20].

Digital intermediation as a boundary-spanning mechanism

Digital intermediation operates as the central mechanism enabling boundary spanning [3, 6]. Leong *et al.* highlight how platform leadership manages interfaces to foster network growth while controlling core value propositions [3]. Kohtamäki and colleagues extend this to servitization ecosystems, where digital tools permit firms to reposition boundaries through modular service delivery [6]. Recent studies confirm that intermediation lowers coordination costs across firm boundaries, enabling selective participation rather than full integration [2, 8].

Complementor integration and ecosystem governance

Complementor integration represents a core shift from internalization to ecosystem participation [8, 28, 29]. Foerderer's examination of Apple's developer ecosystem reveals how innovation occurs through orchestrated exchanges rather than proprietary development [8]. Santoso *et al.* [28] propose typologies of open innovation in digital ecosystems that rely on crowd-complementor synergies. Governance emerges as a hybrid—combining

platform rules with relational norms—to maintain coherence without rigid boundaries [11, 12, 23].

Organizational scope redefinition through platform participation

Organizational scope in platform markets expands via participation rather than ownership [9, 15, 19]. Nambisan et al. [9] argue that global platforms reshape international business theories by enabling ecosystem-level scope adjustments. Menz et al. [15] link digital transformation to corporate strategy, showing how scope becomes fluid through data-driven boundary management. Cennamo et al. [19] further illustrate modalities of value co-creation that redefine scope boundaries in transformation contexts.

Competitive dynamics and strategic positioning in platform environments

Competitive strategy in platforms emphasizes positioning within ecosystems over standalone rivalry [16, 20, 22]. Clough and Wu demonstrate how decentralized AI structures alter platform dynamics, favoring firms that master boundary permeability [16]. Subramanian and Mitra show that value capture from user-generated content depends on strategic boundary choices [20]. Ranganathan and Chen extend this to multi-firm technology coordination, revealing ecosystem-level antecedents of competitive advantage [22].

Ecosystem governance and boundary permeability

Table 1 conceptualizes the mechanisms through which digital intermediation transforms traditional firm boundaries into permeable ecosystem interfaces.

Table 1. Mechanisms of firm boundary transformation in platform economies

Boundary transformation mechanism	Classical firm boundary logic	Platform economy logic	Digital intermediation mechanism
Activity coordination	Hierarchical supervision within firm boundaries	Digitally mediated coordination	APIs, cloud infrastructure and algorithmic coordination

		across ecosystems	
Resource integration	Internal ownership of assets and capabilities	Distributed resource participation	Data-sharing interfaces, modular architecture
Innovation generation	Internal R&D and controlled partnerships	Complementor-driven ecosystem innovation	Developer platforms, open innovation channels
Governance structure	Managerial authority and contracts	Platform governance rules and algorithms	Ranking systems, certification protocols, revenue sharing
Market expansion	Entry through investment or acquisition	Ecosystem participation and platform affiliation	Digital intermediation enabling platform participation
Organizational scope	Defined by internalized activities	Defined by orchestrated ecosystem participation	Interface-based boundary management

Ecosystem governance regulates permeability to balance openness and control [12, 25, 27]. Holgersson and Baldwin model ecosystem evolution forces that drive boundary adjustments [12]. Das and Dey highlight Industry 4.0 platforms where manufacturing networks rely on permeable boundaries for global value creation [25]. Boudreau's foundational work on platform boundary choices underscores the strategic trade-offs between opening and coordinating [27]. Collectively, these foundations set the stage for a new theoretical synthesis centered on digital intermediation.

Digital Intermediation and Ecosystem Boundary Dynamics: Transforming Organizational Scope and

Market Participation in Platform Economies

Building upon the theoretical synthesis of digital platforms, ecosystem governance, and network-based competition, this section advances a comprehensive theory of ecosystem boundary dynamics. The theory explains how digital intermediation fundamentally restructures organizational scope, firm boundaries, and patterns of market participation in platform-based economies. Rather than viewing firms as discrete entities operating within relatively stable industry boundaries, the platform economy introduces a fluid architecture in which boundaries become strategically permeable interfaces for coordination, innovation, and value creation. Digital intermediation operates as the central coordinating mechanism that enables this transformation, allowing firms to expand economic reach and orchestrate distributed activities without traditional hierarchical integration.

In classical organizational theory, firm boundaries were defined primarily by the logic of internalization. Firms internalized activities when market transactions became too costly due to uncertainty, opportunism, or coordination complexity. Hierarchical governance structures emerged as the dominant mechanism for organizing production, controlling resources, and coordinating interdependent activities. However, the rise of digital platforms challenges this assumption by introducing digitally mediated coordination infrastructures that reduce transaction costs while maintaining distributed participation [1, 2]. Platforms achieve this by embedding coordination rules, interaction protocols, and governance mechanisms directly into digital interfaces, enabling economic actors to collaborate through standardized technological architectures rather than hierarchical authority.

Digital intermediation, therefore, transforms the very logic of organizational boundaries. Instead of functioning as rigid demarcations between internal and external activities, boundaries become programmable interfaces that regulate participation in platform ecosystems. Through application programming interfaces (APIs), data-sharing protocols, modular architectures, and algorithmic governance mechanisms, platforms enable firms to selectively integrate external contributors while retaining strategic oversight of the ecosystem's core architecture. This transformation creates a form of boundary permeability, enabling organizational scope to expand or contract dynamically in

response to strategic priorities, ecosystem conditions, and governance capabilities.

Boundary permeability should not be interpreted as the disappearance of organizational boundaries; rather, it represents a deliberate managerial design choice. Platform firms strategically determine the degree of openness in their ecosystems by controlling access to digital interfaces, defining participation rules for complementors, and regulating flows of data and value across ecosystem participants. The resulting system resembles a semi-permeable membrane, where participation is encouraged but remains governed by the platform's architectural and institutional rules. In this configuration, digital intermediation becomes the mechanism through which firms orchestrate decentralized innovation while preserving control over the ecosystem's core infrastructure.

The theory of ecosystem boundary dynamics proposed here identifies three interrelated processes that collectively explain how digital intermediation reshapes organizational scope and market participation. **Figure 1** presents the Ecosystem Boundary Dynamics model, illustrating how digital intermediation mechanisms reshape firm boundaries, organizational scope, and competitive strategy through interface-enabled permeability, complementor orchestration, and ecosystem governance.

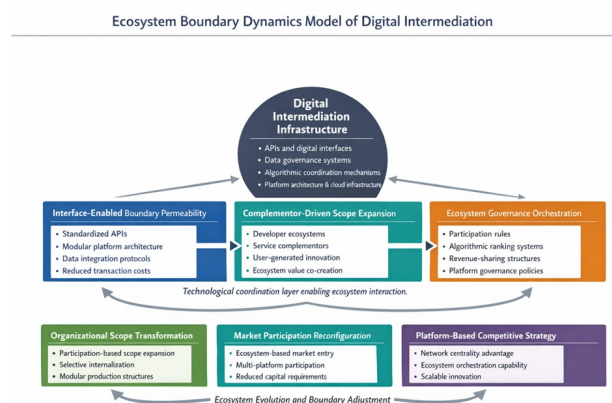


Figure 1. The ecosystem boundary dynamics model of digital intermediation in platform economies

The first process involves permeability enhancement through digital interfaces. Platforms lower the barriers to inter-organizational coordination by providing standardized digital interfaces that enable external actors to connect with core platform services. APIs, software development kits, data integration tools, and cloud-based infrastructure

collectively reduce the friction associated with collaboration across firm boundaries. As a result, firms no longer need to internalize complementary capabilities to expand their offerings. Instead, they can rely on external developers, service providers, and content creators who contribute innovations through platform interfaces. This digital architecture transforms the firm from a closed production unit into an open coordination hub embedded within a larger ecosystem [2, 27].

The second process concerns organizational scope transformation via complementor participation. In platform ecosystems, value creation increasingly emerges from interactions among multiple actors rather than from vertically integrated production chains. Complementors—such as application developers, service providers, hardware manufacturers, and content creators—extend the platform's functionality and value by building complementary innovations on its core architecture. Because complementors operate outside the formal boundaries of the platform firm, they allow the ecosystem to scale rapidly without requiring the platform owner to internalize all productive activities. Organizational scope thus expands through participation rather than ownership. The platform firm retains control over critical infrastructural components while relying on distributed actors to generate innovation and market expansion [8, 18].

The third process involves strategic repositioning through ecosystem governance. As platform ecosystems grow, governance mechanisms become essential for maintaining coordination, trust, and value distribution among participants. Platforms establish rules governing participation, pricing, data access, and quality standards, thereby shaping how value flows within the ecosystem. Through governance instruments such as ranking algorithms, certification systems, developer policies, and revenue-sharing models, platforms can strategically influence complementor behavior and guide the ecosystem's evolution. In this way, governance replaces hierarchical authority as the primary mechanism for maintaining coherence within distributed organizational structures. Firms that effectively manage ecosystem governance can leverage their central position to orchestrate interactions among participants while preserving strategic control over the ecosystem's direction [15, 25].

Together, these three processes—interface-enabled permeability, complementor-driven scope expansion, and

governance-based orchestration—redefine competitive strategy in platform economies. Competitive advantage no longer depends solely on internal resources or proprietary capabilities; instead, it emerges from the firm's ability to position itself as a central node within a network of distributed actors. Network centrality becomes a key strategic asset, allowing platform firms to coordinate value creation across multiple participants and capture a share of the resulting economic activity. In such environments, the strategic objective shifts from controlling assets to designing ecosystems that attract, coordinate, and sustain participation.

This reconceptualization of strategy has profound implications for how firms approach market entry, diversification, and innovation. Traditional models of market expansion relied on internal capability development, acquisitions, or alliances to enter new domains. Platform ecosystems introduce an alternative pathway: firms can expand into adjacent markets simply by enabling complementors to develop new applications or services within the platform environment. Because the platform infrastructure already provides the technological and governance foundations for collaboration, new market opportunities can be explored with relatively low incremental investment. Consequently, the boundaries between industries become increasingly blurred, and firms can participate in multiple ecosystems simultaneously without fully committing resources to each [9, 26].

The implications of boundary permeability also extend to patterns of competition. In traditional industries, firms competed primarily through product differentiation, cost efficiency, or technological innovation within well-defined market segments. Platform ecosystems introduce a new dimension of competition centered on ecosystem scale and participation density. Platforms compete not only through the capabilities of their core products but also through their ability to attract and retain large networks of users and complementors. Network effects amplify the value of participation, reinforcing the centrality of successful platforms while making it difficult for smaller competitors to gain traction. However, because ecosystem boundaries remain permeable, firms can participate in multiple platforms simultaneously, creating complex patterns of multi-homing and cross-ecosystem competition [16, 20].

In this context, ecosystem boundary dynamics become a critical determinant of competitive advantage. Platforms must carefully balance openness and control when

designing their ecosystems. Excessive openness may dilute value capture or create governance challenges, while excessive control may discourage complementor participation and limit innovation. Effective platform strategy, therefore, involves managing selective permeability, allowing external actors to contribute innovations while preserving the platform's authority over core infrastructure and strategic direction. This delicate balance ensures that ecosystem expansion enhances rather than undermines the platform's competitive position.

The theory also highlights the role of digital intermediation in enabling multi-ecosystem participation. Firms increasingly participate in several platform ecosystems simultaneously, leveraging interoperable digital infrastructures to extend their reach across markets. For example, application developers may build software that operates across multiple operating systems, while service providers may integrate offerings across different digital marketplaces. Digital intermediation makes such cross-ecosystem participation feasible by providing standardized protocols for communication and data exchange. This flexibility allows firms to experiment with new market opportunities while maintaining existing ecosystem relationships.

At the organizational level, changes in ecosystem boundaries require firms to adopt new managerial capabilities. Traditional management practices focused on optimizing internal operations and controlling hierarchical structures. Platform ecosystems require capabilities in ecosystem orchestration, including interface design, governance policy development, and participant engagement. Managers must also monitor ecosystem health by analyzing participation patterns, innovation rates, and network growth dynamics. These capabilities transform the firm's role from producer to orchestrator, responsible for facilitating interactions among diverse ecosystem participants.

The seven propositions articulated below formalize the theoretical relationships underpinning ecosystem boundary dynamics. Together, they explain how digital intermediation enables firms to expand their organizational scope, coordinate distributed innovation, and strategically reposition themselves within platform ecosystems.

Proposition 1

Digital intermediation increases boundary permeability by providing standardized interfaces that reduce transaction costs and enable indirect coordination among complementors, thereby diminishing the necessity for full internalization of activities [1, 2, 27].

Proposition 2

Platform participation substitutes for internalization when ecosystem governance mechanisms allow firms to orchestrate complementors without ownership, expanding organizational scope while maintaining control over core value propositions [8, 18, 28].

Proposition 3

Digital intermediation redefines market participation by facilitating multi-ecosystem involvement, allowing firms to enter new markets through permeable boundaries rather than traditional entry modes [9, 19, 26].

Proposition 4

Complementor integration via platform-mediated coordination lowers overall coordination costs across firm boundaries, enabling modular ecosystem participation that enhances innovation without increasing hierarchical complexity [3, 6, 10].

Proposition 5

Ecosystem boundary dynamics moderate competitive strategy such that higher permeability improves strategic positioning in multi-sided markets by leveraging network effects and user-generated value [16, 20, 22].

Proposition 6

Organizational scope transformation occurs through selective boundary management, in which digital intermediation enables firms to internalize only high-value activities while externalizing others to complementors under platform governance [12, 15, 25].

Proposition 7

In platform economies, boundary permeability positively influences competitive advantage when firms align digital intermediation mechanisms with the forces of ecosystem evolution, creating sustainable differentiation through dynamic scope adjustment [1, 21, 27].

Collectively, these propositions articulate a comprehensive theoretical explanation of how platform-based coordination mechanisms reshape organizational boundaries and competitive strategy. Digital intermediation enables firms to transcend traditional limitations of scale and scope by orchestrating distributed networks of contributors rather than by expanding hierarchical structures. As platform ecosystems continue to proliferate across industries—from software and media to transportation, finance, and healthcare—understanding ecosystem boundary dynamics becomes essential for explaining how firms create and sustain competitive advantage in digitally mediated markets.

The theory, therefore, contributes to strategic management and digital business research by reconceptualizing the firm not as an isolated entity but as a boundary-managing orchestrator embedded within a dynamic ecosystem of participants. In platform economies, the ability to design permeable boundaries, coordinate complementor innovation, and govern distributed participation emerges as a central determinant of long-term strategic success.

These propositions collectively form an integrated theory that explains how digital intermediation drives the observed redefinition of firm boundaries, organizational scope, and market participation. The framework offers testable relationships for future research while providing immediate conceptual clarity for scholars and practitioners navigating platform environments.

Advancing Ecosystem Boundary Dynamics: Theoretical Contributions of Digital Intermediation to Firm Scope and Market Participation

The propositions developed in the preceding section extend classical boundary theory by positioning digital intermediation as the central driver of permeability, scope transformation, and market participation in platform economies. Traditional theories treated boundaries as relatively fixed outcomes of transaction costs or resource ownership [7, 10]. In contrast, the current framework demonstrates that digital interfaces actively dissolve these fixed demarcations, replacing them with dynamic, governance-mediated permeability [1, 27]. Proposition 1

and Proposition 4 together establish that standardized interfaces and platform-mediated coordination reduce coordination costs to the point that selective externalization becomes superior to internalization, thereby expanding organizational scope without proportional increases in hierarchical control [2, 6, 10].

This advancement integrates and refines ecosystem literature. Where Adner conceptualized ecosystems as structures of interdependent activities [18], the present theory adds the digital intermediation layer that makes such interdependence scalable and low-cost. Similarly, while Nambisan *et al.* highlighted implications for international business theories through global platforms [9], the propositions specify the micro-mechanisms—complementor orchestration and multi-ecosystem participation—that enable scope expansion across borders [19, 26]. The framework further contributes to competitive dynamics research by showing how boundary permeability moderates network effects and value capture [16, 20, 22]. Higher permeability, as articulated in Propositions 5 and 7, enables firms to leverage user-generated content and decentralized structures without ceding strategic control, thereby resolving the openness-control paradox identified in earlier platform studies [11, 12, 27].

The theory resolves long-standing tensions between transaction-cost logic and ecosystem orchestration. It demonstrates that organizational scope in platform economies is no longer a binary make-or-buy decision but a continuous, digitally calibrated variable shaped by ecosystem governance and boundary management practices [15, 23, 25]. These theoretical contributions reposition firm boundary scholarship from static efficiency arguments toward dynamic, technology-enabled strategic flexibility, offering a unified lens for understanding platform-driven organizational change.

Navigating Permeable Boundaries: Managerial Strategies for Competitive Strategy in Platform Economies

Managers operating in platform economies must treat boundary permeability as a deliberate strategic lever rather than an exogenous feature. The propositions offer actionable guidance: firms should prioritize digital interface

design to lower transaction costs (Proposition 1) and selectively orchestrate complementors rather than pursue vertical integration (Proposition 2). Platform owners, for instance, can expand market participation by opening core interfaces while retaining governance over data flows and value allocation rules [3, 8, 27]. Complementors, conversely, benefit from participating in multiple ecosystems simultaneously, using permeable boundaries to access diverse user bases without heavy asset commitment [9, 19, 26].

Practical implementation begins with ecosystem governance audits. Managers should map current boundary permeability levels—assessing interface openness, complementor integration depth, and coordination costs—and align them with strategic objectives [12, 25]. When innovation speed is paramount, increasing permeability through modular APIs and standardized protocols accelerates complementor contributions while preserving core value propositions [6, 28]. In competitive multi-sided markets, selective boundary tightening around data assets and algorithmic control prevents value leakage while still enabling network effects [16, 20].

Firms can also apply the propositions to repositioning decisions. Organizational scope transformation (Proposition 6) suggests internalizing only high-value, non-imitable activities (e.g., platform algorithms) and externalizing others to specialized complementors under platform rules [15, 22]. This hybrid approach reduces capital intensity and enhances agility in rapidly evolving digital markets. Finally, alignment with ecosystem evolution forces (Proposition 7) requires continuous monitoring of network centrality and boundary adjustments to ensure that digital intermediation mechanisms sustain long-term competitive advantage [1, 21]. These strategies translate the theoretical model into concrete managerial tools for redefining firm scope and market participation without traditional ownership burdens. **Table 2** presents strategic modes of boundary management that firms employ to balance ecosystem openness and control in platform markets.

Table 2. Strategic boundary management modes in platform ecosystems

Boundary strategy mode	Degree of boundary permeability	Platform governance intensity	Typical platform example

Closed platform control	Low	High	Proprietary ecosystems
Selective ecosystem opening	Moderate	High	Curated developer ecosystems
Open ecosystem participation	High	Moderate	Open digital marketplaces
Multi-ecosystem participation	High	Distributed	Cross-platform complementor
Hybrid boundary orchestration	Dynamic	Dynamic	Platform leaders orchestrating ecosystems

Emerging Research Horizons in Digitally Mediated Organizational Scope: Future Directions for Platform Economy Scholarship

The proposed theory opens multiple avenues for future literature-based inquiry. First, empirical testing of the seven propositions is essential. Longitudinal studies could track changes in boundary permeability following major platform interface updates, measuring impacts on coordination costs, innovation rates, and competitive positioning using the causal pathways outlined [1, 2, 27]. Cross-industry comparisons—contrasting manufacturing ecosystems [25] with creative or service platforms—would validate the generalizability of ecosystem boundary dynamics.

Second, the interplay between emerging technologies and boundary mechanisms warrants deeper exploration. Artificial intelligence and blockchain, already noted in foundational works [16, 29], could further amplify or constrain permeability; future research should examine how decentralized ledgers alter governance without centralized platform ownership. Third, multi-ecosystem participation (Proposition 3) raises questions about firm-level portfolio strategies: how do organizations manage competing or complementary platform affiliations, and what are the resulting scope trade-offs [9, 19, 26]?

Fourth, the theory invites micro-level investigations into complementor decision-making. Studies could unpack the relational and contractual mechanisms that sustain participation rather than internalization, extending typologies of open innovation in digital ecosystems [8, 28]. Finally, comparative international research is needed to assess how regulatory contexts moderate boundary permeability and competitive strategy outcomes [15, 21]. These directions collectively position the current framework as a generative platform for advancing scholarship on digital intermediation, organizational scope, and market participation in evolving platform economies.

Conclusion

Digital intermediation has irrevocably altered the logic of firm boundaries, organizational scope, and market participation in the platform economy. By synthesizing recent scholarship and articulating seven propositions, this theory-development article demonstrates that permeable boundaries, orchestrated complementor integration, and platform-mediated coordination constitute the new foundations of competitive strategy. Firms no longer compete primarily through internalization but through strategic management of ecosystem dynamics and selective scope adjustment.

The framework resolves core theoretical tensions by showing how digital tools simultaneously reduce transaction costs and enable scalable governance, thereby expanding organizational reach while preserving autonomy. Managerial practice must now center on interface design, governance calibration, and continuous boundary realignment to capture platform-driven value. Future research will test and refine these mechanisms across contexts, technologies, and regulatory environments.

Ultimately, rethinking firm boundaries through the lens of digital intermediation provides both scholars and practitioners with a coherent explanation of why and how platform economies redefine competitive advantage. The platform economy is not merely a new market form; it is a fundamental reconfiguration of the firm itself—one in which organizational scope and market participation become fluid, digitally orchestrated, and strategically permeable.

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