Manexia
Journal of Business, Management, and Creative Economy

e-ISSN: 3124-6532
Vol. 2 | Issue 1 | January 2026
Pages 37-51
DOI
https://doi.org/10.66203/manexia.02104

Algorithmic Integration Boundaries: Rethinking the Theory of the Firm in Platform Ecosystems

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Article History:
Submitted: 27-09-2025
Approved: 18-11-2025
Published: 05-01-2026

OPEN ACCESS
Available at the open access journal:
https://sciedex.com/manexia

Abstrak

The theory of the firm has long assumed alignment between ownership, coordination authority, and capability execution, conceptualizing firm boundaries as governance solutions that internalize control when markets become inefficient. The diffusion of artificial intelligence (AI) infrastructures within platform ecosystems destabilizes this alignment by relocating decision-relevant intelligence beyond formal ownership domains. Firms increasingly embed externally governed algorithmic systems into pricing, forecasting, visibility management, and workflow coordination, allowing coordination and monitoring to occur without asset transfer or hierarchical integration. This article reconceptualizes firm boundaries as algorithmic integration boundaries defined by infrastructural control over coordination and learning processes. A mechanism-based framework identifies four cumulative processes driving boundary reconfiguration: data dependency intensification, workflow embedding, algorithmic visibility and control redistribution, and capability redistribution. Together, these mechanisms produce algorithmic boundary permeability, a condition in which legal ownership persists while effective coordination authority and adaptive capacity extend into externally governed infrastructures. This reconceptualization refines boundary theory, extends resource-based and dynamic capability perspectives through the notion of infrastructure-dependent capabilities, and identifies algorithmic mediation as a structural source of interorganizational power asymmetry.

Keywords

theory of the firm; organizational boundaries; algorithmic governance; platform ecosystems; dynamic capabilities; artificial intelligence

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1. Introduction

The theory of the firm has long rested on a foundational alignment: ownership confers control, and control anchors coordination and capability execution within organizational boundaries. From Coase's (1937) distinction between markets and hierarchies to Williamson's (1985) transaction cost framework and Grossman and Hart's (1986) property rights theory, firm boundaries are conceptualized as governance solutions that internalize coordination when market exchange becomes inefficient. Across these perspectives, the boundary of the firm demarcates the locus of residual control rights, decision authority, and capability orchestration.

The resource-based view (RBV) and dynamic capability theory reinforce this alignment. Sustained competitive advantage derives from firm-specific resources and capabilities embedded in internal routines and managerial cognition (Barney, 1991; Teece et al., 1997; Teece, 2007). Even when firms engage in alliances or ecosystems, distinctive capabilities are presumed to reside within organizational boundaries and to remain subject to managerial discretion. Ownership, coordination authority, and capability execution are therefore implicitly co-located.

Digital platform ecosystems increasingly destabilize this alignment. Firms embed externally governed artificial intelligence (AI) infrastructures into pricing systems, demand forecasting tools, visibility mechanisms, workflow integration protocols, and performance monitoring dashboards. These AI systems often function as centralized coordination infrastructures controlled by platform orchestrators rather than by participating firms. As algorithmic outputs become integrated into core routines, decision-relevant intelligence and coordination mechanisms extend beyond formal ownership domains.

This development raises a fundamental theoretical problem. If firm boundaries traditionally mark the locus of coordination authority and capability localization, how should those boundaries be conceptualized when coordination and learning processes are executed through infrastructures situated outside the firm's legal control? When ownership no longer guarantees authority over visibility mechanisms, data architectures, and optimization routines, the correspondence between legal demarcation and functional control weakens.

Existing research provides important but partial insights. Studies of algorithmic management demonstrate how AI reshapes internal monitoring and authority structures (Kellogg et al., 2020). Research on AI-enabled decision architectures shows how machine-generated analyses influence managerial cognition and coordination (Shrestha et al., 2019; Raisch & Krakowski, 2021). Platform ecosystem scholarship highlights architectural control points that shape participation conditions and value capture (Adner, 2017; Jacobides et al., 2018). Yet these streams remain analytically fragmented. They do not systematically address how AI embedded in external infrastructures reconfigures the conceptual foundations of firm boundaries.

Classical boundary theories presuppose that coordination authority ultimately derives from ownership or enforceable contractual safeguards. Even hybrid governance forms assume that effective control can be traced to asset ownership or negotiated agreements. AI-mediated infrastructures challenge this presupposition. Algorithmic systems can coordinate, monitor, and evaluate behavior at scale without requiring asset transfer or formal integration. Decision parameters embedded in code—such as ranking criteria, pricing recommendations, visibility thresholds, and learning weights—may be governed externally while firms retain legal ownership of assets. Under such conditions, ownership and coordination authority decouple.

This decoupling signals a structural transformation in the nature of the firm. Under conditions of algorithmic integration, firm boundaries are determined less by ownership demarcations and more by infrastructural control over AI-mediated coordination mechanisms. Organizational boundaries become permeable when core workflows, visibility governance, and learning processes are mediated by externally governed algorithmic architectures. Legal boundaries remain formally intact, yet the effective boundary of the firm shifts toward the locus of algorithmic control.

AI is therefore conceptualized not merely as a technological tool, but as an algorithmic coordination infrastructure. Such infrastructures centralize data aggregation, embed decision rules into workflows, and govern visibility and evaluation mechanisms across legally independent actors. When firms integrate these infrastructures into operational and strategic routines, they enter a condition of infrastructural coupling. This coupling alters interorganizational dependence, redistributes strategic control, and relocates capability execution beyond traditional ownership boundaries.

This conceptual architecture clarifies the structural shift from classical boundary alignment to algorithmic decoupling under AI integration. It isolates the theoretical problem: the progressive divergence between ownership, coordination authority, and capability execution as algorithmic infrastructures mediate organizational processes.

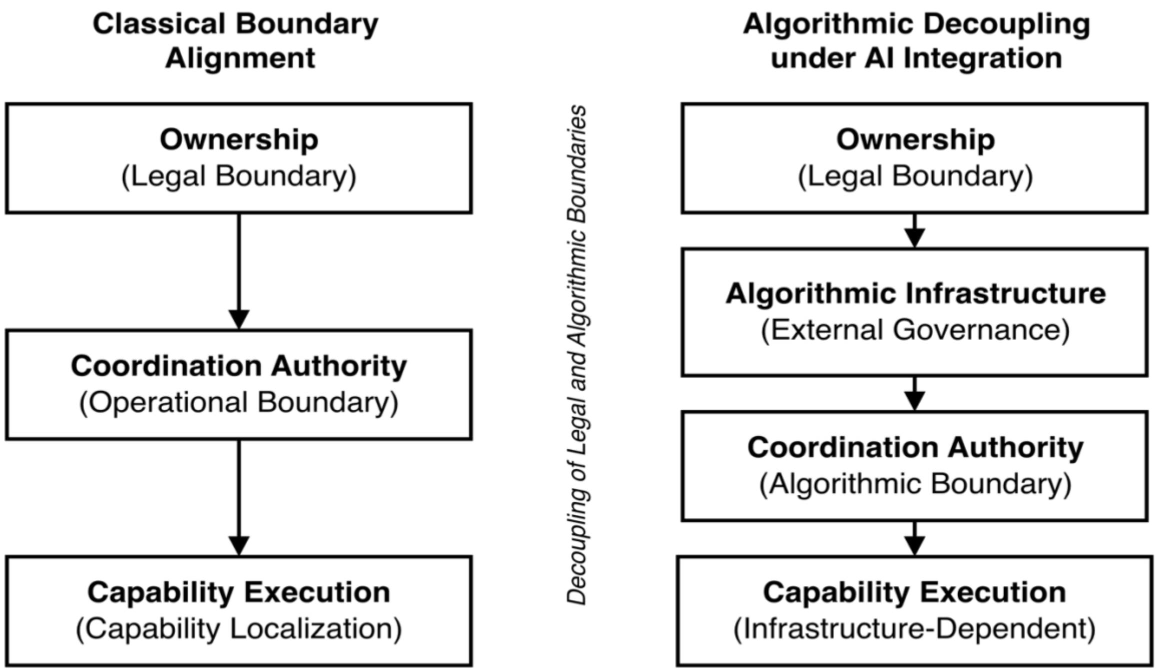

Figure 1. Alignment and Decoupling of Organizational Boundaries under Algorithmic Integration
Source: Author's conceptualization

Figure 1 contrasts the classical alignment of ownership, coordination authority, and capability execution with their structural decoupling under algorithmic integration. In the left panel, legal, operational, and capability boundaries coincide, reflecting traditional boundary theory assumptions. In the right panel, coordination and capability execution are mediated through externally governed algorithmic infrastructures, illustrating how the effective boundary of the firm shifts from ownership-based demarcation to algorithmic control.

To theorize this transformation, a mechanism-based framework is developed explaining how AI integration induces organizational boundary reconfiguration through four interrelated processes: (1) data dependency intensification, (2) workflow embedding and algorithmic coupling, (3) algorithmic visibility and control redistribution, and (4) capability redistribution accompanied by strategic autonomy trade-offs. Collectively, these mechanisms produce algorithmic boundary permeability—a condition in which the effective boundary of the firm is defined less by ownership and more by infrastructural governance over coordination and learning.

This analysis makes three theoretical contributions. First, it reconceptualizes firm boundaries as algorithmic integration boundaries, extending classical governance theories beyond ownership-based demarcations. Second, it refines resource-based and dynamic capability perspectives by introducing the concept of infrastructure-dependent capabilities, distinguishing them from internally orchestrated capabilities. Third, it extends interdependence theory by identifying algorithmic mediation as a structural source of power asymmetry within platform ecosystems.

As AI infrastructures become central to coordination and value creation, the theory of the firm must account for infrastructural governance as a determinant of effective control. The relevant question is no longer solely why firms internalize activities, but where coordination authority and capability execution effectively reside under algorithmic integration.

2. Theoretical Foundations

Understanding how AI embedded in platform ecosystems reshapes organizational boundaries requires revisiting the foundational assumptions of four major theoretical traditions: (1) boundary theory of the firm, (2) the resource-based and dynamic capability perspectives, (3) interdependence and power asymmetry theory, and (4) platform ecosystem governance research. Although these streams differ in analytical emphasis, they share a structural premise: ownership, coordination authority, and capability execution are assumed to be co-located within organizational boundaries. AI-mediated infrastructures destabilize this alignment.

This table condenses the shared structural assumptions across four theoretical traditions and specifies how AI-mediated infrastructures destabilize each of them. It clarifies the theoretical gap that motivates the reconceptualization of firm boundaries as algorithmic integration boundaries.

Table 1 Theoretical Assumptions and AI-Induced Destabilization

Theoretical Tradition	Core Assumption about Boundaries	Locus of Control (Classical View)	AI-Induced Destabilization
Boundary Theory (TCE & Property Rights)	Ownership aligns with coordination authority	Asset ownership and hierarchical governance	Coordination occurs via external algorithmic rule-setting without asset transfer
Resource-Based & Dynamic Capability View	Capabilities are localized within firm routines	Internal managerial orchestration	Capability execution becomes infrastructure-dependent
Interdependence Theory	Power derives from control over critical exchange resources	Resource ownership and contractual leverage	Control embedded in algorithmic mediation and visibility governance
Platform Ecosystem Research	Architectural control shapes value capture	Platform positioning and interface governance	Algorithmic infrastructures reshape internal routines and boundary configuration

Source: Author's conceptualization

Table 1 synthesizes how each theoretical stream implicitly assumes alignment between ownership, control, and capability execution. By specifying the distinct mode of destabilization introduced by AI-mediated infrastructures, Table 1 clarifies the conceptual gap that necessitates the article's reconceptualization of firm boundaries. It therefore anchors the subsequent mechanism-based framework in a structured theoretical comparison rather than a fragmented literature review.

2.1 Organizational Boundaries and the Alignment of Ownership and Control

Classical boundary theory conceptualizes firms as governance structures designed to economize on transaction costs and mitigate incomplete contracting problems. Coase (1937) argued that firms internalize transactions when the costs of market exchange exceed the costs of hierarchical coordination. Williamson (1985) emphasized asset specificity and opportunism, proposing vertical integration as a safeguard against contractual hazards. Property rights theory refined this view by asserting that ownership confers residual control rights over non-contractible decisions (Grossman & Hart, 1986; Hart & Moore, 1990).

Across these formulations, the boundary of the firm represents the locus of coordination authority. Ownership ensures control over assets; hierarchical governance ensures coordinated execution of activities. Even hybrid arrangements ultimately trace authority back to asset ownership or enforceable contractual safeguards. Legal boundaries are therefore presumed to correspond to effective control boundaries.

This alignment rests on a critical assumption: coordination authority derives from ownership or contractual integration. However, AI-mediated infrastructures challenge this assumption. Platform-controlled algorithms can coordinate pricing, matching, forecasting, and monitoring across legally independent firms without requiring asset transfer or formal integration. Decision parameters embedded in algorithmic systems shape behavior at scale while asset ownership remains unchanged.

Under such conditions, ownership and coordination authority decouple. Control over decision-relevant processes may reside outside the legal boundary of the firm. Classical boundary theory does not explicitly account for coordination infrastructures that operate beyond ownership domains yet shape internal routines. As a result, it lacks a conceptual framework for explaining how firms can remain legally autonomous while functionally embedded within externally governed algorithmic architectures.

2.2 Resource-Based View and the Assumption of Capability Localization

The resource-based view (RBV) posits that sustained competitive advantage derives from firm-specific resources that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). Dynamic capability theory extends this logic by emphasizing the firm's capacity to integrate, build, and reconfigure competences in response to environmental change (Teece et al., 1997; Teece, 2007). Capabilities are embedded in organizational routines, managerial cognition, and accumulated learning processes.

An implicit but central assumption of these perspectives is capability localization. Distinctive capabilities reside within firm boundaries and are subject to managerial orchestration. Even when firms engage in alliances or ecosystems, competitive advantage ultimately depends on internally governed recombination processes.

AI integration complicates this assumption. In platform ecosystems, firms frequently rely on externally governed AI infrastructures for demand forecasting, dynamic pricing, recommendation optimization, and workflow coordination. Performance improvements may be observed at the firm level, yet the execution and evolution of these capabilities depend on access to centralized data architectures and algorithmic rule-setting controlled externally.

This dependence introduces conceptual ambiguity. If capability execution is contingent on externally governed infrastructures, the locus of capability no longer coincides with the legal boundary of the firm. Dynamic capability theory presumes discretion over sensing, seizing, and transforming processes. Under high algorithmic integration, however, these processes may be mediated by platform-level systems. The internal localization of adaptive capacity becomes structurally conditioned by infrastructural governance.

RBV and dynamic capability theory have not systematically theorized such infrastructure-dependent capabilities. Their internalist orientation presumes alignment between organizational boundaries and capability execution—an alignment destabilized by AI-mediated coordination systems.

2.3 Interdependence Theory and the Limits of Exchange-Based Dependence

Interdependence theory argues that organizations depend on external actors for critical resources, and asymmetries in dependence generate power differentials (Pfeffer & Salancik, 1978). Gulati and Sytch (2007) further distinguish between joint dependence and asymmetric dependence, emphasizing how embeddedness influences bargaining power and performance.

Traditional resource dependence accounts conceptualize power as deriving from control over tangible resources, supply inputs, or contractual terms. Dependence is typically exchange-based: organizations rely on external actors for resources that can be withheld, conditioned, or substituted at a cost.

AI-mediated infrastructures introduce a distinct mechanism of dependence: algorithmic mediation. Platform orchestrators may control data architectures, ranking algorithms, recommendation systems, and compliance metrics that structure visibility and resource allocation. Participating firms depend not merely on discrete exchanges, but on rule-setting embedded within digital infrastructures.

This form of dependence operates continuously and at scale. Algorithmic visibility determines market exposure; performance metrics shape behavioral adaptation; centralized learning systems accumulate ecosystem-wide data beyond the reach of individual firms. Control is exercised through infrastructural governance rather than through episodic transactions.

Interdependence theory does not explicitly address infrastructural opacity or algorithmic rule-setting as structural sources of power. It lacks an account of how dependence may arise from control over coordination logic itself, rather than from ownership of exchangeable resources.

2.4 Platform Ecosystems and Architectural Control

Platform ecosystem research extends analysis beyond the single firm, conceptualizing value creation as occurring within interdependent structures coordinated through shared architectures (Adner, 2017; Jacobides et al., 2018). Ecosystem orchestrators occupy architectural control points that shape participation conditions and value capture. Governance mechanisms such as APIs, standards, and access protocols structure complementarities without requiring vertical integration.

This literature recognizes that control may stem from architectural positioning rather than direct ownership. However, its primary analytical focus lies in value capture, complementor positioning, and competitive advantage within ecosystems. Less attention is given to how infrastructural governance redefines the internal boundaries of participating firms.

AI infrastructures deepen architectural control by embedding decision rules directly into coordination processes. Ranking criteria, recommendation algorithms, and matching systems influence not only value capture but also internal routines and strategic adaptation. The relevant issue extends beyond architectural positioning to the relocation of coordination authority and capability execution.

Platform research identifies control points but does not systematically integrate these insights with boundary theory. The question at stake is not solely who captures value, but where effective coordination authority resides and how that authority reshapes the boundary of the firm.

2.5 Theoretical Tension: Decoupling Ownership, Control, and Capability

Across boundary theory, RBV, interdependence theory, and ecosystem research, a common structural alignment persists: ownership underpins control, and control anchors capability execution. AI-mediated infrastructures destabilize this alignment by relocating coordination mechanisms, learning processes, and visibility governance beyond formal ownership domains.

This relocation produces a decoupling between legal boundaries and functional control. Firms may retain asset ownership and contractual autonomy, yet critical elements of sensing, monitoring, and optimization are governed through externally controlled algorithmic architectures. The effective boundary of the firm can therefore no longer be inferred solely from ownership demarcations.

Existing theories provide partial explanations of governance, capability, and dependence. None fully account for coordination infrastructures that operate across legally independent entities while shaping internal routines and adaptive capacity. This theoretical gap necessitates a mechanism-based framework explaining how AI integration reconfigures organizational boundaries.

3. Mechanisms of AI-Induced Boundary Reconfiguration

The preceding discussion demonstrates that classical boundary theory, resource-based perspectives, and interdependence theory share an implicit alignment between ownership, coordination authority, and capability execution. AI-mediated infrastructures destabilize this alignment. The following section develops a mechanism-based framework explaining how algorithmic integration reconfigures the effective boundary of the firm.

3.1 Reconceptualizing Organizational Boundaries

Organizational boundaries can be analytically disaggregated into three distinct but historically aligned forms:

1) Legal Boundary – Defined by ownership structures, employment contracts, and residual control rights over assets.
2) Operational Boundary – Defined by managerial authority over workflows, routines, and decision processes.
3) Algorithmic Boundary – Defined by infrastructural control over coordination, visibility, and learning mechanisms embedded in AI systems.

In classical theory, these boundaries largely coincide. Ownership confers control; control governs workflows; workflows execute capabilities. Under conditions of high AI integration, however, divergence emerges. Firms may retain legal ownership while operational routines become structurally coupled with algorithmic infrastructures governed externally. The algorithmic boundary—rather than the legal boundary—begins to determine the locus of coordination authority.

Organizational boundary reconfiguration refers to the progressive divergence between legal boundaries and algorithmic control boundaries. Reconfiguration occurs when core coordination, monitoring, and learning processes are mediated by externally governed AI infrastructures.

AI integration denotes the extent to which a firm's workflows, analytics, and decision processes are structurally dependent on external algorithmic systems. Four mutually reinforcing mechanisms drive this reconfiguration.

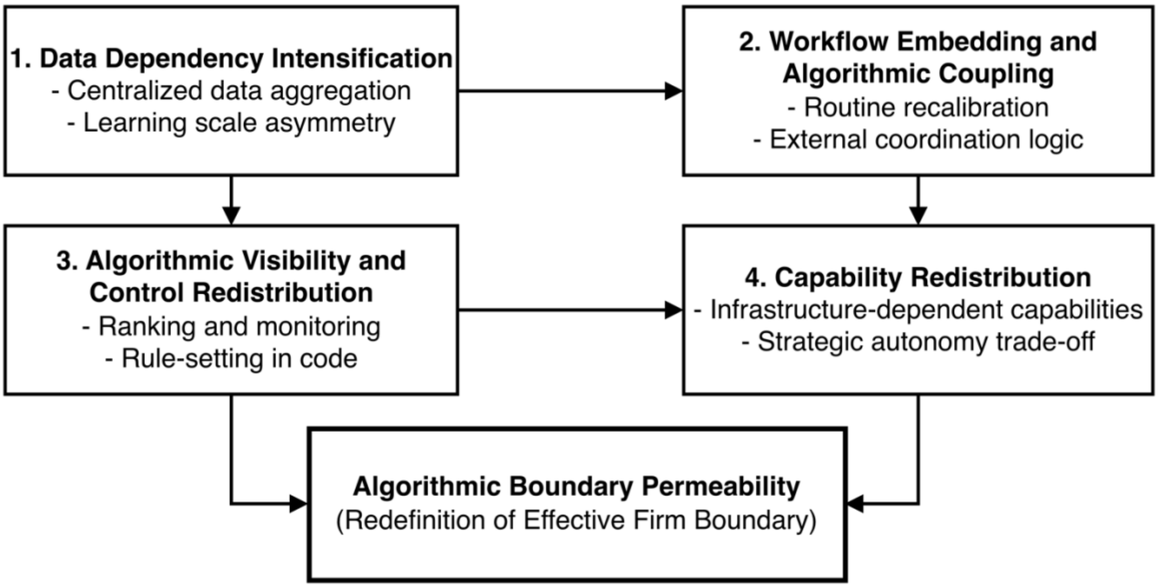

Figure 2. Mechanism-Based Model of AI-Induced Boundary Reconfiguration
Source: Author's conceptualization

The framework articulated in Figure 2 clarifies how AI integration triggers organizational boundary reconfiguration through four cumulative mechanisms. Data dependency intensification generates structural asymmetry, which reinforces workflow embedding and algorithmic coupling. Visibility governance redistributes strategic control, and capability redistribution shifts execution toward infrastructure-dependent forms. Together, these interacting processes produce algorithmic boundary permeability, redefining the effective locus of coordination authority and adaptive capacity beyond legal ownership boundaries.

3.2 Mechanism 1: Data Dependency Intensification

AI systems rely on large-scale, continuously updated datasets. In platform ecosystems, data aggregation and learning processes are often centralized at the infrastructural level. Participating firms contribute transactional and behavioral data while accessing predictive outputs generated by shared AI systems.

This arrangement intensifies structural dependence in two ways.

First, centralized data architectures create scale advantages in learning. Algorithms trained on ecosystem-wide datasets outperform models trained on firm-level data alone. As predictive accuracy improves, firms become increasingly reliant on centralized AI outputs.

Second, dependence becomes recursive. Greater reliance on AI-driven coordination generates additional data contributions, reinforcing infrastructural learning advantages. This cumulative feedback loop increases asymmetry between infrastructure controllers and participating firms.

Unlike traditional exchange-based dependence, data dependency is embedded within learning architectures. Firms may retain ownership of local assets yet lack control over aggregated data structures that determine predictive capacity. Control over learning processes thus shifts toward the infrastructure.

Proposition 1:
Greater AI integration increases firm dependence on externally governed data architectures, intensifying asymmetrical interdependence between firms and algorithmic infrastructure controllers.

3.3 Mechanism 2: Workflow Embedding and Algorithmic Coupling

As AI outputs are integrated into pricing engines, inventory systems, recommendation tools, and performance dashboards, internal workflows become structurally coupled with external infrastructures.

Workflow embedding occurs when organizational routines are recalibrated to align with algorithmic parameters. Pricing strategies may be adjusted to optimize ranking metrics; inventory allocation may follow predictive demand signals; customer engagement processes may be redesigned to enhance visibility scores.

Over time, such adaptations produce algorithmic coupling: internal decision processes become dependent on externally defined coordination logic. The operational boundary of the firm becomes partially externalized. Managerial authority remains formally intact, yet decision execution is mediated by infrastructural rules.

This coupling differs from conventional outsourcing. Rather than delegating discrete tasks, firms embed external coordination logic within core routines. The locus of coordination shifts from hierarchical command toward algorithmic mediation.

Proposition 2:
Higher levels of AI-mediated workflow embedding increase divergence between legal boundaries and operational control boundaries, thereby intensifying organizational boundary reconfiguration.

3.4 Mechanism 3: Algorithmic Visibility and Control Redistribution

In digital ecosystems, AI systems frequently govern visibility, ranking, recommendation placement, and compliance monitoring. Visibility functions as a critical strategic resource influencing revenue flows and competitive positioning.

Control redistribution occurs when infrastructural governance over visibility mechanisms shapes firm behavior without transferring asset ownership. Firms may retain ownership of productive assets and intellectual property, yet market access depends on algorithmic exposure determined externally.

Algorithmic control operates through rule-setting embedded in code. It structures incentives, channels resource allocation, and shapes strategic investments. Behavioral adaptation to opaque algorithmic criteria reinforces infrastructural authority.

This mechanism shifts the basis of control from asset ownership to infrastructural governance. The algorithmic boundary increasingly determines which decisions materially affect outcomes.

Proposition 3:
Greater reliance on AI-driven visibility and monitoring systems redistributes strategic control from asset-owning firms to infrastructure-governing actors, expanding the scope of algorithmic boundaries.

3.5 Mechanism 4: Capability Redistribution and Strategic Autonomy Trade-offs

The cumulative effect of data dependency, workflow embedding, and visibility governance is capability redistribution.

Capability redistribution refers to the relocation of effective capability execution from internally orchestrated routines to externally mediated algorithmic systems.

Three analytically distinct capability forms can be identified:
1) Internally orchestrated capabilities – Fully governed and executed within firm boundaries.
2) Accessed capabilities – External tools used discretionarily without structural dependence.
3) Infrastructure-dependent capabilities – Capabilities whose execution and evolution are contingent on access to externally governed AI infrastructures.

Infrastructure-dependent capabilities may enhance operational efficiency, improve forecasting accuracy, and optimize coordination. However, they introduce a strategic autonomy trade-off. Discretion over algorithmic parameters, data access conditions, and infrastructural rule changes may be limited. Adaptive capacity becomes partially contingent on external governance decisions.

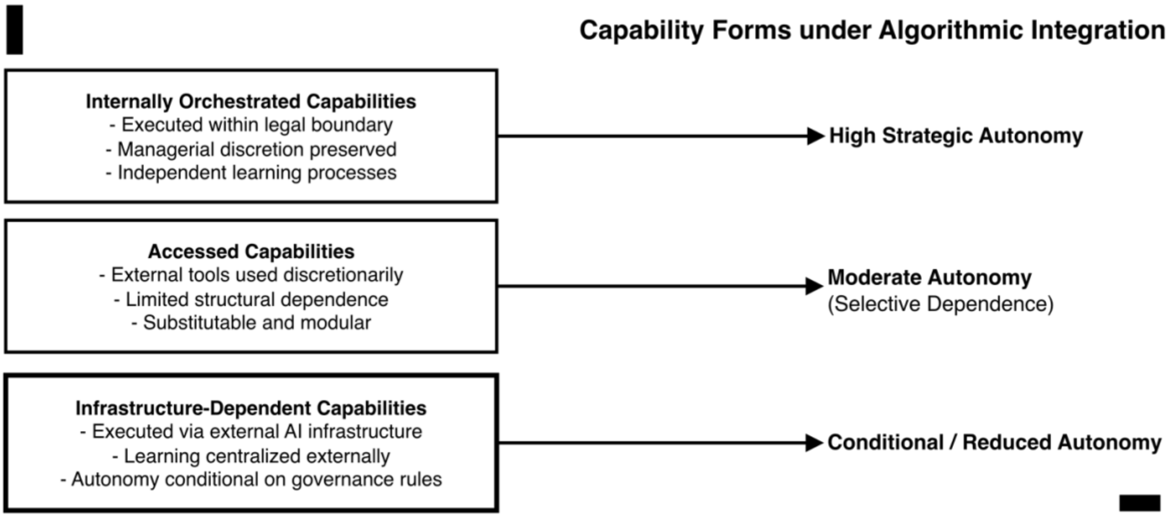

Figure 3. Typology of Capability Forms under Algorithmic Integration
Source: Author’s conceptualization

Figure 3 differentiates three analytically distinct capability forms according to their locus of execution and degree of infrastructural dependence. Internally orchestrated capabilities remain embedded within the legal and operational boundaries of the firm. Accessed capabilities involve discretionary use of external tools without structural coupling. In contrast, infrastructure-dependent capabilities are executed and evolved through externally governed AI systems, rendering strategic autonomy conditional on infrastructural rule-setting. This typology sharpens the article’s extension of RBV by relocating the question of competitive advantage from capability possession to capability governance.

Dynamic capability processes—sensing, seizing, and transforming—may thus be mediated by platform-level AI systems. The firm remains an adaptive entity, but adaptation is structurally conditioned by algorithmic infrastructures.

Proposition 4:
As capabilities become increasingly infrastructure-dependent through AI integration, firms experience operational efficiency gains accompanied by reductions in strategic autonomy.

3.6 Integrative Logic: Algorithmic Boundary Permeability

The four mechanisms are cumulative and mutually reinforcing. Data dependency intensification increases infrastructural asymmetry. Workflow embedding structurally couples internal routines with external coordination logic. Algorithmic visibility redistributes control over resource flows. Capability redistribution relocates execution and adaptation processes beyond legal ownership domains.

Collectively, these mechanisms produce algorithmic boundary permeability—a condition in which the effective boundary of the firm is determined less by ownership and more by infrastructural control over coordination and learning processes.

Proposition 5:
The cumulative interaction of data dependency intensification, workflow embedding, algorithmic visibility governance, and capability redistribution increases algorithmic boundary permeability, thereby redefining the effective boundary of the firm.

Under high algorithmic permeability, legal and operational boundaries persist formally, yet the algorithmic boundary becomes the primary determinant of coordination authority and capability execution. The theory of the firm must therefore account for infrastructural governance as a structural determinant of boundary configuration.

4. Discussion

The preceding framework demonstrates that AI integration within platform ecosystems produces a structural decoupling between ownership, coordination authority, and capability execution. This section interprets these mechanisms in relation to foundational theories of the firm, clarifies theoretical contributions, specifies boundary conditions, and outlines implications for future research.

4.1 Reinterpreting the Theory of the Firm Under Algorithmic Integration

Classical boundary theories conceptualize firms as governance structures that internalize coordination when markets become inefficient (Coase, 1937; Williamson, 1985). Property rights theory further anchors firm boundaries in the allocation of residual control rights over assets (Grossman & Hart, 1986; Hart & Moore, 1990). Across these perspectives, ownership remains the institutional foundation of control.

AI-mediated infrastructures challenge this foundation without requiring asset transfer or vertical integration. Coordination authority may be exercised through algorithmic rule-setting embedded in digital architectures that operate across legally independent firms. Pricing logic, ranking criteria, forecasting models, and visibility thresholds can shape decision processes while asset ownership remains unchanged.

This shift suggests that the traditional market–hierarchy dichotomy is incomplete under conditions of algorithmic integration. Algorithmic infrastructures constitute a distinct governance layer that enables coordination without ownership integration and exercises control without hierarchical authority. Firm boundaries can no longer be inferred solely from ownership demarcations; they must also be understood in relation to infrastructural control over coordination and learning processes.

The theory of the firm thus requires reconceptualization. Effective boundaries are not exclusively legal demarcations but are increasingly determined by the locus of algorithmic integration.

4.2 Extending the Resource-Based View: From Localization to Redistribution

The resource-based view and dynamic capability theory assume that competitive advantage derives from firm-specific capabilities embedded within organizational routines (Barney, 1991; Teece, 2007). Adaptive capacity depends on managerial discretion over sensing, seizing, and transforming processes.

AI integration complicates this internalist assumption. When forecasting accuracy, pricing optimization, and visibility management depend on externally governed infrastructures, capability execution becomes infrastructure-dependent. Operational effectiveness may increase, yet discretion over the parameters that shape those capabilities may be limited.

This dynamic reframes competitive advantage as relational and infrastructural rather than purely internal. Firms may operate advanced analytical capabilities without fully controlling their evolution. Capability execution is redistributed across ecosystem actors, and adaptive capacity becomes co-determined by infrastructural governance.

Rather than invalidating RBV, this development extends it. The relevant analytical question shifts from whether capabilities are valuable and rare to where they are executed and who governs their evolution. Infrastructure-dependent capabilities represent a distinct category requiring theoretical differentiation from internally orchestrated capabilities.

4.3 Algorithmic Mediation as Structural Power

Resource dependence theory conceptualizes power as arising from control over critical resources (Pfeffer & Salancik, 1978). AI-mediated ecosystems introduce a structurally different source of power: algorithmic mediation.

Control over data architectures, ranking systems, recommendation engines, and compliance metrics enables infrastructural actors to shape competitive conditions continuously and at scale. Dependence becomes embedded in coordination logic rather than limited to discrete exchanges. Visibility governance, learning centralization, and workflow coupling produce asymmetries that may not be contractually explicit yet materially constrain strategic discretion.

This form of power is infrastructural and often opaque. Algorithmic parameters can change dynamically, altering competitive positioning without renegotiation or asset reallocation. Interdependence theory must therefore incorporate algorithmic rule-setting as a structural source of asymmetry distinct from exchange-based dependence.

4.4 Distinguishing Boundary Reconfiguration from Platform Value Capture

Platform ecosystem research emphasizes architectural control points and value capture (Adner, 2017; Jacobides et al., 2018). While architectural positioning explains differential value appropriation, boundary reconfiguration addresses a deeper question: the relocation of coordination authority and capability execution.

Value capture concerns who appropriates economic surplus. Boundary reconfiguration concerns where decision-relevant intelligence and control mechanisms reside. AI-enabled infrastructures not only shape value distribution but also restructure internal routines and adaptive processes within participating firms.

This distinction clarifies that algorithmic boundary permeability is not reducible to ecosystem positioning. It concerns the ontological location of control and the functional locus of capability execution.

4.5 Boundary Conditions

The proposed framework applies most strongly under specific structural conditions.

First, AI infrastructures must be centralized and controlled by dominant ecosystem actors. High data aggregation and learning centralization amplify asymmetrical dependence.

Second, workflow coupling must be substantial. When internal routines are tightly integrated with external algorithmic systems, operational boundaries diverge more significantly from legal boundaries.

Third, governance opacity intensifies boundary reconfiguration. Limited transparency regarding ranking criteria, data usage, or algorithmic updates increases infrastructural asymmetry.

Fourth, switching costs and limited interoperability reinforce infrastructure dependence. Where firms can easily multi-home or deploy independent AI architectures, boundary permeability may be reduced.

Conversely, boundary reconfiguration is attenuated when firms maintain proprietary AI stacks, when data portability regulations constrain centralization, or when modular architectures allow selective integration. In such contexts, legal and operational boundaries may remain more closely aligned.

This table structures the boundary conditions under which algorithmic boundary permeability intensifies or remains attenuated. It specifies the structural moderators that determine whether legal and operational boundaries diverge significantly under AI integration.

Table 2. Boundary Conditions of Algorithmic Boundary Permeability

Structural Condition	High Permeability Scenario	Low Permeability Scenario	Implication for Boundary Alignment
Data Centralization	Ecosystem-wide data aggregation controlled by dominant actor	Decentralized or firm-level data architectures	Greater divergence between legal and algorithmic boundaries
Workflow Coupling	Core routines embedded in external AI systems	Modular and selectively integrated workflows	Operational boundary remains closer to legal boundary
Governance Transparency	Opaque ranking and rule-setting mechanisms	Transparent algorithms and predictable rule updates	Reduced asymmetry and lower control redistribution
Switching Costs & Interoperability	High lock-in, limited multi-homing	Low switching costs, interoperable systems	Lower infrastructural dependence and reduced permeability

Source: Author's conceptualization

Table 2 specifies the structural contingencies that moderate the extent of boundary reconfiguration. By distinguishing high- and low-permeability scenarios, Table 2 prevents theoretical overgeneralization and clarifies when algorithmic integration meaningfully redefines the effective boundary of the firm. It therefore anchors the framework within explicit scope conditions rather than universal claims.

These boundary conditions prevent overgeneralization and clarify the scope of the theoretical claims.

4.6 Strategic Autonomy and the Efficiency–Control Trade-off

AI integration introduces a structural trade-off between operational efficiency and strategic autonomy. Centralized infrastructures may enhance predictive accuracy, coordination speed, and cost efficiency. However, increased reliance on externally governed algorithms may reduce discretion over pricing logic, visibility mechanisms, and adaptive pathways.

Strategic autonomy erosion may manifest through algorithmic lock-in, reduced innovation directionality, constrained experimentation, or vulnerability to infrastructural rule changes. Firms may achieve short-term performance gains while increasing long-term exposure to governance shifts beyond their control.

This trade-off complicates optimistic narratives of digital transformation. Technological integration does not uniformly enhance competitive advantage; its effects depend on the distribution of control embedded in algorithmic infrastructures.

4.7 Implications for Future Research

Several avenues emerge for empirical investigation. First, comparative studies across industries can examine variation in algorithmic boundary permeability and its performance implications.

Second, research may explore governance mechanisms that moderate infrastructural dependence, such as data-sharing arrangements or hybrid AI architectures.

Third, longitudinal analyses can investigate how capability redistribution evolves as AI infrastructures mature.

Fourth, regulatory contexts affecting data centralization and interoperability may provide natural experiments for testing boundary reconfiguration dynamics.

Empirical exploration of these directions would refine understanding of how algorithmic integration reshapes organizational architecture over time.

5. Conclusion

The theory of the firm has historically equated organizational boundaries with ownership demarcations, hierarchical authority, and residual control rights. Across transaction cost economics, property rights theory, and resource-based perspectives, control and capability execution have been presumed to reside within legally defined firm boundaries. This alignment has provided the conceptual foundation for understanding why firms exist, how they govern activities, and how they sustain competitive advantage.

The diffusion of AI-mediated infrastructures within platform ecosystems destabilizes this foundation. Coordination, monitoring, visibility governance, and learning processes can be embedded in algorithmic systems that operate beyond formal ownership domains. Legal autonomy may persist, yet decision-relevant intelligence and capability execution increasingly depend on externally governed infrastructures. Ownership no longer guarantees control over coordination mechanisms.

The framework developed in this article identifies four cumulative mechanisms—data dependency intensification, workflow embedding, algorithmic visibility and control redistribution, and capability redistribution—that collectively produce algorithmic boundary permeability. Under conditions of high algorithmic integration, the effective boundary of the firm is defined less by asset ownership and more by infrastructural control over coordination and learning architectures.

This reconceptualization shifts the analytical focus of boundary theory. The relevant question is no longer confined to why firms internalize transactions, but extends to where coordination authority and adaptive capacity effectively reside in digitally mediated ecosystems. Firm boundaries must be understood not only as legal constructs, but as algorithmic integration boundaries shaped by infrastructural governance.

As AI systems become central to economic coordination, theories of the firm must incorporate infrastructural rule-setting, learning centralization, and algorithmic mediation as structural determinants of control. The evolution of digital infrastructures thus requires a reexamination of foundational assumptions about ownership, capability, and authority in contemporary organizational forms.

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