Simulation-Based Models for B2B Platform Dynamics

Purushothaman Ganesh
Institute for Engineering of Products and Systems (IEPS), Otto von Guericke University Magdeburg, Germany
Purushothaman.ganesh@ovgu.de

Sebastian Lang
Institute for Engineering of Products and Systems (IEPS), Otto von Guericke University Magdeburg, Germany

Abstract
Business-to-business (B2B) trade has historically been bilateral: the complexity and specificity of industrial products make it difficult to standardize transactions, limiting the emergence of platform-mediated exchange. Recent advances in artificial intelligence driven automation are changing this. Platforms can now automate supplier discovery, qualification, negotiation, and contracting at scale, making platform-mediated complex sourcing increasingly feasible. As adoption grows, network effects become plausible in B2B markets, raising the possibility of critical mass dynamics and potentially monopolistic concentration analogous to what has occurred in business-to-consumer platforms. This paper reviews simulation-based studies of B2B platform diffusion across six structural dimensions: methodology, actor representation, network topology, platform scope, adoption dynamics, and empirical calibration. Agent-based modeling (ABM) offers the necessary actor-level resolution, yet within the reviewed sample no study combines heterogeneous firms, structured supply-chain ties, and procurement-specific adoption rules based on trading-partner presence. Multi-platform competition was also not identified in the reviewed sample. On this basis, the paper outlines design requirements for a future ABM in which diffusion emerges from supply-chain topology, without implementing the model itself, as a useful next step toward understanding B2B platform adoption dynamics.

1. Introduction
Digital platforms have become the dominant organizational form of the modern economy, underpinning the world's largest companies and reshaping how value is created and exchanged (PricewaterhouseCoopers, 2025). At their core, digital platforms are centralized technological systems that provide shared infrastructure enabling coordination among many users (Alt, 2020; de Reuver et al., 2018). Their fundamental advantage lies in topology: by acting as a central hub, a platform reduces the complexity of bilateral relationships from $n(n-1)$ to n connections, while its search, matching, and settlement functions lower transaction costs across the entire network (Alt, 2020). Following Alt (2020), digital platforms are centralized technological systems that provide shared core functionality for coordination among multiple users. For the present study, B2B platforms are defined more specifically in the sense of de Reuver et al. (2018) as interorganizational platforms that coordinate external actors around a stable core and variable periphery. Within that broader category, the focus here is on supply-chain and industry platforms rather than internal platforms, because the phenomenon of interest is procurement coordination across organizational boundaries.

These properties make platforms particularly consequential in business-to-business (B2B) commerce. Capital One Shopping Research (2025) estimates the global B2B e-commerce market at approximately $32.1 trillion, dwarfing the $5.1 trillion business-to-consumer (B2C) market. Yet despite this scale, the majority of industrial trade volume continues to flow through Source-to-Pay suites such as SAP Ariba and Coupa. According to Metzger (2025), SAP's network alone facilitates over $6.3 trillion in annual trade. These systems, however, remain largely digitization layers in which the core procurement lifecycle is still a manual, human-supervised process (Sarferaz, 2024). The reason is straightforward. B2B products are rarely standardized or easily described (Alt, 2020; Malone et al., 1987), contract values are high, and the consequences of errors severe, making the case for human oversight compelling. This is reflected in current platform penetration: Brohan (2021) and Xometry (2025) report that platforms such as Amazon Business ($83 billion in trade) and Xometry ($678 million) capture only a marginal share of total industrial trade. Even Alibaba's request for quotation functionality, while available, is widely regarded as unreliable for complex

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sourcing, with genuine manufacturers discouraged by the platform's incentive structure and the prevalence of intermediaries in top listings.
To understand what a meaningful B2B platform would need to do, it is necessary to examine the procurement process directly. Industrial procurement spans two macro-phases: Source-to-Contract, covering supplier search and evaluation, contract negotiation, and supplier relationship management; and Procure-to-Pay, covering purchase order management, fulfillment inspection, and payment (Wlcek et al., 2025). Each phase carries distinct transaction costs, search costs, negotiation costs, coordination costs, confirmation costs, and enforcement costs, and each has historically required manual effort precisely where automation has been unreliable. Recent research, however, documents a shift. Artificial Intelligence (AI)-driven platforms can now consolidate spend data from ERP systems, forecast demand spikes, scan global supplier databases, automate request for proposal distribution, simulate negotiation outcomes, and monitor supplier performance through real-time dashboards (Allal-Chérif et al., 2021; Saihi et al., 2026). Matching systems based on thousands of weighted parameters can identify suitable suppliers for complex requirements (Allal-Chérif et al., 2021), while chatbots are already conducting supplier negotiations; Walmart, for instance, deployed Pactum AI for real-time supplier negotiations (Saihi et al., 2026).

This convergence of capabilities points toward a new platform archetype. A B2B Procurement Platform is a multi-sided system designed to support complex, high-volume industrial sourcing beyond standardized catalog purchasing. It is designed to automate supplier identification, tendering, evaluation, and contracting at scale. By automating these activities, such a platform reconfigures procurement from a sequence of manual coordination tasks into a model centered on human supervision, exception handling, and final decision authority (Wlcek et al., 2025). Once reliable automation makes platform-mediated complex sourcing feasible, the conditions for critical mass and potentially monopolistic effects, well-documented in B2C contexts (Rochet & Tirole, 2003), become plausible in B2B markets as well.

Understanding and anticipating these dynamics demands analytical tools capable of capturing the multi-sided interactions, feedback loops, and evolving structures of platform ecosystems. B2B platform ecosystems are socio-technical systems and complex adaptive systems, in which firm-level behaviors interact to produce emergent market outcomes; simulation methods such as system dynamics (SD) and Agent-based modeling (ABM) are well-established approaches for analyzing and predicting the behavior of such systems (Sterman, 2000; Tesfatsion, 2006). SD has been used to model adoption at the population level, but requires behavioral rules to be specified in aggregate terms, i.e., how a whole population responds, rather than at the level of individual firms (Rand & Rust, 2011; Sterman, 2000). ABM, by contrast, builds on discrete event simulation and object-oriented programming to represent individual actors and allow complex system-wide behavior to emerge from their interactions (North & Macal, 2007; Zutshi et al., 2018). This makes ABM particularly suitable for the B2B context, where actors are heterogeneous, embedded in supply chain relationships, and make adoption decisions based on their supply chain positions and the platform membership of their trading partners (North & Macal, 2007).

Despite this potential, it remains unclear whether and how existing simulation studies adequately capture the dynamics of B2B platform diffusion. The present paper reviews simulation-based studies of B2B digital platforms to identify the methodological approaches employed, the phenomena studied, and the limitations that constrain their explanatory power. We review these studies, identify their structural limitations, and outline the requirements for a model that can more faithfully capture B2B platform diffusion dynamics. The paper addresses the following research question: What methodological approaches and structural assumptions characterize existing simulation-based studies of B2B platform dynamics, and what gaps in the modeling space must be addressed to enable a structurally adequate simulation of B2B procurement platform diffusion?

2. Methodology

This review follows the systematic literature review protocol proposed by Kitchenham & Charters (2007), comprising three phases: planning (defining the review scope, search string, and inclusion and exclusion criteria), conducting (executing the search and applying the criteria in two screening stages), and reporting (extracting data and synthesizing findings across inductively derived structural dimensions). The protocol is designed to minimize selection bias and ensure replicability. The literature selection process is visualized in Figure 1. To identify simulation studies of B2B platform dynamics, a targeted search was conducted in Scopus on 01 March 2026 using the following string: (TITLE-ABS-KEY(("B2B" OR "business-to-business" OR "procurement") AND ("platform" OR "ecosystem" OR "marketplace" OR "multi-sided") AND ("simulation" OR "agent-based" OR "system dynamics")) AND NOT TITLE-ABS-KEY(("software engineering" OR "programming" OR "MAS development" OR "Multi-Agent System*" OR "development framework" OR "system architecture"))). The first

two term groups were used to target B2B platforms used for procurement, and the third to concentrate on simulation studies. A significant share of initial results were related to the development of multi-agent systems for procurement software engineering, so the final NOT clause was included to exclude these. No language restrictions were applied during the search; all retrieved records were considered regardless of publication language.
The search returned 82 results. Papers published before 2010 were excluded, as earlier work predominantly addressed Electronic Data Interchange (EDI)-based procurement infrastructure and was deemed not relevant to platform dynamics; this reduced the pool to 55 papers. Title and abstract screening reduced the pool further to 19 candidates, with 36 papers excluded for one of four reasons: wrong domain (e.g. B2C retail, energy systems, or gaming); software architecture focus rather than ecosystem dynamics; simulation used solely as an optimization or validation tool with no modelling of adoption or diffusion; wrong level of analysis (single firm or financial instrument). All screening stages were conducted by a single coder, which represents a limitation with respect to inter-rater reliability.

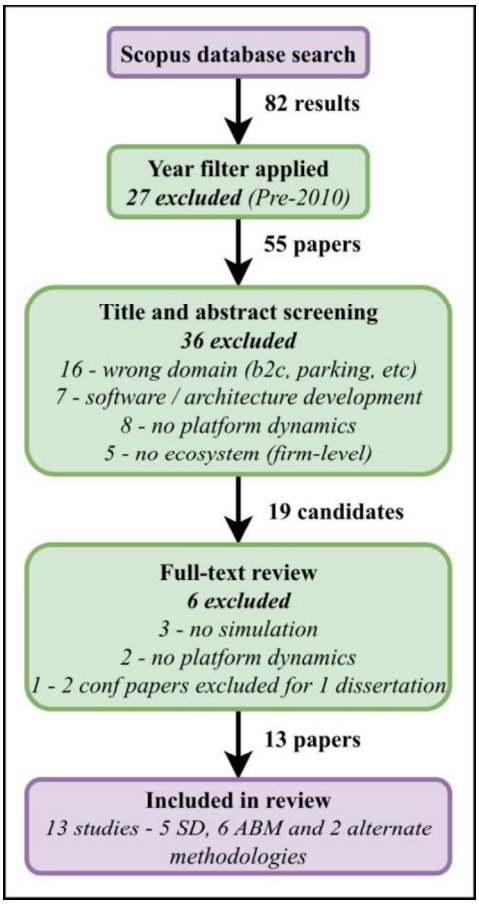

Figure 1: Literature selection process

Full-text review of the 19 candidates yielded 13 papers meeting all three inclusion criteria: (a) employing a formal simulation or modeling methodology, (b) addressing a B2B platform context, and (c) investigating adoption, diffusion, or interaction dynamics among platform participants. Six papers were excluded at this stage: three because no simulation was conducted and two because platform ecosystem-level dynamics were absent, with modelling limited to supply chain coordination among a small number of firms. A further two papers were excluded as they were individual studies subsumed within Schmid's (2023) doctoral dissertation, which was retained in preference to the constituent papers to avoid double-counting contributions from the same body of work. The review was limited to structured Scopus search. Backward and forward citation chaining were not conducted. The resulting sample should therefore be interpreted as a database-led mapping of the retrieved literature rather than as an exhaustive census of all relevant studies.

Six structural dimensions were derived inductively from the reviewed papers: methodology, actor representation, network topology, platform scope, adoption dynamics, and empirical calibration.

3. Simulation studies of B2B platform dynamics

3.1. Review of studies

3.1.1. System Dynamics Models

SD is employed by five of the thirteen reviewed studies. Caporuscio et al. (2023) simulate how crisis shocks propagate through a B2B platform ecosystem, modeling disruptions along three mechanisms: partnership reliability, network effect assessment, and technology availability, and finding that active platform adaptation consistently outperforms passive response regardless of shock intensity. The study has two limitations worth noting. First, partnership reliability and network effect assessment are overlapping, both describe actors' confidence in network relationships and would be disrupted in any supply chain crisis. Second, technological availability represents a different type of disruption from supply chain events used as illustrative examples and conflating the two weakens the model's coherence.

Kazantsev et al. (2023) model the Airbus aerospace supply chain ecosystem using SD, quantifying how digital platforms, smart contracts, and Industry 4.0 tools interact to reduce procurement backlogs; with sufficient digitalization, small and medium-sized enterprises (SMEs) order fulfillment can surpass Tier-1 suppliers within four years. The study provides empirically grounded parameter estimates which are valuable as baselines, though the model is anchored in the aerospace context and treats all SMEs as equivalent. Ksouri-Gerwien & Vorbohle (2024) apply SD to compare subscription and pay-per-use business model alternatives for a German B2B startup, finding that SD can effectively support

business model decisions in a B2B startup ecosystem. While valuable for the single-company case, it is scoped for a single firm's internal decision context and does not address ecosystem-level adoption dynamics.

Sui et al. (2024) model cross-side and same-side network effects in a platform connecting manufacturers, suppliers, and logistics providers, a three-sided design, whereas most prior work considers only two sides (buyers and suppliers), calibrated to the Chinese automobile industry, finding that same-side competition among manufacturers suppresses supplier participation during early growth and motivating a differentiated pricing strategy. Anderson Jr. et al. (2023) develop a normative SD model to determine how multi-sided platforms should dynamically coordinate pricing and engineering investment across their full lifecycle, allocating a fixed budget across standalone value, social features, and integration tools. For B2B industrial IoT platforms specifically, the model finds that sustained standalone value investment is optimal throughout the lifecycle and that integration tools investment should remain minimal given the high cost of recruiting third-party developers. The limitation for procurement-specific applications is that the three investment categories are too broad to map cleanly onto procurement lifecycle modules, supplier discovery, tendering, bid evaluation, contracting, and payment automation, and the model's continuous quality depreciation assumption does not reflect the episodic, module-by-module release cycles typical of enterprise procurement software. The shared limitation across all five SD studies is that actors are treated as homogeneous role-groups: individual firms' supply chain positions, switching costs, and supply chain dependencies, the factors that actually drive B2B platform adoption, cannot be represented.

3.1.2. Agent-Based Models

ABM offer greater actor-level resolution and are used in six of the thirteen reviewed studies. Fraccascia (2020) develops an ABM of an industrial symbiosis platform in which firms exchange waste materials as production inputs, varying platform usage rates across 11 scenarios, each replicated 400 times. The key finding is a threshold effect: below roughly 20% platform adoption the platform provides negligible value, while above 30% both individual user benefits and environmental performance increase significantly, thereby identifying critical mass for such an industrial symbiosis platform. Zutshi et al. (2018) provide the most rigorously calibrated study in the corpus, fitting a Bass-like ABM to willingness-to-pay survey data from 7,000 users of Portugal's dominant e-procurement provider (Vortal.biz) and achieving forecast errors below 0.5%; a genetic algorithm then identifies pricing adjustments projected to increase monthly revenue by 14.4%. The study correctly motivates ABM over SD by arguing that individual decision-making heterogeneity and peer influence are central to platform adoption, both of which an aggregate SD model cannot capture. However, the influence network is initialized as a random graph with fixed-radius neighborhoods, whereas B2B adoption spreads along supply chain relationships, making the network topology a significant limiting assumption.

Renna & Argoneto (2010) model multi-round automated negotiation between customer and supplier agents in an SME e-marketplace to align manufacturing capacity with commercial objectives. The multi-round negotiation modelling between firms is a notable contribution, though all firms are assumed to be pre-registered on a single platform, leaving adoption dynamics absent. Schmid (2023) examines how platform governance and transaction leverage affect generativity and profitability in a B2B innovation platform, using SAP Business Technology Platform as its reference case. Firm capabilities and requirements are encoded as abstract bit-strings, enabling simulation without reliance on extensive empirical data. Partners join the platform when they receive enough positive signals from their local innovation network, and leave when they perceive greater gain in the open market. Adoption rates emerge from the simulation, reaching 71% at high network complexity versus 24% at medium complexity, placing this study closest to a threshold mechanism driven by local network signals. However, the threshold in Schmid's model is conditioned on signals within an innovation network, not on supply chain dependencies. Schmid's result is nonetheless informative for the procurement case: it demonstrates that a local dependency-based threshold mechanism can produce high platform uptake in a B2B context, directly motivating its application to procurement platforms where analogous supply chain dependencies exist.

Barni et al. (2018) design a qualitative business model for an automation value chain platform using the Platform Design Toolkit and propose an ABM to validate it quantitatively, but do not implement the model. Ogai et al. (2019) use ABM combined with empirical network analysis to investigate how information and communication technology advancement affects the structural properties of B2B supply networks in the Japanese textile and apparel industry, finding that reducing geographic friction drives greater centralization around hub companies. The limitation is that the preferential attachment rule, whereby agents seek out the most connected partner, does not reflect actual supplier selection criteria such as price, quality, or product fit, and the single uniform friction parameter cannot represent competing platforms that reduce transaction barriers selectively and

heterogeneously. Two structural limitations recur across all six ABM studies: inter-firm relationships are either absent or approximated with random or geographic-proximity networks, and no study models competition between multiple platforms for the same user base.

3.1.3. Alternative approaches

Two studies use alternative approaches. Li et al. (2015) apply vector autoregression to 250 days of Alibaba.com data, finding that a larger number of sellers improves platform revenue, while competition intensity for paid search rankings (i.e., how aggressively sellers bid for visibility) yields short-term gains but causes long-run revenue decline due to containment and vicious competition among sellers. The study is empirically grounded and addresses platform-level dynamics, but its aggregate market-level analysis cannot capture individual firm adoption decisions or multi-platform competition. Narang et al. (2019) use repeated game theory to design a blockchain-based B2B marketplace in which smart contracts enforce honest behavior as a dominant strategy, using cryptographic protocols to protect reputation data. Like Li et al. (2015), the model is confined to a single-platform market and abstracts away multi-stage procurement workflow.

3.2. Morphological analysis and structural gaps

The six dimensions were identified inductively from recurring design choices observed across the reviewed studies. The values within each dimension describe the range of approaches found in the literature. Each study was assigned one dominant option per dimension based on the mechanism implemented in the model. "Theoretical" under empirical calibration denotes studies whose parameters are hypothetical or constructed for illustrative purposes rather than drawn from real markets, as in Fraccascia (2020), where firm types and waste exchange rates are constructed to demonstrate the platform network effect, or Schmid (2023), where firm capabilities are encoded as abstract bit-strings, enabling simulation without reliance on extensive empirical data.

Table 1: Morphological table with solution space and gaps

Dimension	Option A	Option B	Option C	Option D
Methodology	System dynamics Cap23 Kaz23 And23 KV24 Sui24	Agent-based model Fra20 Zut18 RA10 Sch23 Bar18 Oga19	Game theory / econometric Nar19 Li15	
Actor representation	Aggregate homogeneous Li15 And23	Actors grouped by category Cap23 Kaz23 KV24 Sui24 Nar19 RA10	Heterogeneous individual firms Fra20 Zut18 RA10 Sch23 Bar18 Oga19	
Network topology	None / implicit Cap23 Kaz23 KV24 Sui24 Nar19 RA10 Bar18 And23 Li15	Random / geographic proximity Fra20 Zut18 Oga19 Sch23	Structured supply chain Gap	
Platform scope	Single platform Cap23 Kaz23 KV24 Sui24 Fra20 Zut18 Oga19 Sch23 Nar19 Li15 RA10 And23 Bar18	Multi-platform competition Gap		
Platform participation / Adoption dynamics	Not modeled / membership pre-assumed Bar18 RA10 Nar19	Exogenous / aggregate participation Cap23 Kaz23 And23 KV24 Sui24 Fra20 Oga19 Li15	Bass diffusion (social imitation) Zut18	Threshold driven by supply chain dependency Sch23 Gap
Empirical calibration	Theoretical Cap23 Sch23 Bar18 Nar19 RA10 Fra20 And23	Expert interviews / case study Kaz23 KV24 Sui24	Real transaction / survey data Zut18 Li15 Oga19	

And23=Anderson Jr. et al. (2023) | Bar18=Barni et al. (2018) | Cap23=Caporuscio et al. (2023) | Fra20=Fraccascia (2020) | Kaz23=Kazantsev et al. (2023) | KV24=Ksouri-Gerwien & Vorbohle (2024) | Li15=Li et al. (2015) | Nar19=Narang et al. (2019) | Oga19=Ogai et al. (2019) | RA10=Renna & Argoneto (2010) | Sch23=Schmid (2023) | Sui24=Sui et al. (2024) | Zut18=Zutshi et al. (2018)

Two distinct adoption mechanisms appear in the literature and are captured as separate options under adoption dynamics. In a Bass diffusion model, adoption spreads through individual innovation and peer imitation, i.e., a firm adopts either spontaneously or because neighbors have adopted (Zutshi et al., 2018). In a threshold model, a firm adopts only once a sufficient share of its own network neighbors has already adopted (Stonedahl et al., 2010). For B2B procurement platforms, the threshold mechanism is more appropriate: a firm's adoption decision hinges not on general user counts but on whether its specific suppliers and customers are already present. This distinction is reflected in the table by separating Bass diffusion (Option C) from threshold-based adoption driven by supply chain dependency (Option D). Schmid (2023) employs a threshold mechanism driven by local network signals and is therefore the closest approximation to Option D in the reviewed literature. However, because the threshold is conditioned on signals within an innovation network rather than on supply chain dependencies, it does not fulfill the procurement-specific criterion that defines Option D. Option D accordingly remains unoccupied in the procurement sense: no reviewed study implements a threshold adoption mechanism in which a firm's decision is driven by whether its actual trading partners are present on the platform. "Actors grouped by category" under actor representation denotes models that distinguish actors by category (e.g., buyer, supplier, logistics provider) but treat all members of each category as identical, as in Sui et al. (2024) and Caporuscio et al. (2023).

No reviewed study combines the full set of features for a comprehensive model of B2B procurement platform diffusion: agent-based methodology, heterogeneous firm representation, structured supply chain topology, multi-platform competition, and an endogenous adoption mechanism grounded in supply chain dependencies. Our proposed model targets precisely this gap. It will comprise multiple supply chains belonging to several original equipment manufacturers, each with multiple tiers, in which individual firms make autonomous decisions about both trading partners and platform membership, while competing platforms simultaneously vie for market share.

Table 1 maps each reviewed study to these six dimensions and makes the structural gaps explicit. Within the reviewed sample, three patterns stand out. First, SD models generally operate at an aggregate level that limits representation of firm-level heterogeneity. Second, ABM studies provide greater behavioral resolution but have not yet been combined with structured supply-chain topologies in a procurement setting. Third, the reviewed studies do not jointly model multi-platform competition and procurement-specific threshold adoption based on actual trading-partner presence. A central gap emerging from the sample is therefore the absence of a procurement-specific model that combines these elements.

4. Limitations and Conclusion

This paper reviews thirteen simulation-based studies to map the design space for modeling B2B procurement platform diffusion, addressing the research question of what structural gaps in the simulation literature prevent a comprehensive model of B2B procurement platform diffusion. The search was conducted in Scopus following the systematic literature review protocol of Kitchenham & Charters (2007), using a targeted string combining B2B platform and simulation terminology, with an exclusion clause to filter out software engineering studies; papers before 2010 were excluded as predominantly addressing EDI technology. The morphological analysis organizes studies along six inductively derived dimensions; while these dimensions capture the most consequential structural choices, alternative framings could reveal different patterns. Furthermore, all screening and coding were performed by a single coder; independent verification would strengthen the reliability of the inclusion decisions. In addition, the review relied on a single database search and did not include backward or forward citation chaining. Relevant studies omitted by the search string or by database coverage may therefore be absent from the sample. No primary empirical data was collected: the paper is a methodological review (focused on how studies are designed and what modelling choices they make rather than their empirical findings), and claims about the prevalence or severity of the identified gaps cannot be quantitatively substantiated beyond the reviewed sample.

The review yields three findings within the boundaries of the sampled literature. First, SD models in the reviewed sample generally operate at an aggregate level that limits their ability to represent firm-level heterogeneity and adoption decisions shaped by specific supply-chain relationships. Second, reviewed ABM studies offer higher resolution, but they either model single-platform settings, rely on stylized networks, or address adjacent B2B contexts rather than procurement-specific supply chains. Third, the reviewed sample does not contain a study that jointly models multi-platform competition, structured supply-chain topology, and procurement-specific threshold adoption based on the presence of actual trading partners on the same platform.

More broadly, future work can be organized around five directions that recur across the review: modification of stylized adoption rules, enlargement from single-platform to multi-platform settings, improvement of network realism through

explicit supply-chain structures, combination of modelling paradigms where different mechanisms operate at different levels, and integration of survey, transaction, case, and expert evidence for calibration and validation. The next step is to implement the proposed ABM described here. Parameter estimates will draw on the empirical baseline provided by Kazantsev et al. (2023), who quantify the impact of digital platforms on supply chain transparency and order access in an aerospace context, and where available, real transaction and survey data from comparable settings. The adoption function will be threshold-based as motivated in section 3.2.

From a commercial perspective, the model has potential applications for companies evaluating platform adoption decisions, for platform operators seeking to understand tipping points, for investors assessing platform viability, and for policy-makers concerned with the concentration dynamics that may emerge once AI-driven B2B platforms achieve critical mass. Understanding whether, and under which supply chain configurations, a dominant platform emerges or multiple platforms coexist is a question of significant industrial relevance, particularly given the $32.1 trillion scale of global B2B commerce.

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