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# How Digital Market Infrastructure Generates Interorganizational Trust: An Agent-Based Simulation Study of Networked Business

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# How Digital Market Infrastructure Generates Interorganizational Trust: An Agent-Based Simulation Study of Networked Business

**Abstract**

Digital networked business is changing the conditions under which interorganizational trust is generated. Prior research emphasizes direct interaction, historical experience, and relational embeddedness. In electronic markets, digital platforms, and digital supply chains, however, organizations can form cooperation judgments without sufficient direct cooperation experience by using object visibility, digital signals, public records, third-party evaluations, failure explanations, and remedial mechanisms. This study defines the digital context as digital market infrastructure supported by information systems and uses Agent-based modeling to examine its affects interorganizational trust judgment, conversion, repair, and network sedimentation. The results show that digital market infrastructure improves the conversion efficiency from trust judgment to post-interaction trust ties by changing information visibility, judgment screening, failure handling, and relationship accumulation. Under comprehensive digital infrastructure, it also increases trust network density, cumulative trust ties, and network centralization. This study introduces digital market infrastructure into interorganizational trust research and shows that trust in networked business is generated through a dynamic relational mechanism shaped by information visibility, records and evaluations, failure governance, and network feedback.

Keywords: digital market infrastructure; interorganizational trust; networked business; agent-based modeling; trust mechanism

# 1. Introduction

Interorganisational trust supports cooperation when information is incomplete, performance is uncertain and responsibilities cannot be fully specified in advance.Organisations therefore need to assess potential partners' reliability and cooperative intentions. Digital technologies increase information transparency and allow organizations to obtain more public organizational information. Digital platforms also expand the scope within which organizations search for, contact, and select potential partners. These conditions extend the basis of trust

judgement beyond existing relationships and direct experience to publicly available information and external evaluations.

Recent studies discuss digital environments and trust through digital trust, digital collaboration, and digital governance mechanisms. Digital trust research examines confidence in the reliability, security and institutional arrangements of digital environments (Saveljeva & Volkova, 2025). In interorganizational cooperation, digital information and cross-organizational governance change information transparency, collaboration modes, and relational coordination conditions, potentially affecting interorganizational cooperation, trust formation, and collaborative performance (An et al., 2025; Chen et al., 2025). Digital records and evaluations can also provide evidence about unfamiliar partners before direct cooperation has accumulated (Xu et al., 2025). The process linking these conditions to partner identification, trust judgement, cooperation, failure handling and network formation remains insufficiently specified.This study examines how these stages connect through repeated interorganisational interaction.

Against this background, this study defines the digital context as digital market infrastructure supported by information systems. Digital market infrastructure refers here to information and governance conditions embedded in organisational interaction: partner visibility, accessible records and evaluations, and failure explanation and remedy. These conditions shape partner identification, trust judgement and subsequent relationship maintenance.

We asks the following question: What phenomena emerge when interorganizational trust is generated through object contact, trustworthiness judgment, failure handling, and network sedimentation in digital contexts, and how can the underlying mechanism be modeled and explained?It examines trust manifestations across different digital contexts in terms of the scope of trust objects, the distribution of trust judgments, the state of cooperative trust, and the structural form of trust. We identifies the mechanisms of interorganizational trust under digital market infrastructure.The study constructs an agent-based model of interorganizational trust generation, embedding digital infrastructure functions into object contact, signal acquisition, candidate formation, cooperation choice, performance feedback, and relationship state updating.Then compares simulation results under different digital infrastructure configurations and presents differences in trust judgment coverage, judgment-to-tie conversion, tie disruption and repair, and trust network structure. Finally, it identifies the mechanisms through which digital market infrastructure affects interorganizational trust generation and discusses the implications for research on networked business and digital platform governance.

The study makes two contributions.First, it defines digital market infrastructure as a set of information and governance conditions that enter interorganisational interaction.Second, it develops a model-based explanation linking these conditions to indirect experience substitution, trustworthiness judgement stratification, failure attribution and trust capital accumulation.

The remainder of the article is organized as follows. Section 2 reviews interorganizational trust and develops the concept of digital market infrastructure. Section 3 presents the agent-based model and experimental design.Section 4 reports the simulation results for trust judgment, relation conversion, failure handling, network outcomes, sensitivity analysis, and robustness checks. Then interprets the mechanisms linking digital infrastructure to trust generation. Section 5 discusses contributions, implications, and limitations.

# 2. Literature Review

## 2.1 Research on Interorganizational Trust Mechanisms

Interorganizational trust is central to cross-organizational cooperation. It refers to the relational judgment that an organization forms about another organization's reliability, performance capability, and cooperative intention under incomplete information, cooperation risk, and relationship uncertainty. Trust occurs at multiple levels, including individuals, teams, organizations, and interorganizational relationships, and each level involves different subjects, objects, and mechanisms (Fulmer & Gelfand, 2012). At the interorganizational level, trust formation involves the organizationalization of trust judgments between interacting parties, the expression of trust, and its influence on cooperative behavior (Schilke & Lumineau, 2025). Interorganizational trust can therefore be understood as an organized judgment process with clear subjects, objects, judgment content, and relational carriers.

From relational and structural perspective, interorganizational trust is embedded in existing relationships, power positions, mutual dependence, and opportunism risk. Relational norms and flexibility shape continuing cooperation (Singh et al., 2025), while power positions affect trust perceptions and asymmetric trust can alter opportunistic behaviour and governance (Wang et al., 2024; Oliveira et al., 2025). Interorganizational trust is therefore shaped by relational position, structural dependence, and cooperation risk. Research on interorganizational trust should examine not only how trust forms, but also which organizations enter trust

judgment, how trustworthiness judgments vary across objects, and how trust ties differ structurally within networks.

From governance and risk foundations,interorganizational trust is shaped by information exchange, governance arrangements, and risk coordination. Interorganizational information sharing helps cooperating parties assess each other's behavioral intentions, capabilities, and reliability, but may create knowledge leakage,bargaining power shifts and cooperation risk.Partnerships, monitoring mechanisms, and governance arrangements must coordinate these tensions(Paulraj et al.,2025).Governance mechanisms can shape interorganizational trust and cooperative outcomes (Nguyen et al., 2023). In supply disruption, performance failure, and unclear responsibility, prior relationship history affects problem identification and coordination, while suppliers' cooperative or uncooperative behavior shapes reliance on relational or contractual coordination (Engelhart et al., 2025). Relationship conversion, failure explanation and handling,and the repair or maintenance of damaged ties are therefore important to interorganizational trust formation.

## 2.2 Digital Market Infrastructure and Interorganizational Trust Generation

Digital market infrastructure changes information presentation, behavioral recording, evaluation diffusion, and risk handling in interorganizational cooperation (Chai et al., 2025; Centobelli et al., 2022). In networked business environments, organizations use digital systems to observe potential partners, call historical records, receive third-party evaluations, obtain explanations after cooperation failures. Digital market infrastructure therefore affects whether organizations trust others, but also affects trust judgments, trust judgments converted into actual cooperation, relationships enter disruption after failures. This study distinguishes digital market infrastructure conditions from interorganizational trust manifestations. Infrastructure functions include information visibility, behavioral traceability and evaluation visibility, risk understandability and controllability, and the composite configuration.Trust manifestation observe organizational trust objects,trustworthiness judgments distribution, cooperative trust states and trust network structure.

Information visibility determines which potential partners can enter organisational observation and judgement (Opriel et al., 2025). In traditional interorganizational cooperation, trust objects are usually shaped by existing relationships, industry ties, and limited search capabilities (Atouba and Shumate, 2020). In digital contexts, organizations can identify visible objects and use public information to include unfamiliar

organizations in trust judgment (Hara and Choi, 2025). Visibility can therefore extend partner recognition beyond existing relationship boundaries.

Behavioural traceability preserves performance and transaction records, while evaluation visibility makes assessments available for comparison and diffusion. In digital contexts, behavior and performance records can provide a basis for trustworthy judgments under governance conditions (Berninger et al., 2025). Trustworthiness judgment depends on a partner's capability, performance record, behavioral consistency, and reputation evaluation (Abuzaid et al., 2024). In digital contexts, organizations with higher evaluations and stable performance records receive more trust, whereas others may be marginalized because of negative records or low visibility (Zhu et al., 2025). Records and evaluations can thus support differentiated judgements of potential partners.

Failure explanation and remedy address the understandability and controllability of cooperation risks.Explanation helps organisations assess what went wrong, while remedy provides means of limiting losses and responding to failure. Interorganizational cooperation involves opportunism, performance failure, unclear responsibility, and information asymmetry, while digital technologies can support risk identification, assessment, response, and recovery. These conditions may shape whether a failed interaction leads to trust rupture and whether a damaged relationship can continue or recover.

Under digital market infrastructure, information visibility, behavioral traceability and evaluation visibility, and risk intelligibility and controllability jointly affect interorganizational trust.In comprehensive digital market infrastructure, interorganizational relationships are shaped by multiple digital functions and data governance conditions. Data governance needs to handle data rules, governance arrangements, and collaboration relations among different participants (Volz et al., 2025).

Under comprehensive digital market infrastructure, digital platforms, real time data exchange, and multi-actor connection change business relationships and resource linkages, making interorganizational trust better suited to network level observation (Baptista and Nunes, 2026). Trust relationships can consequently be examined as networks whose scale, continuity and concentration evolve through interaction (Wang and Yin, 2025).

# 3. Methodology

## 3.1 Research model

This study centers on the mechanism of interorganizational trust. Trust ties evolve through complex interaction, accumulated experience, and digital support within an ecosystem. Agent based modeling can construct heterogeneous actors and allow them to interact under bounded conditions according to their attributes (Bruch and Atwell, 2015). The model embeds digital functions in partner exposure, signal acquisition, record and evaluation diffusion, and failure handling. Across repeated interaction rounds, organizational agents form observation sets, obtain signals, update trust judgments, initiate and accept cooperation, revise relationship states by performance outcomes, and generate an interorganizational trust network. Figure 1 shows the generative identification logic.

The model is built on several system-level assumptions. First, organizations are acting agents with attributes such as capability and performance reliability. Through repeated interaction, they experience object contact, signal acquisition, trust judgment, candidate formation, cooperation choice, performance feedback, relationship updating, and stable relationship formation.Second, digital market infrastructure constitutes the functional environment of interorganizational interaction. Digital infrastructure includes object visibility, signal richness, signal precision, record accessibility, record retention, evaluation diffusion, evaluation clarity, failure explainability, remedy availability, and loss mitigation. These functions shape pre-cooperation discovery and signaling, record and evaluation use during cooperation, and failure explanation, remedy, and retention after failure. Third, organizations are heterogeneous.They differ in capability, reliability, resource supply, resource demand, openness, and risk tolerance. Heterogeneity means that organizations can form different candidate sets, trustworthiness judgments, cooperation choices, and trust outcomes under the same digital context. Fourth, interorganizational trust is directional.Organization i's trust judgment of organization $j$ differs from organization j's trust judgment of organization $i$.Cooperation updates both directions with different strength.

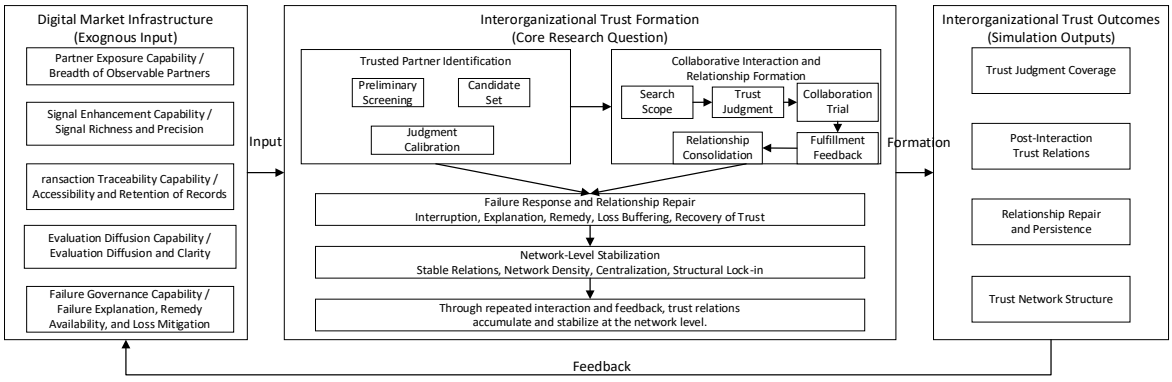



**Fig.1** Research logic framework

## 3.2 Agents Attributes

The model observes trust-related indicators through the activities of organizational agents in each period and uses these indicators to analyze trust mechanisms among organizations. Each organizational agent has heterogeneous attributes. The settings are reported in Appendix A.

Interorganizational interactions and attribute connections are represented through link attributes. Because interorganizational relationships are subjective cognitions of focal organizations, links are directed. In the model, link attributes are denoted with subscripts, where ij indicates the directed relation from organization i to organization j. Link attributes include capability belief($Bcap_{ijt}$), reliability belief($Brel_{ijt}$), cooperation intention belief($Bint_{ijt}$), judgment uncertainty($Unc_{ijt}$), overall trust judgment($T_{ijt}$), stock of interaction experience($n_{ijt}$), stocks of successful and failed experience($s_{ijt}, f_{ijt}$), familiarity($Fam_{ijt}$), remedial experience($RE_{ijt}$), remedial action indicator($Re_{ijt}$), failure cause($Cause_{ijt}$), observable failure-cause indicator($OFC_{ijt}$), unknown failure marker($UF_{ijt}$), cooperation indicator($Coop_{ijt}$), trust judgment relation($J_{ijt}$), post-interaction trust tie($E_{ijt}$), active tie($Active_{ijt}$), stable tie($Stable_{ijt}$), and broken state($Break_{ijt}$).

Digital context variables take functional strength values from 0 to 10. Object exposure ($OE$), signal richness ($SR$) and signal precision ($SP$) control partner visibility and the availability and accuracy of signals. Record accessibility($RA$) and record retention($RR$) represent the extent to which public performance records can be queried and preserved. Evaluation diffusion($ED$) and evaluation clarity($EC$) represent the diffusion and interpretability of third-party evaluations. Failure explanation clarity($FE$), remedy availability($CA$) and loss mitigation(LM) represent post-failure explanation, remedy, and loss-control conditions.

In addition to basic attributes, the model includes variables that update during interaction. First, organizational visibility changes with public performance records, including public records of success($PubSucc_{it}$) and failure($FailRate_{it}$), the number of evaluations, and network activity. Second, recent cooperation success and failure rates are computed using a rolling window over the most recent ten simulation periods. Third,a distance variable in evaluation diffusion represents network distance($Dist_{ijt}$) between organizations, drawing on research on trust diffusion paths (Jain and Singh, 2022). Fourth, remedial experience and prior experience are updated over time.Complete calculation rules are provided in the model rules and Appendix A.

## 3.3 Model construction

In each ticks, organizations form an observation set under limited attention, obtain signals about observed objects, update trust judgments, form candidate partners, and initiate cooperation. Cooperation outcomes enter direct experience, public records, and third-party evaluation systems, affecting object contact, signal acquisition and relationship states in later rounds. The main text retains only the core rules of the complete interaction chain. Appendix A reports complete operational formulas,sampling scales,signal observation probabilities,noise distributions, and cache-processing rules.

## 3.4 Output indicators description

The output indicators are designed to describe how digital market infrastructure shapes interorganizational trust generation. The model observes four connected stages: trust judgment formation, judgment-to-tie conversion, failure handling and repair, and network sedimentation. Table 1 summarizes the main output indicators used in the simulation analysis.

**Table 1. Main output indicators**

| Indicator category | Indicator | Meaning | Role in the analysis |
|---|---|---|---|
| Trust judgment formation | Trust judgment coverage ($JCoverRate_t$) | Proportion of possible directed relationships that reach the trust judgment threshold | Measures the scope of cognitive trust judgment under different infrastructure conditions |
| | Judgment-to-tie conversion rate ($JudgmentToEdgeRate_t$) | Proportion of trust judgments that convert into post-interaction trust ties | Measures the efficiency with which trustworthiness judgments become cooperation relationships |
| Trust tie expansion | New trust tie rate ($NewTrustRate_t$) | Rate at which new post-interaction trust ties form in the current round | Measures the current speed of trust tie formation |
| | Cumulative trust ties ($\mathrm{CumTrustEdge}_t$) | Total number of post-interaction trust ties formed up to the current round | Measures the accumulated stock of cooperation-based trust relations |
| | Current trust network density | Proportion of possible directed relationships that have become post-interaction trust ties | Measures the structural expansion of the trust network |

| | | | |
|---|---|---|---|
| | ($Density_t$) | | |
| Failure handling and repair | Tie break incidence ($BreakIncidence_t$) | Proportion of previously active trust ties that enter the broken state in the current round | Measures the immediate risk of trust rupture |
| | Broken tie stock ($BreakStock_t$) | Proportion of relationships currently in the broken state | Measures the accumulated stock of damaged trust relations |
| | Tie recovery rate ($RecoveredEdgeRate_t$) | Proportion of previously broken ties that recover in the current round | Measures the repair of damaged trust relations |
| Network sedimentation | Trust tie survival rate ($EdgeSurvivalRate_t$) | Proportion of post-interaction trust ties that remain active across adjacent rounds | Measures the continuity of established trust ties |
| | Stable tie rate ($StableRate_t$) | Proportion of interacted ties that enter a stable state | Measures the formation of stable trust relations through repeated interaction |
| | Network stability ($Stability_t$) | Jaccard similarity of post-interaction trust tie sets across adjacent rounds | Measures the continuity of the overall trust network |
| | Network centralization ($Centralization_t$) | Degree to which trust ties concentrate around core organizations | Measures the concentration of trust-based network positions |

The first group describes the starting point of trust generation. Trust judgment coverage records whether organizations can identify and evaluate potential partners under different digital infrastructure conditions, capturing cognitive trust judgment before actual cooperation. Judgment-to-tie conversion rate records the proportion of trust judgments that become post-interaction trust ties, capturing the move from cognitive evaluation to cooperation-based relational trust.The second group of indicators describes the expansion of trust ties after judgment conversion. New trust tie rate records the current speed of trust tie formation. Cumulative trust ties record the accumulated number of cooperation-based trust relations. Current trust network density records the extent to these relations occupy the possible directed relationship space. The third group describes

relationship disruption and repair. Tie break incidence records the entry of active trust ties into the broken state. Broken tie stock records the accumulated level of damaged trust relations. Tie recovery rate records the return of broken ties to an active trust state. These indicators connect the simulation results to the failure handling function of digital market infrastructure. The fourth group of indicators describes network sedimentation. Trust tie survival rate and stable tie rate record the continuity of individual trust relations across time. Network stability records the continuity of the overall trust-tie set across adjacent rounds. Network centralization records the concentration of trust ties around core organizations. These indicators describe how repeated cooperation and accumulated trust records become network level structure.

Except these core indicators, the model outputs auxiliary indicators.These indicators are used to check whether object contact, signal acquisition, candidate formation, and trust judgment processes change. Specific calculation methods are provided in Appendix A.8.

## 3.5 Scenario setting

Digital function variables are normalized on a 0-10 scale.Digitalized supply chains and platform-based business systems often contain basic transparency and governance functions even before these functions become highly developed (An et al., 2025; Centobelli et al., 2022). Therefore, this study sets the baseline value at 2. The enhanced value of 8 represents a substantially stronger infrastructure condition.

The experimental contexts vary selected digital function blocks against this weak baseline. The object visibility and signal block captures partner identification and information recognition,closely related to digital visibility and information access (Al Tera et al., 2024; Tan et al., 2022). The record traceability and evaluation feedback block captures reusable evidence for trust judgment, including retained records, transparent information, and interpretable evaluations (An et al., 2025; Centobelli et al., 2022). The failure explanation and remedial governance block captures post-failure relationship handling, where dispute resolution, service recovery, and remedy mechanisms support trust maintenance after failure (Burtch et al., 2021; Zhao and Chen, 2024). The comprehensive context combines these blocks, reflecting the view that digital platform infrastructure works through the joint configuration of architecture, services, and governance mechanisms (Jovanovic et al., 2022). Table 2 reports the specific values assigned to each experimental context.

**Table 2. Experimental contexts and digital setting**

| Context | Experimental meaning | $OE$ | $SR$ | $SP$ | $RA$ | $RR$ | $ED$ | $EC$ | $FE$ | $CA$ | $LM$ |
|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D0 | Weak digital infrastructure context | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| D1 | Enhanced object visibility and signal infrastructure context | 8 | 8 | 8 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| D2 | Enhanced record traceability and evaluation feedback infrastructure context | 2 | 2 | 2 | 8 | 8 | 8 | 8 | 2 | 2 | 2 |
| D3 | Enhanced failure explanation and remedial governance infrastructure context | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 8 | 8 | 8 |
| D4 | Comprehensive digital market infrastructure context | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

The intensity check sets all D4 digital functions to 5, 8 or 10, while holding other model settings constant.The module checks compare full D4 with configurations lacking visibility and signal infrastructure, evaluation feedback, or failure remedial governance.Supplementary Tables S7–S10 report the complete checks.

The model runs in NetLogo 6.4.0. Each main experimental group includes 80 organizational agents, and the simulation length is 200 ticks. D0 to D4 each run 20 independent replications. Each run uses a fixed random seed generation rule, and the late window is defined as tick 150 to 200. This window corresponds to the latter half of the simulation, when the relationship network has formed and entered a relatively stable evolutionary stage. It reduces proportional volatility from early sparse-network events while retaining late-stage differences in conversion, disruption, survival, and network structure across contexts.

# 4. Simulation Results

This section compares trust generation under five digital infrastructure configurations using average results from 20 repeated runs for each group. These data use the same parameter settings and support analysis of state transitions, post-failure trajectories, and relationship duration. Appendix C reports complete standard errors and 95% confidence intervals.

## 4.1 Formation of Interorganizational Trust Judgments

Trust judgments usually begin when potential partners can be observed, identified, and compared through platform-visible information such as records, ratings, and prior transaction traces(Ma et al.,2021). To observe initial formation of trust between organizations, this part outputs trust judgment coverage.

Figure 2 shows trust judgment coverage increases over time in five groups with different timing and late-stage levels. D1 grows quickly in early and middle stages, reaching 8% at tick 50. D3 continues rising in the middle and late stages and reaches the highest level. D2 remains relatively low, with a late-window mean of 20%. D4 rises quickly in the middle stage and stabilizes after tick 150, with a late-window mean of 27%. These patterns show D1 quickly broadens trustworthiness judgment objects, D3 expands as interaction experience accumulates, D2 keeps judgments concentrated, and D4 accelerates and sustains trust judgment expansion under comprehensive infrastructure.

The ordering of judgment coverage should be interpreted with object entry and judgment screening. Appendix Table B-1 reports the auxiliary indicators. More objects entered observation and candidate pools in D1, matching its early increase. D2's average observed objects were nearly identical to D0. D4 had the highest trust differentiation despite not having the highest coverage, indicating stronger screening when object differences are clearer. D3's average observed objects were close to D0, and its coverage advantage appeared mainly in middle and late stages, suggesting expansion through later failure feedback and judgment correction. Appendix Figures B-8, B-14, B-20, B-26 and B-32 report complete relationship state compositions.

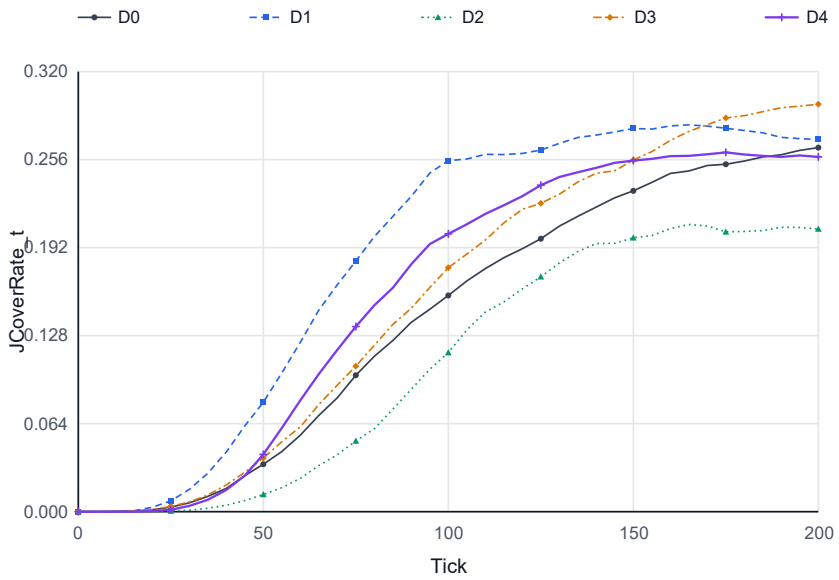



**Fig.2** Evolution of trust judgment coverage

## 4.2 Trustworthiness Judgment and Trust Tie Conversion

Trust judgments need actual interaction before becoming interorganizational trust ties. A larger set of judgment objects does not necessarily imply a higher conversion rate. This section jointly examines judgment-to-tie conversion (Figure 3) and the cumulative post-interaction trust ties and current network density displayed in Figures 4. These indicators capture conversion efficiency, historical accumulation and current relationship scale.

Figure 3 shows judgment-to-tie conversion increases over time in five groups, but its late stage ordering differs from trust judgment coverage. The mean values from tick 150 to 200 are 19% for D4, 12% for D2, 11% for D1, 7% for D3, and 5% for D0. D2 has the lowest judgment coverage, but its conversion rate is higher than several other groups. This cross-ordering shows that the scope of trust judgment and the proportion entering actual cooperation are two distinct phenomena.

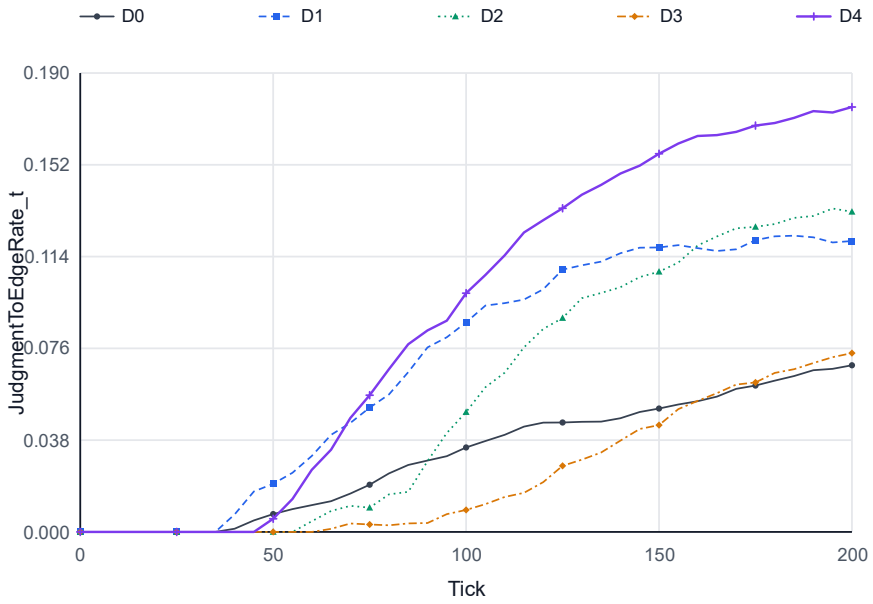



**Fig.3** Post-interaction trust tie conversion rate

Figure 4 compares historically formed trust ties with the density of the current trust network. At tick 200, D4 reaches 687.1, D1 reaches 524.5, D2 reaches 413.3, while D3 and D0 reach 221.2 and 201.4. D1 grows first in the early stage, while D4 surpasses D1 in the middle stages and reaches the highest cumulative value. D2 starts later but grows faster after tick 100. Figure 4b shows the same broad late-stage ordering for current network density: D4 reaches 0.056 at tick 200, followed by D1 (0.034) and D2 (0.028), while D3 (0.022) and D0 (0.016) remain lower. The two panels therefore distinguish historical accumulation from current network scale

while showing their shared advantage under the comprehensive context.

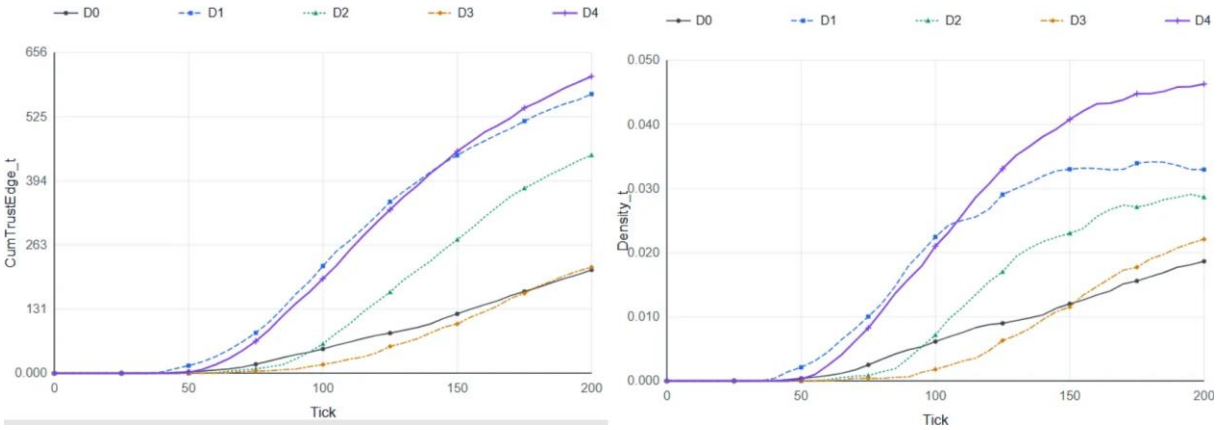



**Fig.4** Cumulative post-interaction and Evolution of network density

Current network density broadly follows the ordering D4, D1, D2, D3 and D0. D1 forms a relatively dense network earlier and becomes stable after tick 150. D2 starts density growth later but remains above D0 in the late stage. D4 surpasses D1 in the middle stages and continues to grow. D3 remains much closer to D0 in relationship scale than D1, D2 and D4, indicating that enhanced failure handling has a different pattern from expanded partner entry.

Figures 3 and 4 show different stages of interorganizational trust formation. Figure 3 records the conversion of trust judgments into interaction ties, whereas Figures 4a and 4b record cumulative trust ties and the density of the current network. One-step transition probability matrices for each context are reported in Appendix Figures B-9, B-15, B-21, B-27 and B-33. Difference matrices for D1 to D4 relative to D0 are reported in Appendix Figures B-16, B-22, B-28 and B-34.

The above results reveal two related but distinct ways in which digital market infrastructure affects interorganizational trust generation. First, the digital context lowers judgment costs without direct cooperation experience by providing transaction records, rating feedback, performance signals, and platform traces. Figure 2 shows that trustworthiness judgments are not highest under the D2 condition. However, Figures 3, 4a and 4b show that D2 has a clearer advantage in converting trustworthiness judgments into cooperative ties, forming cumulative trust ties, and increasing network density. D4 condition shows a similar appears. Judgment coverage is not necessarily the highest, but relationship conversion efficiency, cumulative relationships, and network expansion are more pronounced. Based on this pattern, this study identifies an indirect experience substitution mechanism. This mechanism refers to the process through organizations without direct cooperation history use public records, third-party evaluations, and accessible performance information to convert the experience of other actors into a basis for their own trust judgments. Organizations can form initial expectations from existing

records and external evaluations, reducing reliance on repeated direct trial and error. Trust initiation thus extends from closed bilateral histories to a shared information environment.

This mechanism explains the relationship between trust judgments and actual cooperation when record and evaluation conditions strengthen.Records and evaluations make performance evidence available for organization without direct experience. Organizations show stronger records in indirect experience are more likely to move from trust judgments into actual cooperation. In composite digital contexts where public records, evaluation diffusion, and failure feedback coexist, organizations can cross the cold start threshold created by threshold more quickly. The indirect experience substitution mechanism is consistent with recent research suggesting that under digital conditions, production of trust increasingly depends on system-based, characteristic-based, and institutionalized information, while the sources of trust extend beyond direct familiarity (Lumineau et al., 2023). Its core function is to reduce cold start uncertainty in interorganizational trust. By converting other actors' interaction experience into judgment resources that organizations can use through public records, third-party evaluations, and accessible performance information, the mechanism helps organizations form initial trustworthiness expectations before direct cooperation occurs.

Second, the same results show that digital infrastructure improves partner trustworthiness discrimination. Figures 2 and 3 indicate that, when records, evaluations, and feedback mechanisms are more complete, organizations better identify which actors deserve cooperation. Figures 4a and 4b show that this ability to distinguish among actors affects the subsequent accumulation of trust ties and the expansion of network structure. This study defines this process as the trustworthiness judgment stratification mechanism. It emphasizes the process through which organizations use multiple signals, public records, third-party evaluations, and prior interaction feedback to form differentiated levels of trustworthiness among potential partners and allocate cooperative commitment accordingly. Its focus is the ordering and stratification of trustworthy actors. When information is more complete, organizations can more clearly exclude unsuitable actors and concentrate cooperative choices on a smaller set of more trustworthy actors. In this process, records and evaluations provide organizations with more performance information and external assessments about potential partners. The mismatch between the coverage of trustworthiness judgments and the conversion rate of interaction ties reflects the difference between actor screening and the allocation of cooperative commitment. This process indicates that the formation of interorganizational trust ties in digital contexts depends on how organizations classify the trustworthiness levels of potential partners. The mechanism also appears as stronger trust differentiation. A higher level of trust differentiation means that differences among organizational actors become clearer, and the

boundaries among trustworthy actors, less trustworthy actors, and unsuitable actors become more explicit. After external information is processed through stratification, it is converted into more selective cooperative commitment.

The core function of the trustworthiness judgment stratification mechanism is to reduce partner screening uncertainty, which comes from differences in potential-partner quality, mixed signals, and limited cooperative commitment.Through multiple signals, public records, third-party evaluations, and prior interaction feedback, the mechanism divides observable actors into trustworthiness levels and helps organizations identify more suitable partners.It converts external information into ordered trustworthiness judgments, so organizations allocate limited cooperative commitment to actors at higher trustworthiness levels and reduce relational investment in less trustworthy or unsuitable actors.

## 4.3 Failed Interaction and Trust Differentiation

Interorganizational trust appears not only in relationship formation, but also in relationship maintenance after failure or disruption. This section examines tie-break incidence and tie recovery rate in Figures 5a and 5b, followed by relationship-state trajectories after failure-event alignment in Figure 6. Broken-tie stock and adjacent-period tie survival are reported as supporting diagnostics in Appendix Figures B-3 and B-4.

Since break incidence uses existing trust ties as the denominator, sparse early networks can produce short-term proportional spikes from disruption events. The analysis therefore focuses on evolutionary trend after the first fluctuation and on late-window means. Figure 5a shows D0, D1, and D2 show peaks in the early and middle stages then continue to fluctuate. D3 and D4 remain close to 0 for a long period. The much lower break incidence in D3 and D4 indicates that stronger failure explanation, remedy availability and loss mitigation significantly reduce the risk that post-interaction trust ties enter the broken state.

Figure 5a and Appendix Figure B-3 distinguish the flow and stock of relationship disruption. D3 has both low break incidence and low broken-tie stock, indicating a narrow entry point for damaged relationships and limited accumulation of damage. D1 and D2 have higher broken-tie stock, suggesting that relationship entry and screening expansion also enlarge potential failure exposure. D4 has low break incidence but higher broken-tie stock than D0. The system forms and retains more ties, and a few historically broken ties still create stock. Relationship expansion and damage therefore coexist in different contexts, while post-failure handling conditions determine whether damaged ties enter the broken state.

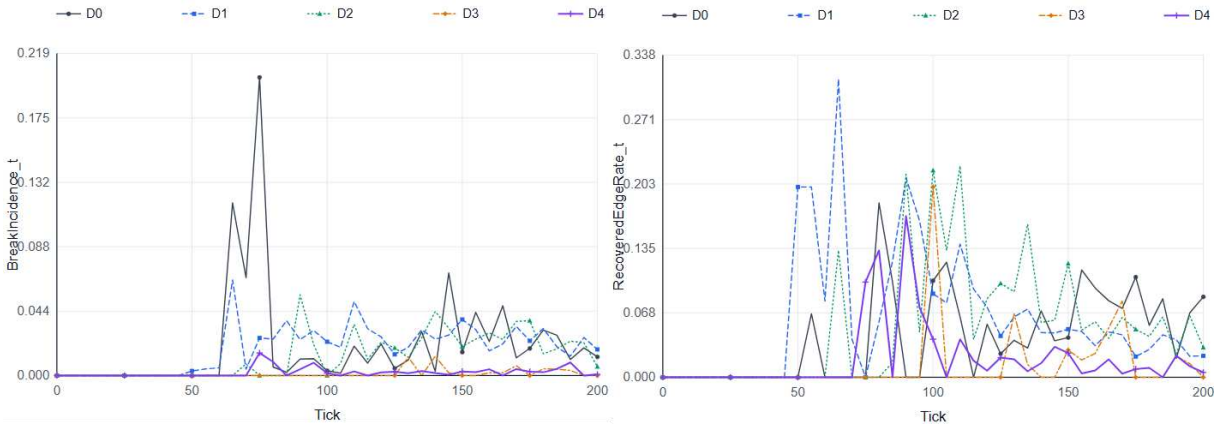



**Fig.5** Evolution of tie-break incidence (a) and tie recovery rate (b)

The recovery rate after disruption must be read with break incidence and failure-event alignment results. Figure 6 aligns failed interactions with relationship states at the same time point and observes state changes within 20 ticks after failure. D3 and D4 have the lowest probability of entering the broken state after failure, and remain low throughout the observation window. D3 has the highest proportion of relationships remaining in interaction trust or stable states after failure. D4 has low disruption probability, but the proportion of interaction-trust or stable relationships is lower than in D3, indicating that some relationships under the comprehensive context may move into other non-broken states. D2 has the lowest proportion remaining in interaction-trust or stable states after failure. Record and evaluation conditions change pre-cooperation object screening rather than post-failure relationship handling.

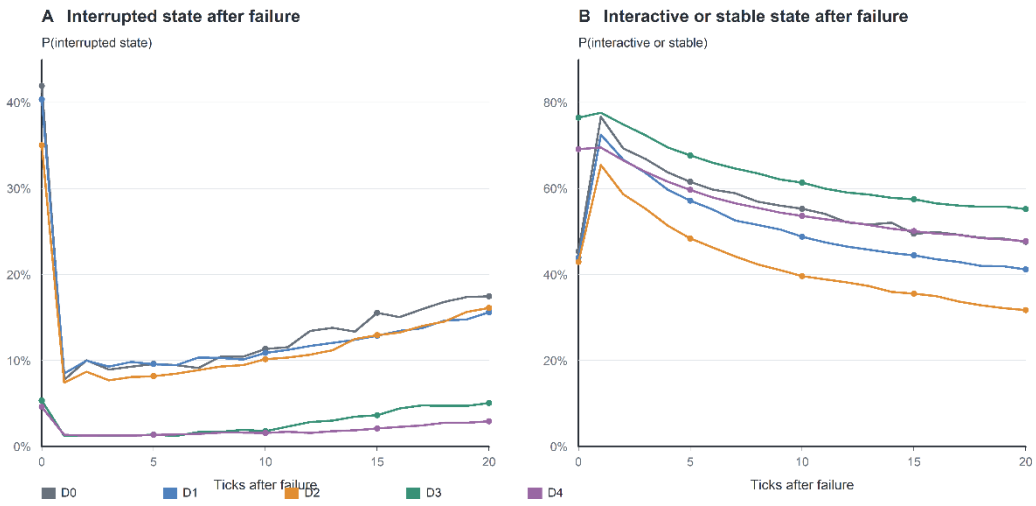



**Fig. 6** Relationship state trajectories after failure-event alignment

Figures 5b and 6 distinguish two phenomena. In D0, D1 and D2, some ties have already entered the broken state, so post-event recovery rates are higher. In D3 and D4, the main change occurs before disruption, as more

failed relationships avoid the broken state. Appendix Figures B-11, B-17, B-23, B-29 and B-35 report failure-event alignment results for each context.

After failed experiences are processed, post-interaction trust ties continue through cross-period retention and stable sedimentation. Figure 7 calculates relationship duration from a tie's first entry into the interaction-trust or stable state to its first exit. D3 and D4 form the high-survival group, with long-term survival probabilities above those of the other contexts. D1 and D2 form more ties, but neither exhibits the long-term survival advantage observed in D3 and D4. Supporting indicators show that D3's adjacent-period survival rate recovers to 89.1% at tick 200 (Appendix Figure B-4), while late-window stable-tie rates are 0.315 for D3, 0.292 for D0, 0.348 for D1, 0.327 for D4 and 0.262 for D2 (Appendix Figure B-5). D4 has the highest density and a relatively high survival rate, but its late-window stable-tie rate is lower than that of D1 and higher than those of D3 and D0.

The results from relationship damage to continuation reveal maintenance differences. D3 reduces conversion of failures into broken states and lets established ties last longer. D4 both reduces disruption probability and expands the relationship network, but continuous entry of new ties temporarily lowers the stable tie rate. D1 and D2 accumulate more broken ties after expanding the interaction range, suggesting relationship entry and maintenance capability do not necessarily move together. Separate survival curves for each context are reported in Appendix Figures B-12, B-18, B-24, B-30 and B-36.

Interorganizational trust does not automatically terminate after a single performance failure in practice. The key issue is whether the failure can be explained and remedied after it occurs (Raza et al., 2023). The simulation results match this practical logic.This finding indicates failure explanation and remediation conditions mainly operate before failure event develops into trust rupture. They help organizations assess failure cause, boundary of responsibility, and possibility of remediation, then decide whether the trust relationship still deserves to continue. Based on this pattern, this study identifies a failure attribution mechanism.

The failure attribution mechanism refers to organizations distinguish cooperation failure from trust rupture through cause explanation, responsibility judgment, and remedy expectations. It converts failure events into relational information that can be understood, attributed, and handled. When failure causes are identified as objective factors, organizations may continue trusting the performer and clarify a remedy path. If failure is attributed to unacceptable breach, malicious behavior, or persistent unreliability, the relation is more likely to break. This mechanism reduces uncertainty in post-failure relationship handling. Failures may arise from

insufficient capability, external disturbance, information error, resource mismatch, or accidental deviation; attribution determine whether failure touches the basis of trustworthiness and whether relationship adjustment remains possible. The mechanism extends interorganizational trust from pre-cooperation judgment to post-failure maintenance, linking trust generation with trust preservation under digital market infrastructure.

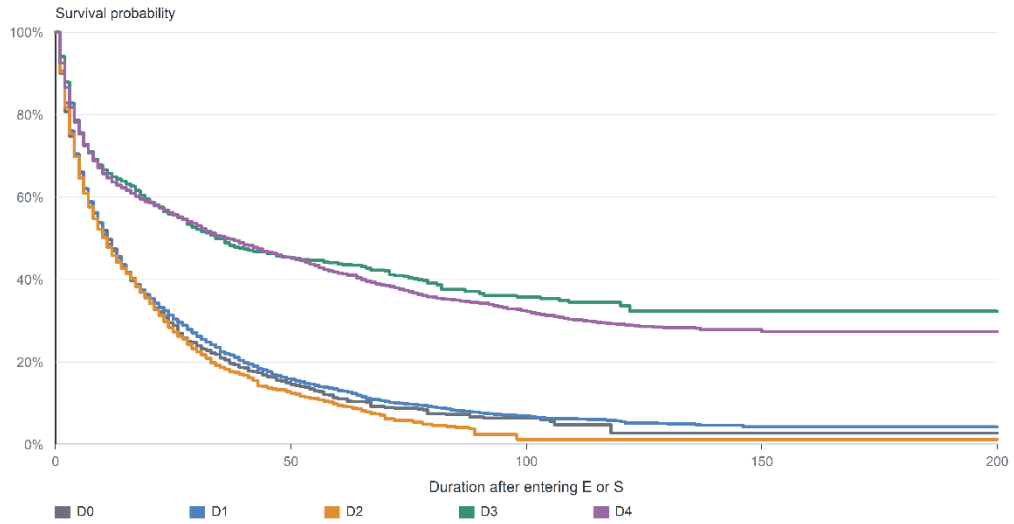



**Fig.7** Survival curve of post-interaction trust ties

## 4.4 Interorganizational Trust Network Structure

As repeated interactions continue, micro-level trust ties sediment into system-level network structures. Network stability measures edge sets across adjacent recording points. Its full trajectory is reported in Appendix Figure B-6. The five groups gradually increase network stability after trust ties form. D3 dips around ticks 140 to 160 together with tie survival rate. In D4, many new ties have not yet satisfied stable tie conditions, but most ties continue from one recording point to the next.

Network expansion is not uniform across organizations. D4 has the highest indegree centralization, with a late-window mean of 0.470. D1 and D2 have means of 0.389 and 0.337, while D0 and D3 have means of 0.252 and 0.272. D1 shows centralizes earlier, while D4 surpasses D1 in the middle stages and remains the highest. D1 and D4 expand object contact, while D2 and D4 allow record and evaluation information to accumulate through interaction. Some organizations are more likely to be observed and selected in repeated interaction, so relationships gradually concentrate toward them. D3 centralization remains close to D0.

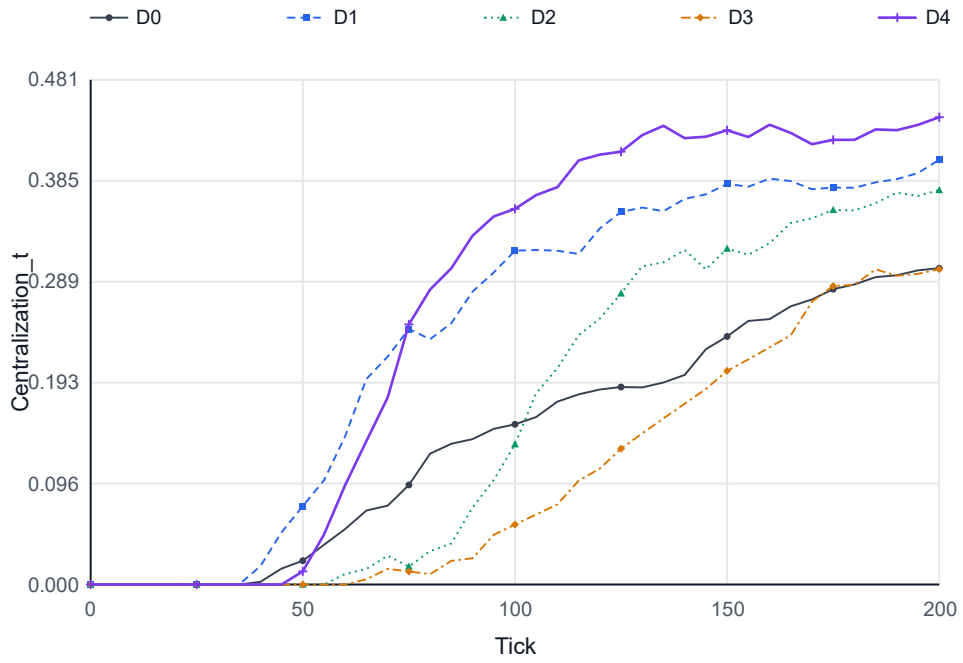



**Fig. 8** Evolution of trust network

Appendix Figure B-10 places each recording point in a two-dimensional space of network density and network stability. D4 has both the highest density and stability. D1 shows strong network expansion, but its final density is lower than D4. D3 expands slowly but later recovers structural continuity. D2 lies between D1 and D3. Together with the centralization results in Figure 8, the D4 network retains more ties while forming higher density and stronger concentration. Separate density–stability trajectories for each context are reported in Appendix Figures B-13, B-19, B-25, B-31 and B-37.

Network structural indicators aggregate the preceding relationship changes into system-level visible outcomes. D1 expands relationship range early and forms density and centralization advantages earlier. D2 gradually expands and concentrates through continuing screening and conversion. D3 has a relationship scale close to baseline, but lower disruption and improved long-term continuation. D4 retains more ties, continuously absorbs new ties, and forms higher centralization.Relationship formation, relationship maintenance, and structural sedimentation do not share a single strength ranking.

## 4.5 Overall Comparison of Cross-Context State Changes

Time-series indicators show different results change as interaction proceeds. Relationship event data show links and paths through which these changes occur in relationship state flows. A directed relationship may be in the unobserved state U, observed-only state O, trust judgment state J, interaction trust state E, stable relationship

state S, or broken state B. Comparing transitions among these states reveals differences digital contexts operate links.

Figure 9 connects the preceding phenomenon chain. D1 and D4 have higher U-to-O transition probabilities, indicating easier entry into the observation range and corresponding to D1's early expansion. D2 and D4 have higher J-to-E transition probabilities, matching the cross-ordering between judgment range and interaction tie conversion. D3 and D4 have clearly lower E-to-B and S-to-B transition probabilities, matching lower disruption after failure shocks. D3 and D4 also have lower B-to-E and B-to-S transition probabilities, but this result needs to be interpreted together with Figure 6. More failures are handled before relationships enter state B, and relationships still entering B are closer to residual relationships that are difficult to recover.

Figure 9 retains only the key paths directly related to the phenomenon chain. Appendix Figures B-9, B-15 to B-16, B-21 to B-22, B-27 to B-28 and B-33 to B-34 report complete transition matrices and differences from D0. The appendix matrices check whether omitted paths show opposite changes and preserve complete state evidence for mechanism induction. The five contexts differ by link. D1 changes object entry and transmits this to relationship formation and network expansion. D2 changes post-judgment screening and conversion, expanding the network in the middle stages. D3 changes mainly after failure shocks by reducing disruption and lengthening relationship duration. D4 changes multiple links, with higher conversion, larger network scale, lower break incidence, and higher stability and centralization.

Interorganizational trust is not disappeard immediately after a single episode of cooperation.Through continued transactions,performance records, evaluation feedback, and accumulated network position, it becomes relational capital usable in later cooperation. The stability of an organization’s trustworthiness record can attract priority attention in new cooperation choices, creating new connection opportunities and advantages in network position (Tran et al., 2024). This suggests trust generation in digital markets has a clear cumulative logic. Trustworthy behavior is preserved through platform records, diffused through evaluations and relationship networks, and further shapes partner selection in subsequent interactions. The experimental results match this real setting. In the composite digital context, trust ties continue to affect later cooperation opportunities through visible records, relationship retention, and accumulation of network structure. Based on this pattern, this study identifies a trust capital accumulation mechanism.

The trust capital accumulation mechanism refers to established trust ties are repeatedly called in continuing interaction and converted into later visibility, selection probability, and network positional advantage. The core function is to reduce uncertainty in later cooperation opportunities and the formation of network positions.This mechanism lets existing trust ties to continue influencing new cooperation choices and helps some organizations gain more stable network positions. Organizations with more trust ties and better performance records are more likely to be observed, judged, and selected by other organizations.New cooperation ties further increase their records, evaluations, and strengthen their network positions. Trust is converted from a dyadic interaction outcome into relational capital in the network. Rising network density and stronger centralization reveal this accumulation process: relationships continue to expand, and cooperation opportunities gradually concentrate toward organizations with higher trust capital.

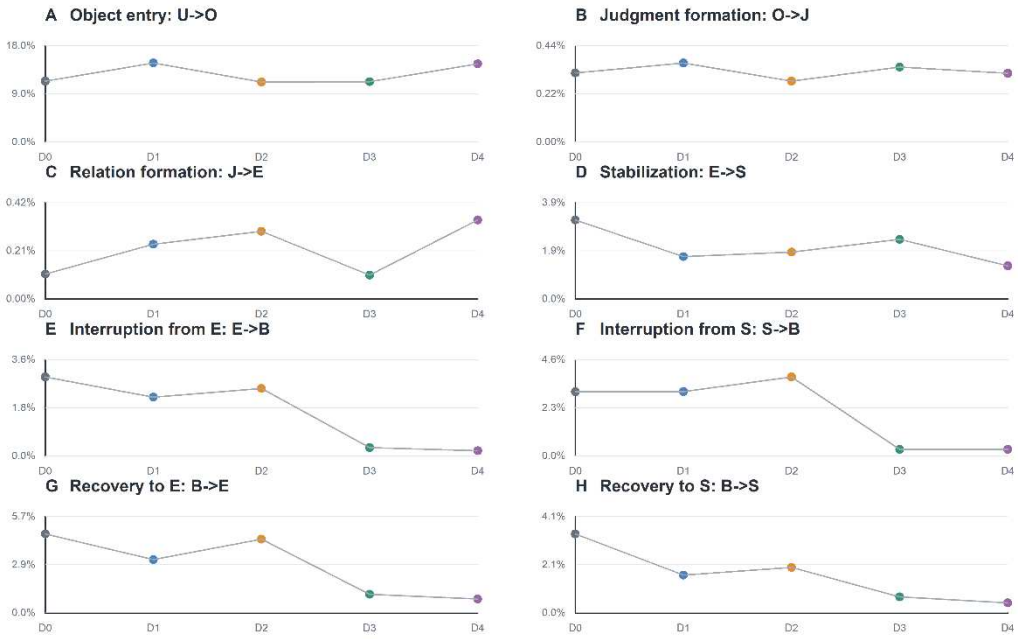



**Fig.9** Key relationship state transition paths under the five contexts

## 4.6 Sensitivity Analysis of Comprehensive Digital Market Infrastructure Strength

To test whether D4 results depend on a single strength setting, this study compares D4_LOW, D4, and D4_HIGH under three strength perturbations. Complete tick-level means, standard deviations, standard errors, and 95% confidence intervals are reported in Appendix D.

The sensitivity analysis shows relationship conversion and relationship under comprehensive digital market infrastructure remain stable under strength perturbation. Judgment-to-tie conversion rises from 0.150 in

D4_LOW to 0.192 in D4 and reaches 0.202 in D4_HIGH. Cumulative post-interaction trust ties rise from 523.50 and 614.60 to 693.79. Network density rises from 0.0397 and 0.0438 to 0.0681.Relationship disruption and continuation show the opposite direction. Break incidence falls from 0.0094 in D4_LOW to 0.0022 in D4 and further to 0.0008 in D4_HIGH. Trust tie survival and network stability rise as digital function strength increases. These results indicate when comprehensive digital market infrastructure is strengthened, fewer failed relationships enter the broken state, established ties are more likely to persist across adjacent recording points, and the network edge set becomes more continuous. As digital function strength increases, trust judgment coverage increases, whereas the stable-tie rate and recovery rate decrease. Centralization rises from D4_LOW to D4 and then declines in D4_HIGH. This result is consistent with the earlier phenomenon chain. Stronger digital functions do not simply expand trust judgment coverage. They also improve object distinguishability, conversion efficiency, and relationship retention.This result supports the main pattern under comprehensive digital market infrastructure.

## 4.7 Robustness Test of Comprehensive Digital Market Infrastructure

To examine how different internal functional modules support the result pattern under comprehensive digital market infrastructure,robustness test uses D4 as the baseline and separately removes object visibility and signal infrastructure, evaluation feedback infrastructure, and failure remedial governance infrastructure. Removing visibility and signal infrastructure reduces trust judgment coverage, judgment-to-tie conversion, cumulative post-interaction trust ties, and network density, showing that object entry and signal recognition underlie relationship generation. Removing evaluation feedback raises trust judgment coverage but lowers conversion and cumulative trust ties, showing that evaluation feedback improves screening quality. Removing failure remedial governance sharply increases break incidence and broken tie stock, showing that it reduces post-failure entry into the broken state. Appendix E reports complete results.

## 4.8 Trust Generation under Digital Market Infrastructure

The simulation results show several nonlinear trust patterns across different contexts, a mismatch between judgment coverage and relationship conversion,coexistence of low disruption and low recovery, high density and high stability without the highest proportion of stable ties, and the accumulation of network centralization. Based on these phenomena, this study proposes a generative explanatory framework composed of four mechanism components. In the simulation framework, interorganizational trust in digital contexts can be explained as a

recursive relational mechanism in which indirect experience substitution provides the basis for trust initiation, trustworthiness judgment stratification serves as the mode of partner screening, failure attribution provides the condition for relationship maintenance, and trust capital accumulation forms the path of structural reproduction.

Figure 10 summarizes the explanatory framework for interorganizational trust generation under digital market infrastructure. Digital market infrastructure occupies the contextual condition layer, indicating changes in information availability, record callability, and failure explainability. Interorganizational trust mechanisms are located at the mechanism layer, indicating how organizations process experience, objects, failures, and relational positions under these conditions. The outcome layer points to trust generation, trust maintenance and structural reproduction.

In mechanism relationships, indirect experience substitution mechanism addresses the initiation of interorganizational trust. Digital infrastructure allows public records, third-party evaluations, and shareable performance information to be called by organizations. Interorganizational trust no longer depends entirely on direct experience accumulated after long-term bilateral interaction. Digital technology provides an experiential source for initial trust judgments among unfamiliar organizations. The trustworthiness judgment stratification mechanism further addresses the selection of trust objects. Organizations distinguish the trustworthiness strata of different objects through multiple signals and external records and allocate limited cooperation commitments to more trustworthy objects. The indirect experience substitution mechanism provides information for trust initiation, while the trustworthiness judgment stratification mechanism converts this information into differentiated rankings of cooperation objects.

Failure attribution mechanism addresses the maintenance of trust ties. Organizations can distinguish cooperation failure from trust rupture after failure occurs. When failure can be explained, attributed, and remedied, interorganizational relationships do not necessarily enter the broken state. This mechanism gives established trust ties a degree of resilience and extends trust from pre-cooperation trustworthiness judgment to post-cooperation relationship handling. The trust capital accumulation mechanism addresses the structuring of trust ties. Established trust ties are repeatedly called in later interactions and further affect organizational visibility, selection opportunities, and network positions.

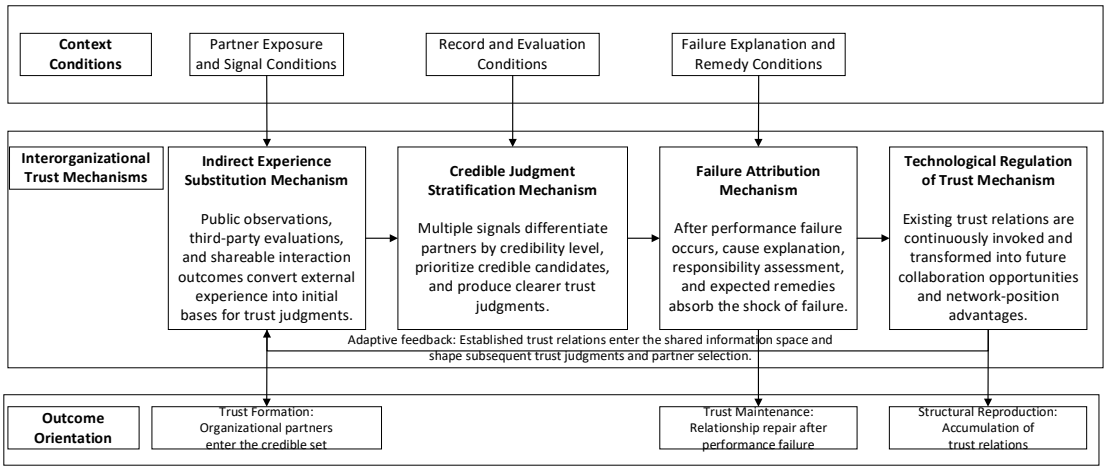



**Fig.10**. Explanatory framework for interorganizational trust generation under digital market infrastructure

# 5. Conclusion and Discussion

This study examines how digital market infrastructure changes interorganizational trust generation. It defines the digital context as digital market infrastructure supported by information systems and develops an agent-based modeling framework for interorganizational trust generation.The model classifies interorganizational relationships into unobserved, observed only, trustworthiness judgment, post-interaction trust, stable relationship, and broken relationship.Under five digital infrastructure contexts from D0 to D4, the study compares the evolution of trustworthiness judgments, trust tie conversion, tie disruption and recovery, network density, network stability, and centralization. It also uses sensitivity analysis and module-removal robustness tests to examine whether the main results depend on a single parameter setting or a single functional module.

For platform and electronic-market governance, the findings suggest attending to evidence use and failure handling alongside partner visibility. For digital platform and electronic market governors, platform development should not focus only on traffic aggregation and transaction matching. It should also give attention to infrastructure functions such as trustworthy records, evaluation feedback, performance tracking, responsibility explanation, and dispute remediation. Only when platforms can continuously preserve and present verifiable behavioral records, and provide clear explanation and remediation channels for failure events, are organizations more likely to include unfamiliar actors in cooperative judgment and retain room for relationship repair after failures occur.

For firms participating in digital supply chains and platform ecosystems, the findings suggest that firms should treat digital records and evaluation information as important bases for partner selection, but should not

equate visibility with trustworthiness. A more effective approach is to combine historical performance records, evaluation stability, failure handling performance, and existing network position to make stratified judgments about potential partners. Firms also need to incorporate failure event management into interorganizational trust governance. Timely explanation, responsibility allocation, and remediation arrangements can prevent a single performance failure from being directly interpreted as long-term unreliability or opportunistic behavior.

For policymakers and industry regulators, the findings highlight the public governance significance of digital market infrastructure. Trustworthy records, evaluation mechanisms, and dispute resolution mechanisms affect not only the efficiency of individual transactions, but also whether interorganizational relationships can continue to form and expand stably. Policy design can therefore focus on supporting the standardization of cross-platform credit records, the explainability of evaluation data, the transparency of platform dispute handling mechanisms, and the ability of small and medium-sized enterprises to obtain credible digital identities and performance records.Trust capital accumulation may also lead cooperation opportunities to concentrate among highly visible or highly reputable organizations. Monitoring concentrated opportunities and barriers to entry may therefore complement efforts to improve transaction trustworthiness; reputation lock-in and persistent exclusion remain questions for empirical investigation.

This study has several limitations.It mainly uses agent-based modeling for mechanism identification. This approach can present multi-actor interaction, repeated cooperation, relational feedback, and network structural change under controlled conditions, while tracing how micro-level rules generate macro-level trust manifestations. However,real interorganizational cooperation is also affected by industry institutions, platform rules, contractual arrangements, data governance rules, and historical relationships. Future studies can use platform behavior data, supply chain transaction data, case studies, or survey data to further test the mechanism paths proposed here.

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# Figure legends

Figure legends

Fig. 1 Research logic framework. Digital market infrastructure is modelled as a set of contextual conditions that shape partner exposure, signal interpretation, record and evaluation use, and failure handling. These conditions influence trust judgment, relationship formation, relationship repair and network-level trust outcomes through repeated interaction and feedback.
Fig. 2 Evolution of trust judgment coverage. Lines show the proportion of potential partners receiving a trustworthiness judgment at each simulation tick. Values are means across 20 simulation runs for the baseline (D0), partner exposure and signal condition (D1), record and evaluation condition (D2), failure explanation and remedy condition (D3), and integrated digital market infrastructure condition (D4).
Fig. 3 Evolution of judgment-to-tie conversion. Lines show the proportion of trust judgments converted into post-interaction trust ties at each simulation tick. Values are means across 20 simulation runs; scenarios are defined as in Fig. 2.
Fig. 4 Post-interaction trust-tie accumulation and network density. (a) Cumulative number of post-interaction trust ties. (b) Density of the current post-interaction trust network. Lines show means across 20 simulation runs; scenarios are defined as in Fig. 2.
Fig. 5 Tie disruption and recovery. (a) Incidence of trust-tie breaks among existing post-interaction trust ties. (b) Recovery rate of disrupted ties. Lines show means across 20 simulation runs; scenarios are defined as in Fig. 2.
Fig. 6 Relationship-state trajectories after failure-event alignment. (a) Probability that a relationship is in the broken state after a directional failure event. (b) Probability that a relationship remains in an interaction-trust or stable state after the event. Curves are aligned at the failure event (tick 0) and followed for 20 subsequent ticks across the five scenarios.
Fig. 7 Survival of post-interaction trust ties. Curves show the probability that a relationship remains in the interaction-trust or stable state as relationship duration increases. A relationship spell begins when a tie first enters either state and ends when it first exits; scenarios are defined as in Fig. 2.
Fig. 8 Evolution of trust-network centralization. Lines show in-degree centralization of the post-interaction trust network at each simulation tick. Values are means across 20 simulation runs; scenarios are defined as in Fig. 2.
Fig. 9 Key relationship-state transition paths across scenarios. Panels report pooled one-tick transition probabilities for selected relationship-state pathways. U, unobserved; O, observed only; J, trust judgment; E,

interaction trust; S, stable relationship; B, broken relationship. Each panel uses its own vertical scale and should be interpreted within the corresponding pathway.
Fig. 10 Explanatory framework for interorganizational trust generation under digital market infrastructure. Digital market infrastructure shapes conditions for partner exposure, record and evaluation use, and failure explanation and remedy. These conditions operate through indirect experience substitution, credible judgment stratification, failure attribution and trust-capital accumulation, producing trust formation, trust maintenance and structural reproduction.

## Data availability

The raw and processed simulation data supporting this study, together with the model source code for NetLogo 6.4.0 and the accompanying data use guide, are provided as research materials with this submission. The data files include run-level simulation outputs and the summaries used in the analyses. Location: Data availability section at the end of the revised manuscript; accompanying research data, model source code and Data use guide files.

## Author contributions

Author contributions have been redacted for double-anonymised peer review.

## Ethical statements

This study did not involve human participants, human data or animals. Ethical approval was therefore not required.

## Supplementary Files

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- Appendix.docx