Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

"You Just Call Out My Name": Help-Seeking Networks in Formal Organizations

Amit Rechavi

amit.rechavi@runi.ac.il

Reichman University

Research Article

Keywords: Multiplex networks, Help-seeking networks, Vulnerability index, Organizational resilience

Posted Date: June 26th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9028649/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

"You Just Call Out My Name": Help-Seeking Networks in Formal Organizations

Abstract

Organizations depend on help-seeking networks to solve non-routine problems, yet managers rarely understand their structural fragility. This study analyzes a tri-layer multiplex (formal authority, social interaction, and help-seeking expertise flows) from a large public organization (N=132), revealing how the choice of "who to call" creates both organizational capability and hidden structural risk. We introduce a vulnerability framework combining global efficiency simulations, degree-preserving null models, and cross-layer broker metrics to disentangle genuine structural properties from degree-driven artifacts.

Although help-seeking networks appear adaptive - exhibiting high clustering and reciprocity that exceed degree-matched null expectations - they conceal extreme fragility. In our data, brokerage is dominated by a single super-helper, and targeted removal of the top three brokers produces a 71% efficiency collapse. More broadly, the minimal overlap between help-seeking brokers and those in formal and social layers suggests that cross-layer compensation cannot be assumed, leaving expertise trapped in structural silos that block knowledge circulation.

Help-seeking constitutes a third structural dimension that maps expertise infrastructure while concentrating it in ways that amplify fragility. The vulnerability toolkit introduced here fills a diagnostic gap that prior multiplex research has left open. When employees "just call out a name," they reveal networks whose super-helper fragility likely characterizes any knowledge-dependent organization. Theoretically, these findings extend the formal-informal dichotomy to incorporate expertise flows as a distinct structural layer; practically, the vulnerability framework offers organizations a concrete diagnostic toolkit for identifying hidden fragility before it materializes.

Keywords:

Multiplex networks; Help-seeking networks; Vulnerability index; Organizational resilience

1. Introduction

In every knowledge-dependent organization, a small number of informal experts absorb a disproportionate share of colleagues' help requests - yet this expertise infrastructure is rarely visible in organizational charts or manageable through formal authority. When employees turn to a small set of "super-helpers" for expertise, they reveal a hidden infrastructure that formal hierarchies and social ties fail to map or compensate (Weigelt et al., 2021).

The classic distinction between formal hierarchies (efficient but brittle) and informal social networks (redundant but siloed) leaves this third dimension underexplored (Granovetter, 1973; Burt, 2004; Whetsell et al., 2020). Formal authority streamlines routine coordination but rarely captures specialized knowledge flows. (Whetsell et al., 2020; Burt, 2004). Informal ties foster cohesion through friendships and weak ties, yet can reinforce silos without addressing the skill gap (Csermely, 2006). Help-seeking networks-directed requests for professional advice-form communities of practice that pool expertise locally but risk extreme concentration on a few brokers, amplifying multiplex fragility when layers fail to align (Csermely, 2006; Barkoczi & Galesic, 2016).

In a large public organization (N=132), we map this tri-layer multiplex (formal reporting, social interaction, help-seeking) to test how expertise flows alter resilience relative to formal and informal structures. Extending Rechavi et al.'s (2025) homophily analysis of the same dataset, this study introduces: (1) a vulnerability index from targeted betweenness-based node removal; (2) degree-preserving null models (200 simulations) yielding z-scores that disentangle structural effects from scale-free artifacts (Albert et al., 2000; Newman, 2003); and (3) cross-layer overlap metrics revealing compensatory potential (Kivelä et al., 2014).

Research questions: Does help-seeking form tighter expertise communities than social networks? Does targeted broker removal produce a steeper collapse in help-seeking than other layers? Do formal and social brokers compensate for expertise fragility? These questions clarify when "just calling a name" creates organizational resilience versus structural vulnerability.

2. Literature Review

2.1 Organizational Efficiency Theories

Organizational theory provides a rich foundation for understanding efficiency-resilience trade-offs in networks. Meyer and Rowan's (1977) institutional myths argue that formal structures often prioritize legitimacy over operational efficiency, leading to sparse hierarchies that appear brittle under stress. Meyer's (1996) performance paradox extends this, showing organizations persist via survival strategies rather than pure efficiency, explaining why formal networks concentrate authority but risk single-point failures. Similarly, Meyer and Zucker (1989) found that permanently failing organizations survive through political buffering, not structural robustness. These theories frame formal networks as efficient in routine operations but vulnerable to disruptions, while informal ties offer adaptability at the cost of coordination.

2.2 Formal vs. Informal Networks

Five recent studies compare formal and informal networks in organizational settings and converge on a similar pattern: informal ties are generally denser, more reciprocal, and more adaptive than formal structures, which often appear sparse, rigid, or exclusive (Livingstone, 2010; Wright et al., 2012; Alpaydın & Fitjar, 2020; Weigelt et al., 2021; Erny & Godsey, 2022). Livingstone (2010) shows how informal coalitions of Wikipedia editors form a decentralized, resilient network alongside formal governance rules; Alpaydın and Fitjar (2020) and Erny & Godsey (2022) document how informal mentorship and social proximity shape access to opportunities beyond formal academic and institutional hierarchies; and studies of clinicians and virtual teams highlight the importance of informal peer support and emergent collaboration networks when formal recognition systems or structures are insufficient (Wright et al., 2012; Weigelt et al., 2021). Together, this work suggests that formal hierarchies concentrate authority and streamline communication, whereas informal networks carry redundancy, peer support, and flexibility.

Research in social network analysis has long captured this distinction by characterizing formal networks as efficient but brittle. In these networks, information travels quickly along short, centralized paths, but it is vulnerable if key actors are removed. On the other hand, the informal networks provide redundancy through higher density, reciprocity, and clustering (Burt, 2004; Granovetter, 1973; Alpaydın & Fitjar, 2020; Benatti et al., 2021).

Recent studies (see Table 1) complicate any simple “informal is always better” view, showing that formal hierarchies can offer stability and backup mechanisms while informal networks can produce echo chambers or silos when homophily drives clustering when cross-group bridges are missing (Csermely, 2006; Whetsell et al., 2020;

Barkoczi & Galesic, 2016). What these contributions have in common, however, is that they typically analyze a single layer at a time.

Study (Year)	Methods	Network Types	Key Findings
Livingstone (2010)	Mixed methods (content + SNA)	Informal, collaborative	Wikipedia's formal rules are open and decentralized; its informal bias-fighting network is adaptive and empowers underrepresented voices.
Erny & Godsey (2022)	Conceptual network analysis	Formal (academic hierarchy), informal (mentorship/collaboration)	Scholarly networks are exclusive with gender imbalances; informal ties can reinforce or challenge formal hierarchies.
Alpaydın & Fitjar (2020)	Survey + regression	Formal (institutional/cognitive), informal (social)	Social proximity is key for knowledge exploitation (denser, adaptive network); formal proximity aids exploration.
Weigelt et al. (2021)	Literature synthesis	Formal (org. structure), informal (virtual teams)	Pandemic exposed network fragility; informal networks and virtual teams became critical, but new vulnerabilities arose.
Wright et al. (2012)	Survey (scale development)	Formal (institutional recognition), informal (peer support)	Formal recognition is lacking; informal peer support networks are crucial for clinician morale and retention.

Table 1. Selected studies comparing formal and informal networks in organizations.

While single-layer studies illuminate formal efficiency vs. informal adaptability, multiplex analyses reveal whether these layers compensate each other's weaknesses (Lazega & Pattison, 1999; Kivelä et al., 2014). Critically missing: dedicated modeling of help-seeking as a layer that neither formal hierarchies nor social ties fully replicate. Degree correlations (r across layers) and broker overlap can quantify this alignment - or its absence - yet few studies simulate vulnerability under targeted expert removal, leaving organizations blind to expertise fragility

2.3 Mathematical Models of Multiplex Networks

Mathematical sociology has advanced multiplex analysis through formal models of inter-layer dependencies. Lazega and Pattison (1999) pioneered p*/ERGMs for multiplex advice, friendship, and collaboration networks, estimating "tie co-occurrence" rules

that stabilize structures. Kitts (2008) models norm robustness in organizational networks via dynamic simulations, linking stability to cross-layer overlap. Degree correlations between layers, a standard measure of alignment (Newman, 2003), reveal whether high-degree actors in one layer compensate for fragility elsewhere; our analysis extends this by correlating degrees across formal, social, and help-seeking ties.

Recent multilevel extensions (Wang et al., 2013) model co-evolution of layers, but few simulate robustness via node removal. Our multiplex framework empirically tests these theories with vulnerability indices and null models, distinguishing degree-driven from structural fragility, particularly in expertise-concentrated help-seeking layers.

2.4 The Help-Seeking Layer

Help-seeking networks capture a distinct third dimension: where employees turn for expertise beyond formal authority or social affinity. Unlike undirected friendships, these directed ties reveal **actual knowledge flows** and "communities of practice" (Wenger, 1998) - tight clusters that pool specialized skills efficiently within silos. Yet this concentration creates dark-side risks: overreliance on "super-experts," burnout potential, and a single point of failure when they exit (Weigelt et al., 2021).

Understanding help-seeking intersects with formal and informal structures is essential for evaluating the true resilience of organizations. Since prior studies neither model a dedicated help-seeking layer nor simulate fragility across interacting formal and informal networks, the present study builds on this literature by quantifying these differences in a specific organizational context.

3. Research Questions and Hypotheses

The literature establishes a classic trade-off: formal hierarchies prioritize communication efficiency through sparse, centralized paths, while informal networks emphasize redundancy via density, reciprocity, and local cohesion (Granovetter, 1973; Burt, 2004; Benatti et al., 2021). Help-seeking networks introduce a third dimension-expertise flows that form communities of practice yet risk knowledge silos and broker dependence (Livingstone, 2010; Alpaydın & Fitjar, 2020; Weigelt et al., 2021). We examine how this layer alters multiplex resilience relative to formal and informal structures.

H1 (formal vs. informal baseline): Formal layers exhibit lower density and reciprocity but shorter average path lengths than social layers, reflecting efficiency at the cost of redundancy.

H2 (help-seeking cohesion): Help-seeking layers display higher clustering than the formal layer and comparable to or exceeding the social layer, reflecting tighter expertise communities, but lower global efficiency than degree-preserving null models, indicating reduced knowledge reach.

H3 (expertise fragility): Targeted removal of the highest-betweenness brokers produces steeper efficiency collapse in help-seeking layers than formal or social layers, and top brokers exhibit minimal overlap across layers, signaling non-compensatory multiplex risk.

Together, these hypotheses test whether expertise concentration generates structural vulnerabilities that neither formal coordination nor social cohesion can offset - a risk invisible to single-layer analyses.

4. Methodology

To diagnose the robustness of organizational help-seeking networks, we analyze a tri-layer multiplex from a large public organization (N=132): (1) Formal (reporting authority), (2) Social (informal interaction), and (3) Help-seeking (directed requests for professional knowledge/advice). Using standard SNA methods (Wasserman & Faust, 1994), we compute core metrics for each directed layer:

- **Density**: proportion of observed directed ties out of all possible.
- **Reciprocity**: fraction of dyads with mutual ties.
- **Average path length**: mean shortest path among reachable node pairs.
- **Clustering coefficient**: global measure of local transitivity (average over all nodes: fraction of node pairs with common neighbors that are also connected).
- **Betweenness centrality**: fraction of shortest paths passing through each node (identifies brokers, especially help-seeking "super-helpers").

We quantify global efficiency (Latora & Marchiori, 2001) and vulnerability via targeted simulations: iteratively removing the highest-betweenness nodes to trace efficiency collapse.

Three innovations distinguish structural effects from degree artifacts:

(1) vulnerability index $V = 10(1 - \text{AUC}_{\text{norm}})$

(2) z-scores vs. 200 degree-preserving configuration nulls

(3) cross-layer overlap (Jaccard, degree correlations)

4.1 Research Design and Setting

The study uses whole-network data from a large hierarchical public organization where departments have distinct roles coordinated via a chain of command. We model it as three directed layers: Formal (reporting), Help-seeking (professional knowledge exchange), Social (informal chats) - extending Rechavi et al.'s (2025) homophily analysis of its formal layer to multiplex efficiency-resilience trade-offs.

4.2 Data Collection and Ethics

The Data came from a Qualtrics roster survey (~250 employees, Apr–Jun 2022). Respondents named ties from their department roster for four prompts: "I give/receive work orders from," "I ask/provide professional knowledge to/from," "I chat socially with."

Voluntary participation followed organizational/academic ethics: full disclosure, confidentiality (identifiers stripped post-matching), withdrawable consent. Data quality controls included consistency flags, manual review of anomalies, and automated checks for missingness/structural impossibilities (e.g., invalid degrees).

Node identifiers used throughout the analysis are algorithmically assigned by ORA during network construction and bear no relationship to original survey identifiers or respondent attributes. This process ensures that individual actors cannot be identified from reported node labels.

4.3 Network Construction

Python/ORA scripts yielded three binary directed adjacency matrices:

- Formal: union of "give orders" (A→B) + "receive orders" (A→B).
- Help-seeking: "ask/provide professional knowledge" nominations (A↔B).
- Social: "chat socially" ties.

Mutual ties are treated as reciprocated; isolates are retained for boundary integrity. For path/clustering/efficiency: symmetrized to undirected. Betweenness: original directed.

4.4 Measures

4.4.1 Node-level:

- Role (Dep. Manager, Deputy, Employee), Department; normalized out-degree, normalized in-degree, betweenness, closeness; composite centrality (standardized aggregate).

4.4.2 Network-level (per layer):

- Density, reciprocity, avg. path length/diameter, clustering, and Betweenness (as defined at the beginning of the chapter).

4.4.3 Global efficiency

- Global efficiency quantifies a layer's capacity for knowledge/problem-solving reach:

$$E(G) = \frac{1}{N(N-1)} \sum_{i \neq j} \frac{1}{d_{ij}},$$

where $\mathrm{d_{ij}}$ is the length of the shortest path between nodes i and j (and $\frac{1}{\mathrm{d_{ij}}} = 0$ if j is unreachable from i)

4.4.4. Vulnerability Analysis

To reveal single-point-of-failure risks (especially super-helper dependence), a simulated targeted removal was generated: iteratively deleting the highest-betweenness nodes, recompute $E(G)$ after each. The vulnerability index traces

the efficiency curve:

$$V = 10(1-\text{AUC}_{\text{norm}})$$

where $\text{AUC}_{(\text{norm})}$ is the normalized area under the post-removal $E(t)$ curve ($t = fraction\ removed$). Higher V = steeper collapse (e.g., 71% drop post top-3 help-seekers). Simulations used NetworkX (Python).

4.7 Null Models

Degree-preserving configuration models (200 iterations per layer) generate expected clustering/efficiency under random rewiring given observed degrees. Z-scores:

$$z = \frac{\text{observed} - \mu_{\text{null}}}{\sigma_{\text{null}}}$$

disentangle hub artifacts from intrinsic structure.

4.8 Multiplex Overlap

Degree correlations (Pearson's r across layers) test broker alignment. **Jaccard overlap** of top-k brokers (k=3,10) quantifies cross-layer compensation:

$$J(A,B) = \frac{|\ A \cap B\ |}{|\ A \cup B\ |}$$

Low J flags parallel fragilities, meaning in the context of organizational environment that "formal bosses" ARE NOT "social friends" ARE NOT "help experts".

5. Results

5.1 Help-Seeking Fragility: Expert Hub and Brokers

5.1.1 Top Brokers Across Layers

Table 2 presents the top 10 nodes in all three networks.

Node 328371 dominates as a multiplex super-broker (total score 0.552, top-3 all 3 layers), followed by 590920 (0.371, Help and Social networks) and 199598 (0.348, Formal and Help networks). Only 4/10 top nodes span 2+ layers, signaling layer-specific expertise dependence, especially acute in help-seeking.

Rank	Node	Networks	Avg Score	Total Score
1	328371	Formal, Help, Social	0.184	0.552
2	590920	Help, Social	0.186	0.371
3	199598	Formal, Help	0.174	0.348

Rank	Node	Networks	Avg Score	Total Score
4	794298	Formal, Social	0.174	0.348
5	241390	Formal, Help	0.149	0.299
6	400071	Social	0.308	0.308
7	580122	Help	0.277	0.277
8	535912	Social	0.260	0.260
9	750210	Help	0.255	0.255
10	710320	Social	0.245	0.245

Table 2: Top-10 multiplex brokers.

5.1.2 Broker Overlap and Degree Correlations

1. Low Jaccard among top-10:

Formal∩Help=0.18,

Formal∩Social=0.11,

Help∩Social=0.11

2. Moderate alignment:

ρ(Formal-Help)=0.42,

ρ(Formal-Social)=0.31,

ρ(Help-Social)=0.48.

High-degree nodes partially overlap, but help-seeking hubs are distinct, concentrating expertise risk.

5.1.3 Targeted Removal

Removing top-3 (328371,590920,199598) triggers: Help-seeking 71% efficiency collapse, Social 55%, Formal 62%-exposing help-seeking's elite-dependency as most acute. Layer-specific brokers mean expertise flows fail without social/formal backup.

Node centrality ranks confirm: formal managers rarely broker help-seeking; help-specific actors (e.g., 580122) hold modest formal/social roles, reinforcing siloed expertise.

5.2 Null Model Z-Scores: Structural Versus Degree Effects

Table 3 presents the results of 200 degree-preserving configuration model simulations for each layer. Z-scores compare observed network metrics against the distribution of values produced by randomly rewired networks that preserve each node's degree sequence. Values substantially above zero indicate that the observed metric exceeds what the layer's degree distribution alone would generate; values substantially below zero indicate suppression relative to degree-matched expectations.

Three findings emerge from this analysis.

First, clustering coefficients exceed null expectations in all three layers, but the magnitude differs substantially. The help-seeking layer shows the most extreme deviation (z = +31.6), followed by the social layer (z = +18.1) and the formal layer (z = +10.4). These values indicate that the local cohesion observed in each layer reflects genuine structural tendencies - tightly connected communities of practice - rather than an artifact of degree concentration in a small number of highly connected actors. The help-seeking layer's clustering, in particular, is far beyond what its degree distribution would predict, confirming that expertise communities form through selective tie patterns rather than through the incidental effects of having a few high-degree hubs.

Second, and most consequential, the help-seeking layer's global efficiency falls significantly below null expectations (z = −10.3), while formal and social layers remain close to or above null values. This combination - extreme local clustering paired with suppressed global efficiency - is the structural signature of siloed expertise: knowledge pools effectively within tight communities of practice but fails to circulate across the broader network. The formal and social layers do not exhibit this pattern, suggesting that the silo dynamic is specific to the help-seeking layer rather than a general feature of the organization's network topology.

Third, betweenness centrality z-scores are modest across all three layers, with the exception of the social network (z = +2.4), which shows moderate excess brokerage relative to null expectations. The near-zero betweenness z-scores in the formal (z = +0.88) and help-seeking (z = +0.06) layers indicate that brokerage in these layers is largely explainable by degree effects - high-betweenness actors are high-betweenness primarily because they are highly connected, not because they occupy structurally distinctive bridging positions beyond what connectivity alone would produce.

Layer	Metric	Observed	Null μ	Null σ	z-score
Formal	Clustering	0.394	0.163	0.022	**10.44**
	Betweenness cent.	0.00211	0.00186	0.00028	0.88
	Efficiency	0.462	0.455	0.00464	1.60

Layer	Metric	Observed	Null μ	Null σ	z-score
Help-seeking	Clustering	**0.460**	**0.097**	**0.0115**	**+31.59**
	Betweenness cent.	0.00101	0.00100	0.00013	0.06
	Efficiency	**0.403**	**0.429**	**0.00255**	**-10.3***
Social	Clustering	0.395	0.142	0.0140	**18.06**
	Betweenness cent.	0.00121	0.00090	0.00013	**2.42**
	Efficiency	0.433	0.430	0.00365	0.90

*Table 3. Null model z-scores for clustering coefficient, betweenness centrality, and global efficiency across the three network layers (200 degree-preserving configuration model simulations per layer). *p<0.05 vs null distribution.*

The help-seeking layer exhibits the most extreme structural deviations: clustering 31.59 standard deviations above null expectations, indicating dense expertise communities beyond degree effects; efficiency 10.3 standard deviations below null expectations, indicating suppressed global knowledge reach.

5.3 Layer Contrasts: Help-Seeking vs. Formal/Social

Density: Formal sparse (0.034); help/social denser (~0.060/0.062)-more expertise redundancy potential.

Reciprocity: Formal 16%; help/social ~25%-mutual knowledge norm.

Paths: Formal shortest (2.44); others ~2.61-hierarchy efficient if intact.

Clustering: Help-seeking highest (0.460), social 0.395, formal 0.394- expertise pools locally.

Brokers: All star-like; help-seeking's super-helper (580122, β≈0.18) is the most extreme.

Vulnerability: All high (6.2–6.6); help-seeking steepest drop.

Metric	Formal	Help-Seeking	Social	Interpretation
Density	0.034	**0.060**	0.062	Informal/expertise is redundant
Reciprocity	16%	**25%**	25%	Mutual support in help/social
Avg. Path Length	**2.44**	~2.61	2.61	Formal efficient (pre-fragility)
Clustering Coefficient	**0.394**	**0.460**	0.395	Help-seeking strongest silos

Metric	Formal	Help-Seeking	Social	Interpretation
Betweenness Centralization	High	**Highest**	High	Super-helper risk acute
Vulnerability (V)	~6.2	**~6.22**	~6.6	Help-seeking collapses fastest

Table 4: Layer parameters. Help-seeking looks cohesive but hides fragility.

Formal sparsity/low clustering fits hierarchy; help/social provide cohesion, yet help-seeking's extreme metrics and non-overlap - create uncompensated expertise risk.

5.4 Help-Seeking Network: Expertise, Infrastructure, and Fragility

The help-seeking layer-directed requests for professional knowledge reveal organizations' true expertise infrastructure, distinct from formal authority or social affinity. While formal networks streamline routine coordination and social ties foster cohesion, help-seeking captures demand-driven knowledge flows: who employees *actually call* when facing non-routine problems.

Structural profile confirms H2: moderate density (0.060), high reciprocity (25%), extreme clustering (0.460, z=+31.6), but sub-null efficiency (z=-10.3)-tight communities of practice that silo expertise. Not random hub effects (5.2); intrinsic structure.

Brokerage confirms H3: Node 580122 dominates as "super-helper" (β≈0.182), with top-3 removal causing 71% efficiency collapse (V≈6.22)-steeper than formal (62%) or social (55%). Low overlap (J=0.18 with formal, 0.11 with social) means no backup when expertise brokers fail.

Organizational diagnostics:

- **Hidden hierarchies**: Low-formal-rank employee 580122 brokers most help-seeking; formal managers rarely do.
- **Burnout/bottleneck risk**: 71% collapse reveals single-point-of-failure dependence.
- **Silo trap**: Extreme clustering (+31.6) pools knowledge locally but blocks cross-domain access (z-efficiency -10.3).

Multiplex implication: Only 4/10 top brokers span 2+ layers (5.1); help-seeking operates in parallel isolation. When super-helpers exit, neither bosses nor friends

compensate-expertise remains trapped while formal coordination and social cohesion also fragment.

Methodological value: Vulnerability index + null z-scores turn descriptive SNA into actionable expertise diagnostics, pinpointing expert hub (super-helper) risk, quantifying silo penalties, guiding interventions (load-balancing, backup training).

Help-seeking networks map the hidden flow of organizational learning. Their parameters reveal not just *who knows what*, but *whether that knowledge is accessible or dangerously concentrated* - explaining why "just calling a name" creates catastrophic risk when that name belongs to one person.

6. Discussion and implications

This study set out to examine whether help-seeking networks constitute a structurally distinct layer within organizational multiplexes, and whether their structural properties generate fragility that formal authority and social interaction networks cannot compensate. The empirical findings provide strong and consistent support for this claim across three complementary analytical lenses: layer-by-layer structural comparison, degree-preserving null model diagnostics, and targeted vulnerability simulation.

6.1 Hypothesis Assessment

All three hypotheses received empirical support, with H2 and H3 providing the most theoretically consequential results.

H1 is supported: the formal layer exhibits the lowest density (0.034) and reciprocity (0.16) among the three layers while maintaining the shortest average path length (2.44), consistent with the theoretical expectation that hierarchical structures optimize communication efficiency at the cost of redundancy. This pattern replicates the formal-informal trade-off documented across organizational network research (Granovetter, 1973; Burt, 2004; Whetsell et al., 2020) and confirms that the organization under study conforms to the structural logic of centralized hierarchies.

H2 is strongly supported: the help-seeking layer exhibits substantially higher clustering (0.460) than the formal layer and comparable or greater clustering than the social layer, while simultaneously falling significantly below null model expectations for global efficiency ($z = -10.3$). This combination - high local cohesion paired with suppressed global reach - is the structural signature of expertise silos: tightly connected communities of practice that pool specialized knowledge efficiently within their boundaries while failing to disseminate it across the organization. Critically, the z-score analysis establishes that these patterns are not artifacts of the layer's degree distribution, but reflect genuine structural tendencies independent of hub effects.

H3 is strongly supported: targeted removal of the three highest-betweenness brokers produces a 71% efficiency collapse in the help-seeking layer ($V \approx 6.22$), exceeding the corresponding collapses in the formal (62%) and social (55%) layers. Cross-layer broker overlap is minimal throughout (Jaccard = 0.11–0.18; Pearson r = 0.31–0.48), indicating that the brokers who sustain help-seeking flows are largely distinct from those who sustain formal coordination and social cohesion. When expertise brokers are removed, neither formal authority nor social affinity provides structural compensation.

6.2 Theoretical Implications

6.2.1 Help-Seeking as a Third Structural Dimension

The findings invite a substantive revision of the dominant theoretical framework in organizational network research. The canonical formal-versus-informal dichotomy - in which formal networks are characterized by efficiency and informal networks by redundancy - has organized the field since Granovetter's (1973) foundational work and has been refined through decades of organizational SNA (Burt, 2004; Lazega & Pattison, 1999; Whetsell et al., 2020). The present results suggest this dichotomy is structurally incomplete.

Help-seeking networks occupy a position that is reducible to neither pole. Table 5 summarizes the structural profile of each layer and its corresponding organizational function and vulnerability.

Layer	Characteristic Strength	Structural Vulnerability
Formal	Short paths; efficient routine coordination	Sparse; brittle under targeted removal
Social	Dense; reciprocal; cohesive	Broker-dependent; partial resilience
Help-seeking	Expertise-specialized; high local clustering	Super-helper concentration; silo- trapped knowledge

Table 5. Structural profiles and organizational roles of the three network layers

The help-seeking layer maps the organization's actual expertise infrastructure - the distribution of who holds problem-relevant knowledge and who employees activate when facing non-routine challenges. This function is performed neither by formal authority (which assigns roles but does not track expertise) nor by social interaction (which builds affinity but does not specialize knowledge flows). Hence, help-seeking networks should be modeled as a distinct analytical layer in multiplex organizational research, and added to the resilience assessments (currently including formal and social ties only).

6.2.2 The Expertise Concentration Paradox

A central theoretical tension emerges from the data. The structural properties that make help-seeking networks effective - high local clustering, concentrated brokerage, and

reciprocal expert-to-expert ties - are precisely the properties that generate fragility. Expert hub (here, a super helper single actor with $\beta \approx 0.182$) enables quality control, accelerates problem-solving, and sustains communities of practice. Yet this concentration means that the layer's global efficiency depends on a small number of non-replaceable actors whose removal produces catastrophic efficiency loss.

This finding advances communities-of-practice theory (Wenger, 1998) by providing empirical evidence of what might be termed its structural dark side. Prior theorizing has emphasized the productivity benefits of tight expert communities - knowledge depth, trust, efficient within-group communication (Wenger, 1998; Reagans et al., 2004). The vulnerability simulations reported here demonstrate that these same structural properties simultaneously produce two organizational risks that communities-of-practice theory has not adequately addressed: first, individual-level overload and burnout risk for actors who occupy super-helper positions; and second, succession crises that emerge when such actors exit, because the knowledge they broker is trapped within silos that other layers cannot access or substitute.

The paradox is that organizationally rational behavior - employees seeking help from the most knowledgeable colleague - generates structurally irrational outcomes at the network level. Each individual transaction is efficient; the aggregate pattern is fragile.

6.2.3 Multiplex Non-Compensation and the Limits of Informal Resilience

A recurring assumption in the organizational resilience literature is that informal networks serve as backstop mechanisms when formal structures fail (Granovetter, 1973; Csermely, 2006). The cross-layer overlap findings reported here complicate the picture. With a maximum Jaccard overlap of 0.18 between the formal and help-seeking broker sets, and 0.11 between the help-seeking and social broker sets, there is effectively no structural redundancy between the actors who sustain expertise flows and those who sustain formal coordination or social cohesion. When a super-helper exits, the remaining network - both formal and social - lacks the structural position to absorb redistributed help-seeking demand.

This finding extends Kivelä et al.'s (2014) multiplex framework to organizational contexts by demonstrating empirically that inter-layer compensation cannot be assumed and must be directly measured. The degree correlations between layers ($r = 0.31–0.48$) indicate moderate alignment at the level of overall connectivity, but moderate degree correlation does not imply broker overlap. An organization may have actors who are moderately central across all three layers without having any actor who is a top broker in all three - and it is top-broker overlap, not overall degree correlation, that determines whether expertise fragility can be compensated.

6.3 Future Research Directions

The present findings suggest several directions for extending this analysis. First, agent-based modeling offers a natural next step for investigating the dynamics that cross-sectional SNA cannot capture. Calibrating simulations to the structural parameters reported here (a clustering z-score of +31.6, a super-helper betweenness of 0.182, and a 71% efficiency collapse threshold) would allow researchers to: (1) model under what conditions expertise concentration enhances versus destabilizes organizational performance, and (2) test whether interventions such as load redistribution or backup expert training can restore resilience before crises occur. The field would gain, in other words, a dynamic rather than purely descriptive account of how expertise fragility develops.

Second, the single-organization design of this study, while enabling the whole-network data collection necessary for multiplex analysis, limits claims about generalizability. Future research should replicate the vulnerability framework across organizational types and establish whether super-helper concentration and silo formation are features of hierarchical public bureaucracies specifically or of knowledge-dependent organizations more broadly. The vulnerability index introduced here is sufficiently general to support such comparisons.

Third, the exclusively self-reported nature of the data means that help-seeking ties reflect employees' perceptions of their knowledge-exchange behavior rather than directly observed interactions. Researchers can validate this paper’s self-reported data against digital trace data (communication logs, internal ticketing systems, and collaboration platform records) and assess the degree of convergence between perceived and enacted help-seeking networks. This can confirm whether the super-helper effects documented here persist in behavioral data.

6.4 Practical Implications

The vulnerability framework introduced in this study translates directly into organizational diagnostic practice. The combination of the vulnerability index, null model z-scores, and cross-layer broker overlap metrics provides managers with three actionable instruments that prior SNA applications to organizations have not offered in integrated form.

The vulnerability index identifies which specific actors carry disproportionate brokerage load and quantifies the efficiency cost of their hypothetical departure, allowing organizations to assess succession risk before it materializes rather than after. Z-score comparison against degree-preserving null models distinguishes genuine expertise silos from apparent clustering that simply reflects the presence of highly connected actors -a distinction that matters for intervention design, since genuine silos require cross-domain restructuring while degree-driven clustering may respond to simpler load redistribution. Cross-layer broker overlap metrics identify whether the organization's

most central actors span multiple layers, providing structural backup, or operate in layer-specific isolation, creating compounded fragility.

These diagnostics suggest several evidence-grounded interventions. Redistributing help-seeking demand away from top brokers - through expertise directories or structured referral protocols -could reduce individual overload risk while preserving the expertise communities that make the help-seeking layer effective. Cross-training secondary experts for domains currently monopolized by the expert hub would reduce the vulnerability index without dismantling knowledge-generating communities of practice. Finally, incorporating super-helper identification into talent management and retention processes would treat this structural position as an organizational asset requiring deliberate management, reducing the succession risk the vulnerability simulations reveal.

7. Conclusions

This study introduces a vulnerability framework for analyzing **help-seeking networks** within organizational multiplexes, revealing their distinctive contribution to resilience and fragility. Three methodological advances enable this analysis: (1) a global efficiency-based vulnerability index $V = 10(1 - \text{AUC}_{\text{norm}})$; (2) degree-preserving null models yielding structural z-scores; and (3) cross-layer broker overlap metrics. Help-seeking constitutes a third structural dimension beyond the classic formal-informal dichotomy. While formal networks prioritize efficiency, and social networks provide redundancy, help-seeking networks uniquely map expertise infrastructure, combining high cohesion with acute structural risk and a minimal overlap with formal and social layers. While these findings derive from a single public organization, the vulnerability toolkit introduced here is adequately general to support replication across organizational contexts.

When employees “just call out my name” for expertise, they reveal help-seeking networks that likely characterize any knowledge-dependent organization. Organizational decision-makers would benefit from monitoring super-helper dependence via the vulnerability index, encouraging distributed expertise, and cultivating multiplex brokers who span formal authority, social cohesion, and help-seeking ties.

8. References

Albert, R., Jeong, H., & Barabási, A. L. (2000). Error and attack tolerance of complex networks. *nature*, *406*(6794), 378-382.

Alpaydın, A., & Fitjar, R. D. (2020). Friendship ties and knowledge exchange in organizations. *Research Policy, 49*(1), 103897.

Barkoczi, D., & Galesic, M. (2016). Social learning strategies modify the effect of network structure on group performance. *Nature Communications, 7*, 13109.

Benatti, L. N., dos Santos, A. F., Trindade, E. M., Gomes, N. L., & Prearo, L. C. (2021). Analysis of formal and informal networks and the role of internal actors in organizations: A comparative study. *Research, Society and Development, 10*(4), e35910412783. DOI: e35910412783

Burt, R. S. (2004). Structural holes and good ideas. *American Journal of Sociology, 110*(2), 349–399.

Cellai, D., López, E., Zhou, J., Gleeson, J. P., & Bianconi, G. (2013). Percolation in multiplex networks with overlap. *Phys. Rev. E 88, 052811*.

Csermely, P. (2006). *Weak links: The universal key to the stability of networks and complex systems*. Springer.

Erny, G., & Godsey, M. (2022). Scholarly networks, gender sociology, and knowledge production in Aegean survey and Eastern Mediterranean archaeology. *Journal of Eastern Mediterranean Archaeology & Heritage Studies, 10(3–4)*, 343–355.

Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology, 78*(6), 1360–1380.

Kitts, J. A. (2008). Dynamics and stability of collective action norms. *Journal of Mathematical Sociology*, 32(2), 142-163.

Kivelä, M., Arenas, A., Barthelemy, M., Gleeson, J. P., Moreno, Y., & Porter, M. A. (2014). Multilayer networks. *Journal of Complex Networks*, 2(3), 203–271.

Krackhardt, D. (1994). Graph theoretical dimensions of informal organizations. In K. M. Carley & M. J. Prietula (Eds.), *Computational organization theory* (pp. 89–111). Hillsdale, NJ: Lawrence Erlbaum Associates

Latora, V., & Marchiori, M. (2001). Efficient behavior of small-world networks. *Physical Review Letters, 87*(19), 198701.

Lazega, E., & Pattison, P. E. (1999). Multiplexity, generalized exchange and cooperation in organizations: A case study. *Social Networks, 21*(1), 67–90.

Lazega, E., Jourda, M. T., Mounier, L., & Stofer, R. (2008). Catching up with big fish in the big pond? Multi-level network analysis through linked design. *Social Networks*, *30*(2), 159-176.

Livingstone, R. M. (2010). Let's leave the bias to the mainstream media: A Wikipedia community fighting for information neutrality. *M/C Journal, 13*(6).

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology, 83*(2), 340–363.

Meyer, M. W., & Gupta, V. (1994). The performance paradox. *Research in organizational behavior*, *16*, 309-369.

Meyer, M. W., & Zucker, L. G. (1989). *Permanently failing organizations*. Sage Publications.

Rechavi, A., Weiss, O. & Kunin, D. (2025) Homophilic relations in a formal organization. *Computational and Mathematical Organization Theory* Vol. 31(4): 370-392.

Reagans, R., Zuckerman, E., & McEvily, B. (2004). How to make the team: Social networks vs. demography as criteria for designing effective teams. *Administrative Science Quarterly, 49*(1), 101–133.

Wang, P., Robins, G., Pattison, P., & Lazega, E. (2013). Exponential random graph models for multilevel networks. *Social Networks, 35*(1), 96–115.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge University Press.

Weigelt, O., Marcus, B., Felfe, J., Kluge, A., & Grewe, F. (2021). An empirical study on the instant adjustment to virtual teamwork in the COVID-19 pandemic. *Psychologische Rundschau*, 72(3), 177–189.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge University Press.

Whetsell, T., Kroll, A., & DeHart-Davis, L. (2020). Hierarchy and information-seeking in public organizations. *Public Administration Review, 80*(1), 69–79.