Leadership Practices for Sustaining Innovation Ecosystems: A Qualitative Study of Knowledge-Based Organizations

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Abstract

This qualitative study aimed to explore how leaders in knowledge-based organizations enact practices that sustain innovation ecosystems through knowledge mobilization, collaborative governance, experimentation, and interorganizational alignment. The study employed a qualitative descriptive design based on semi-structured interviews with 24 senior managers, founders, R&D directors, innovation managers, and ecosystem partnership leaders working in knowledge-based organizations in Tehran, Iran. Participants were selected through purposive sampling with maximum variation in organizational role, sector, professional experience, and involvement in innovation partnerships. Data collection continued until theoretical saturation was reached; saturation was identified after the twenty-first interview, and three additional interviews were conducted to confirm the stability of the categories. Interviews lasted between 45 and 75 minutes, were audio-recorded with informed consent, transcribed verbatim, and analyzed using thematic analysis. NVivo software was used to organize transcripts, support coding, compare patterns across participants, and develop higher-order categories. Credibility was enhanced through member checking, peer debriefing, analytic memoing, and maintaining an audit trail. The analysis generated five main categories of leadership practices: ecosystem orchestration and boundary-spanning alignment, knowledge mobilization and absorptive learning, ambidextrous empowerment and disciplined experimentation, trust-based governance and resource resilience, and institutional navigation with long-term ecosystem orientation. Participants described sustainable innovation ecosystems as leadership-dependent relational systems in which leaders connect actors, translate knowledge across boundaries, protect experimentation from premature judgment, balance autonomy with accountability, and maintain trust despite uncertainty, competition, and resource constraints. The findings suggest that sustaining innovation ecosystems in knowledge-based organizations requires leaders to move beyond internal managerial control toward orchestration, learning-centered coordination, and ecosystem-level value creation. Effective leaders act as translators, connectors, legitimizers, and guardians of collaborative innovation, enabling organizations to sustain innovation not only through technical expertise but also through relational, cognitive, and institutional capabilities.

Keywords: Innovation ecosystem; leadership practices; knowledge-based organizations; qualitative research; ecosystem orchestration; absorptive capacity; Tehran.

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1. Introduction

Innovation has increasingly become an ecosystemic rather than a purely firm-internal process. In knowledge-based sectors, organizations rarely create, develop, commercialize, and scale innovations through isolated internal resources alone. Instead, innovation depends on the coordinated participation of firms, universities, research centers, suppliers, customers, regulators, investors, accelerators, professional communities, and digital platforms. This shift has redirected scholarly attention from individual firms and linear innovation pipelines toward innovation ecosystems, which are commonly understood as evolving configurations of actors, activities, artifacts, institutions, and relationships that shape innovation performance (Adner, 2017; Granstrand & Holgersson, 2020; Jacobides et al., 2018). In such settings, leadership is not limited to strategic decision-making inside organizational boundaries. It also involves shaping interdependencies, mobilizing knowledge, creating trust, aligning incentives, and sustaining collaboration among actors who are legally independent but innovation-interdependent.

The concept of the innovation ecosystem has developed in response to the growing complexity of value creation. Adner (2017) conceptualized ecosystems as structures of interdependent actors that must align for a value proposition to materialize. Jacobides et al. (2018) similarly argued that ecosystems are formed around complementarities, roles, and shared rules that enable actors to jointly create value while retaining organizational independence. Granstrand and Holgersson (2020) expanded this view by emphasizing that innovation ecosystems include not only actors and complementarities but also artifacts, institutions, substitute relations, and evolving patterns of interaction. These perspectives indicate that innovation ecosystems are neither simple networks nor ordinary supply chains. They are dynamic, knowledge-intensive arrangements in which innovation outcomes depend on the quality of coordination among diverse actors whose goals, resources, capabilities, and time horizons may not naturally converge.

Knowledge-based organizations represent a particularly important context for examining innovation ecosystems because their competitive advantage depends heavily on the creation, integration, transformation, and application of specialized knowledge. The knowledge-based view of the firm argues that organizations exist partly because they provide mechanisms for integrating specialist knowledge that is difficult to coordinate through markets alone (Grant, 1996). Nonaka's (1994) theory of organizational knowledge creation further emphasizes that innovation depends on the conversion of tacit and explicit knowledge through socialization, externalization, combination, and internalization. In knowledge-based organizations, therefore, leadership is deeply connected to knowledge processes: leaders must create conditions in which experts can exchange ideas, translate complex knowledge into usable forms, and transform dispersed expertise into innovation outputs.

However, knowledge alone does not guarantee sustained innovation. Organizations must also develop absorptive capacity, defined as the ability to recognize the value of external knowledge, assimilate it, and apply it commercially (Cohen & Levinthal, 1990). Zahra and George (2002) later reconceptualized absorptive capacity as a dynamic capability involving acquisition, assimilation, transformation, and exploitation. In innovation ecosystems, absorptive capacity is not only an internal organizational capability; it is also relational and ecosystemic. Leaders must help their organizations identify relevant external knowledge, interpret weak technological and market signals, connect internal teams with external experts, and convert interorganizational learning into viable products, services, or processes. Without such leadership practices, ecosystem participation may remain superficial, symbolic, or fragmented.

Dynamic capabilities theory provides another useful lens for understanding leadership in innovation ecosystems. Teece et al. (1997) described dynamic capabilities as the ability to integrate, build, and reconfigure internal and external competences in response to changing environments. Teece (2007) further specified the microfoundations of sensing, seizing, and transforming. In knowledge-based organizations, sustaining innovation ecosystems requires all three. Leaders must sense technological opportunities, policy shifts, partner needs, and market discontinuities; seize opportunities by allocating resources and forming partnerships; and transform organizational routines so that ecosystem learning becomes embedded in strategy, structure, and culture. This suggests that leadership practices are not peripheral to ecosystem sustainability; they are central mechanisms through which ecosystem participation becomes strategically meaningful.

The literature on open innovation also highlights the importance of leadership in boundary-spanning knowledge flows. Chesbrough (2003) argued that firms can no longer rely exclusively on internal R&D and must use inflows and outflows of knowledge to accelerate innovation. Digital innovation scholarship has similarly emphasized distributed agency, generativity, and the increasingly blurred boundaries of innovation work (Nambisan et al., 2017). Yet open innovation creates managerial challenges. External collaboration may increase access to knowledge but also intensify risks related to intellectual property, opportunism, coordination overload, strategic misalignment, and loss of focus. Therefore, leaders must balance openness with protection, autonomy with integration, and exploration with disciplined execution.

Ecosystem orchestration is one of the most relevant concepts for understanding such leadership work. Dhanaraj and Parkhe (2006) argued that hub firms orchestrate innovation networks by enabling knowledge mobility, ensuring innovation appropriability, and preserving network stability. Although innovation ecosystems are not always controlled by a single hub, the orchestration perspective remains highly useful because it clarifies that ecosystem sustainability depends on purposeful coordination without full hierarchical authority. Leaders in knowledge-based organizations often need to influence partners whom

they cannot command. They must persuade, translate, negotiate, legitimize, and coordinate. Their authority is therefore relational and cognitive as much as formal. Valkokari (2015) also distinguished among business, innovation, and knowledge ecosystems, showing that organizations may need to navigate multiple ecosystem logics simultaneously. This complexity makes leadership practices especially consequential.

Leadership research provides further insight into the practices needed to sustain innovation ecosystems. Mumford et al. (2002) argued that leading creative people requires the orchestration of expertise and relationships rather than simple supervision. Rosing et al. (2011) proposed ambidextrous leadership as a framework for innovation, emphasizing the need to switch between opening behaviors that support exploration and closing behaviors that support implementation. O'Reilly and Tushman (2013) similarly described organizational ambidexterity as the ability to explore new opportunities while exploiting existing capabilities. In ecosystem contexts, ambidexterity becomes both intraorganizational and interorganizational: leaders must support experimentation with external partners while also maintaining internal coherence, accountability, and strategic discipline.

Complexity leadership theory is also relevant because innovation ecosystems display nonlinearity, emergence, interdependence, and adaptive tension. Uhl-Bien and Arena (2018) argued that leadership for organizational adaptability involves enabling adaptive dynamics while maintaining operational systems. This perspective is valuable for knowledge-based organizations because innovation ecosystems cannot be fully planned or controlled. New ideas may emerge from unexpected actor combinations; collaborative opportunities may shift rapidly; and uncertainty may require leaders to create enabling conditions rather than fixed prescriptions. Leaders must therefore cultivate connectivity, psychological safety, learning loops, and adaptive space in which innovation can emerge without losing organizational direction.

Despite growing research on innovation ecosystems, important gaps remain. Much of the ecosystem literature focuses on structural positions, platform strategies, complementarities, or firm-level ecosystem strategies, while less attention is given to the lived practices through which leaders sustain ecosystem participation over time. Quantitative studies often examine innovation performance, absorptive capacity, or dynamic capabilities as measurable constructs, but they may overlook how leaders interpret, negotiate, and enact these capabilities in daily organizational life. In addition, knowledge-based organizations in emerging and developing innovation environments may face specific challenges, including resource scarcity, institutional uncertainty, unstable partner commitments, regulatory ambiguity, and dependence on trust-based informal coordination. These conditions make qualitative inquiry particularly useful because it can reveal the meanings, tensions, and practical judgments that underlie leadership action.

A qualitative approach is appropriate for this topic because sustaining innovation ecosystems involves complex social processes that cannot be fully captured through

predetermined variables. Semi-structured interviews allow participants to explain how they experience ecosystem collaboration, how they define effective leadership, what practices help sustain innovation, and what barriers undermine ecosystem continuity. By focusing on leaders and senior innovation actors in knowledge-based organizations in Tehran, this study contributes context-sensitive evidence on how leadership practices operate in an environment where knowledge, relationships, and institutional navigation are critical to innovation continuity.

Therefore, the aim of this study was to explore the leadership practices through which knowledge-based organizations sustain innovation ecosystems, with particular attention to ecosystem orchestration, knowledge mobilization, experimentation, trust-based governance, and long-term ecosystem orientation.

Methods and Materials

This study employed a qualitative descriptive design to explore leadership practices that sustain innovation ecosystems in knowledge-based organizations. A qualitative design was selected because the research objective required an in-depth understanding of participants' experiences, interpretations, and practical strategies rather than measurement of predetermined variables. The study focused on leaders and senior professionals working in knowledge-based organizations located in Tehran, Iran. Participants were recruited from organizations active in knowledge-intensive sectors, including information and communication technology, digital platforms, biotechnology and medical devices, advanced manufacturing, electronics, fintech, data analytics, and environmental technologies.

The participants included 24 individuals who had direct experience in managing innovation, leading knowledge workers, coordinating external partnerships, or participating in ecosystem-level collaboration. Purposive sampling with maximum variation was used to ensure diversity in gender, age, role, sector, organizational size, and years of professional experience. The inclusion criteria were employment in a knowledge-based organization in Tehran, at least five years of professional experience, direct involvement in innovation-related leadership or ecosystem collaboration, and willingness to participate in an audio-recorded interview. Participants who lacked direct involvement in innovation processes or interorganizational collaboration were excluded.

The final sample consisted of founders, chief executive officers, R&D directors, innovation managers, strategy managers, partnership managers, human resource and knowledge management leaders, and senior technical managers. Data collection continued until theoretical saturation was reached. Saturation was considered achieved when interviews no longer produced substantially new codes, categories, or conceptual relationships. Initial saturation emerged after 21 interviews, and three additional interviews were conducted to confirm the adequacy and stability of the coding structure. This approach was consistent with qualitative sampling principles that emphasize information richness, analytic depth, and saturation rather than statistical representativeness.

Data were collected through semi-structured interviews. Semi-structured interviewing was selected because it allows researchers to address predefined research topics while also giving participants sufficient freedom to describe experiences, examples, meanings, and unexpected issues in their own words. An interview guide was developed based on the literature on innovation ecosystems, leadership for innovation, knowledge-based organizations, absorptive capacity, dynamic capabilities, and ecosystem orchestration. The guide included open-ended questions about participants' roles in innovation processes, experiences of collaboration with external actors, leadership practices used to sustain innovation, knowledge-sharing mechanisms, challenges in ecosystem coordination, trust-building practices, experimentation processes, and strategies for maintaining long-term innovation capacity.

Examples of interview questions included: "How do leaders in your organization support collaboration with external actors such as universities, suppliers, customers, investors, or regulators?" "What leadership practices help transform external knowledge into usable innovation?" "How do leaders manage tensions between experimentation and operational discipline?" "What practices help maintain trust among ecosystem partners?" and "What challenges make innovation ecosystems difficult to sustain?" Probing questions were used to clarify meanings, obtain concrete examples, and explore contradictions or tensions in participants' accounts.

Interviews were conducted individually in Persian, either face-to-face or through secure online communication platforms depending on participant availability. Each interview lasted between 45 and 75 minutes. Before each interview, participants received information about the purpose of the study, voluntary participation, confidentiality, the right to withdraw, and the use of anonymized quotations. Written or recorded informed consent was obtained. Interviews were audio-recorded with permission and transcribed verbatim. To protect confidentiality, participants were assigned codes from P1 to P24, and identifying details of individuals and organizations were removed from the transcripts.

Data were analyzed using thematic analysis. The analysis followed an iterative process of familiarization, initial coding, category construction, theme development, review, definition, and interpretation. First, the researchers read the transcripts repeatedly to become familiar with the data and wrote analytic memos about recurring meanings, contradictions, and emerging leadership practices. Second, initial codes were generated inductively from the transcripts. These codes captured meaningful units related to leadership behaviors, ecosystem relationships, knowledge processes, decision-making practices, innovation barriers, and sustainability mechanisms.

NVivo software was used to organize transcripts, assign codes, compare coded segments across participants, and develop higher-order categories. Coding began with open coding and gradually moved toward axial and thematic organization. Similar codes were grouped into subcategories, and related subcategories were integrated into main categories. For example, codes such as "connecting partners," "translating between technical and business actors,"

"aligning expectations," and "managing partner roles" were grouped under the broader category of ecosystem orchestration and boundary-spanning alignment. The research team continuously compared data within and across interviews to identify convergent and divergent patterns.

Trustworthiness was strengthened through several strategies. Credibility was supported through member checking with selected participants, peer review of codes, and the use of direct quotations. Dependability was enhanced by maintaining an audit trail of coding decisions, category revisions, and analytic memos. Confirmability was addressed through reflexive memoing to reduce the influence of researcher assumptions. Transferability was supported by providing detailed descriptions of the participants, organizational context, data collection procedures, and findings. Ethical principles were observed throughout the study, including informed consent, confidentiality, voluntary participation, secure storage of interview files, and anonymization of participant quotations.

Findings

The demographic profile of the participants showed diversity in gender, age, education, managerial role, professional experience, and sectoral background. Of the 24 participants, 14 were men and 10 were women. In terms of age, seven participants were between 30 and 39 years old, eleven were between 40 and 49 years old, and six were between 50 and 59 years old. Regarding educational level, 15 participants held a master's degree and nine held a doctoral degree. In relation to organizational role, six participants were founders or chief executive officers, five were R&D directors, five were innovation or strategy managers, four were knowledge management or human resource managers, and four were partnership or ecosystem development managers. Participants' professional experience ranged from 6 to 28 years; six participants had 6–10 years of experience, nine had 11–15 years, five had 16–20 years, and four had more than 20 years. Sectorally, seven participants worked in ICT and digital platform organizations, five in biotechnology or medical-device companies, five in advanced manufacturing or electronics, four in fintech and data analytics, and three in environmental or energy-related technologies.

The first main category was **ecosystem orchestration and boundary-spanning alignment**. Participants emphasized that sustaining innovation ecosystems requires leaders to act as orchestrators who connect actors, clarify roles, align expectations, and reduce coordination gaps among organizations with different languages, priorities, and time horizons. Leaders were described as boundary spanners who translated between technical teams, market actors, investors, universities, suppliers, and regulators. Participants stated that innovation often failed not because of weak ideas but because ecosystem actors did not understand each other's constraints or expectations. One participant explained, "In our projects, the leader is not only managing employees; he is managing the space between organizations. If that space is empty, the project collapses" (P4). Another participant noted, "The university speaks with the language of publication, the investor speaks with the language of return, and the technical

team speaks with the language of feasibility. Someone must translate these languages into one project logic" (P11). This category included subcategories such as partner role clarification, interorganizational translation, expectation management, coordination of complementary capabilities, and development of shared innovation roadmaps.

The second main category was **knowledge mobilization and absorptive learning**. Participants described knowledge as the central resource of knowledge-based organizations, but they repeatedly emphasized that knowledge becomes valuable only when it is mobilized, interpreted, and applied. Leaders sustained innovation ecosystems by creating routines for scanning external knowledge, inviting expert feedback, organizing technical meetings with partners, supporting cross-functional learning, and converting external insights into organizational decisions. Several participants argued that leaders must prevent knowledge from remaining isolated in expert groups or partnership meetings. One participant stated, "Many organizations attend ecosystem events, but they do not absorb anything. The leader must ask: what did we learn, who needs this knowledge, and how will it change our product?" (P8). Another participant said, "The most useful knowledge is often informal. It comes from a conversation with a customer, a regulator, or a researcher. Leaders should create channels so this knowledge does not disappear" (P17). This category included environmental scanning, external knowledge acquisition, cross-boundary interpretation, internal knowledge sharing, and transformation of knowledge into innovation routines.

The third main category was **ambidextrous empowerment and disciplined experimentation**. Participants reported that innovation ecosystems require leaders to provide autonomy for exploration while maintaining discipline for implementation. Leaders who overcontrolled teams were perceived as weakening creativity and slowing ecosystem collaboration, while leaders who allowed unlimited experimentation were seen as creating confusion and resource waste. Effective leadership involved defining strategic boundaries, supporting rapid experimentation, accepting intelligent failure, and then closing the loop through evaluation, prioritization, and execution. One participant stated, "If you punish every failed experiment, people stop bringing new ideas. But if every idea becomes a project, the organization loses focus. Leadership is the balance between freedom and discipline" (P2). Another participant explained, "We tell teams: test fast, learn fast, but show evidence. Experimentation is not chaos; it must have learning value" (P19). This category included psychological safety for experimentation, tolerance of intelligent failure, stage-based decision-making, balancing exploration and exploitation, and protecting innovation teams from premature financial pressure while still requiring evidence of progress.

The fourth main category was **trust-based governance and resource resilience**. Participants considered trust a core condition for sustaining innovation ecosystems, especially when collaboration involved uncertainty, intellectual property concerns, unequal resources, and long development cycles. Leaders built trust by communicating transparently, honoring commitments, defining fair benefit-sharing mechanisms, protecting partner

contributions, and resolving conflicts before they damaged relationships. Participants also emphasized that resource constraints were common in knowledge-based organizations and that leaders had to develop resilience by combining internal resources with external partnerships, grants, investor networks, shared laboratories, and customer co-development. One participant said, “In our ecosystem, contracts are important, but trust is faster than contracts. When partners trust each other, problems are solved before they become legal issues” (P6). Another participant added, “Sustaining innovation is not only about money. It is about keeping people, partners, and knowledge connected during difficult periods” (P14). This category included trust-building communication, relational governance, fair appropriation, conflict management, resource bricolage, and continuity of collaboration under financial or institutional uncertainty.

The fifth main category was **institutional navigation and long-term ecosystem orientation**. Participants stated that leaders in knowledge-based organizations must navigate regulatory requirements, market uncertainty, policy changes, certification processes, funding structures, and cultural expectations. Rather than viewing institutions only as barriers, effective leaders interpreted institutional conditions, built legitimacy, engaged with public and private stakeholders, and aligned innovation projects with long-term ecosystem development. Participants also emphasized that some leaders focus narrowly on short-term organizational gains, which can weaken ecosystem sustainability. In contrast, ecosystem-oriented leaders invest in relationships, talent development, shared standards, and long-term credibility. One participant explained, “A knowledge-based company cannot survive alone. If the ecosystem is weak, even a strong company becomes tired” (P21). Another participant stated, “Leadership means thinking beyond the next contract. Sometimes you help a partner today because tomorrow the whole ecosystem will be stronger” (P9). This category included institutional sensemaking, legitimacy-building, policy navigation, long-term relationship investment, ecosystem citizenship, and alignment between organizational strategy and collective innovation capacity.

Discussion

The present study explored leadership practices for sustaining innovation ecosystems in knowledge-based organizations. The findings revealed five interrelated leadership practice domains: ecosystem orchestration and boundary-spanning alignment, knowledge mobilization and absorptive learning, ambidextrous empowerment and disciplined experimentation, trust-based governance and resource resilience, and institutional navigation with long-term ecosystem orientation. Collectively, these findings show that leadership in knowledge-based innovation ecosystems is not limited to internal supervision, strategic planning, or technical decision-making. Instead, it is a distributed and relational practice through which leaders connect actors, translate knowledge, create adaptive conditions, govern collaboration, and maintain ecosystem continuity under uncertainty. This interpretation is consistent with ecosystem theory, which views innovation outcomes as

dependent on interdependent actors and complementary activities rather than on the isolated capabilities of a focal firm (Adner, 2017; Granstrand & Holgersson, 2020; Jacobides et al., 2018).

The first category, ecosystem orchestration and boundary-spanning alignment, supports previous research emphasizing that innovation ecosystems require coordination among independent but interdependent actors. Dhanaraj and Parkhe (2006) argued that innovation network orchestration involves knowledge mobility, appropriability, and stability. The present findings extend this idea by showing how orchestration is experienced as everyday leadership work in knowledge-based organizations. Participants described leaders as translators among technical, financial, academic, regulatory, and market logics. This aligns with Adner's (2017) structural view of ecosystems, in which the success of an innovation depends on the alignment of multiple actors around a value proposition. It also supports Jacobides et al. (2018), who emphasized roles and complementarities as defining features of ecosystems. In this study, leaders sustained ecosystems by clarifying roles, managing expectations, and building shared project logic. Therefore, leadership practice functioned as a mechanism for reducing ambiguity in complex interorganizational systems.

The second category, knowledge mobilization and absorptive learning, is strongly aligned with the knowledge-based view of the firm and absorptive capacity theory. Grant (1996) argued that firms are institutions for integrating specialist knowledge, while Nonaka (1994) emphasized dynamic knowledge creation through interaction between tacit and explicit knowledge. The present findings indicate that leaders in knowledge-based organizations sustain innovation ecosystems by making knowledge mobile across boundaries. Participants did not view knowledge acquisition as sufficient; they emphasized interpretation, internal distribution, and application. This finding is consistent with Cohen and Levinthal's (1990) argument that innovative performance depends on the ability to recognize, assimilate, and apply external knowledge, and with Zahra and George's (2002) distinction between potential and realized absorptive capacity. Leaders in this study helped transform potential knowledge exposure into realized innovation capability by asking what was learned, who needed the knowledge, and how it should alter product or strategic decisions.

The third category, ambidextrous empowerment and disciplined experimentation, confirms the relevance of ambidextrous leadership and dynamic capabilities for innovation ecosystem sustainability. Rosing et al. (2011) argued that innovation requires both opening leader behaviors that encourage exploration and closing leader behaviors that support implementation. Similarly, O'Reilly and Tushman (2013) conceptualized ambidexterity as the ability to explore new opportunities while exploiting existing capabilities. Participants in this study described effective leaders as those who protect experimentation while preventing disorder. This finding suggests that knowledge-based organizations need leadership practices that create psychological safety for trial, error, and learning while also establishing evidence-based criteria for continuation, scaling, or termination of projects. The result also aligns with

Teece's (2007) dynamic capabilities framework: leaders support sensing through experimentation, seizing through prioritization, and transforming through integration of learning into routines.

The fourth category, trust-based governance and resource resilience, highlights the social and relational foundations of sustainable innovation ecosystems. Innovation ecosystems involve uncertainty, incomplete contracts, intellectual property risks, and uneven resource contributions. Under these conditions, formal agreements are necessary but insufficient. Participants emphasized transparent communication, fair benefit-sharing, commitment fulfillment, and conflict resolution as practices that sustain collaboration. This finding aligns with Dhanaraj and Parkhe's (2006) argument that network stability and appropriability are essential to innovation orchestration. It also complements open innovation theory, which recognizes that external knowledge flows require mechanisms for managing openness, protection, and value capture (Chesbrough, 2003). In resource-constrained environments, leaders also practiced resource resilience by combining internal and external assets, maintaining partner commitment, and preventing innovation projects from collapsing during financial or institutional pressure. Thus, trust and resilience were not soft peripheral issues; they were core governance mechanisms.

The fifth category, institutional navigation and long-term ecosystem orientation, extends the discussion beyond firm-level innovation management. Participants described leaders as institutional interpreters who manage certification requirements, policy shifts, funding structures, legitimacy concerns, and public-private interactions. This finding is compatible with Granstrand and Holgersson's (2020) argument that innovation ecosystems include institutions and relations, not only actors and technologies. It also resonates with Uhl-Bien and Arena's (2018) view that leadership for adaptability requires enabling conditions across complex systems. In this study, leaders sustained ecosystems by thinking beyond immediate organizational benefit and investing in long-term ecosystem credibility, partner development, and shared standards. This suggests that leadership for ecosystem sustainability includes an ethical and strategic orientation toward collective capacity. Knowledge-based organizations may benefit from short-term competition, but long-term innovation depends on ecosystem health, shared learning, and credible collaboration.

Overall, the findings suggest that leadership practices for sustaining innovation ecosystems are multidimensional and mutually reinforcing. Orchestration creates alignment, knowledge mobilization enables learning, ambidextrous experimentation produces innovation options, trust-based governance preserves collaboration, and institutional navigation protects long-term viability. These categories should not be interpreted as separate stages but as overlapping leadership capabilities. For example, leaders cannot mobilize knowledge effectively without trust, cannot experiment sustainably without resource resilience, and cannot coordinate ecosystem actors without institutional legitimacy. This integrated view contributes to the literature by showing that ecosystem leadership is not

merely a strategic position but a practice-based capability enacted through daily interactions, decisions, and relational commitments.

The study also contributes to leadership theory by demonstrating that leadership in innovation ecosystems operates across organizational boundaries. Traditional leadership models often focus on leader-follower relationships within formal organizations. However, participants in this study described leadership as influence without full control. Leaders had to coordinate independent organizations, negotiate shared meaning, and mobilize voluntary commitment. This supports complexity leadership perspectives that emphasize connectivity, adaptive space, and emergent collaboration (Uhl-Bien & Arena, 2018). It also suggests that leaders in knowledge-based organizations must be evaluated not only by internal performance indicators but also by their ability to strengthen the relational and knowledge infrastructures of the ecosystems in which their organizations participate.

The practical significance of these findings is considerable. Knowledge-based organizations often possess strong technical expertise but struggle to commercialize, scale, and sustain innovation because ecosystem coordination is weak. The findings indicate that leaders should deliberately develop boundary-spanning routines, knowledge translation mechanisms, experimentation governance, trust-building practices, and institutional engagement strategies. These practices can help transform ecosystem participation from occasional cooperation into sustained innovation capacity. Leadership development programs in knowledge-based organizations should therefore include ecosystem thinking, partnership governance, knowledge integration, ambidextrous decision-making, and institutional strategy, rather than focusing only on internal management competencies.

Conclusion

This qualitative study examined leadership practices for sustaining innovation ecosystems in knowledge-based organizations. The findings showed that effective leaders sustain innovation ecosystems through five interconnected practice domains: orchestrating ecosystem relationships, mobilizing and absorbing knowledge, balancing empowerment with disciplined experimentation, governing collaboration through trust and resilience, and navigating institutions with a long-term ecosystem orientation. These practices indicate that leadership in knowledge-based organizations is increasingly ecosystemic, relational, and adaptive. Leaders must not only manage internal employees and resources but also connect external actors, translate knowledge across boundaries, protect experimentation, maintain trust, and build legitimacy within broader innovation environments.

The study contributes to the literature by providing a practice-based understanding of how leaders sustain innovation ecosystems in knowledge-intensive contexts. It integrates insights from innovation ecosystem theory, knowledge-based theory, absorptive capacity, dynamic capabilities, open innovation, ambidextrous leadership, and complexity leadership. The findings suggest that sustainable innovation depends on leadership capabilities that connect organizational strategy with ecosystem-level collaboration. For knowledge-based

organizations, innovation sustainability is not achieved only by investing in technology or hiring experts. It also requires leaders who can build the relational, cognitive, and institutional conditions through which knowledge becomes shared value. Therefore, leadership development in knowledge-based organizations should move beyond conventional managerial training and include ecosystem orchestration, knowledge translation, collaborative governance, and adaptive experimentation as core competencies.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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