This paper was presented at the XXXVI ISPIM Innovation Conference, held in Bergen, Norway on 15 June to 18 June 2025. ISBN 978-952-65069-9-9.

The Interrelationship Between Public Innovation Ecosystems, Business Innovation Ecosystems, and Organizational Innovation Management Systems

Håkan Ozan*

Novelty Quest Research, Wargentinsgatan 2, 11229 Stockholm, Sweden
E-mail: hakan.ozan@noveltyquest.com

Annika Steiber

RDHY Silicon Valley Research Center, 1982 Dakin Ave., Menlo Park, CA, USA
E-mail rdhy.siliconvalley@gmail.com
* Corresponding author

Abstract: This paper develops an integrated perspective on how public innovation ecosystems (PIE), business innovation ecosystems (BIE) and organizational innovation management systems (IMS) interact to shape regional innovation performance. Synthesizing three literatures with fresh evidence from the METRIC program of 1 682 firms' responses across five Swedish regions, we uncover a self-reinforcing misalignment loop incorporating low IMS maturity, weak governance fit, sparse orchestration and capability bottlenecks. To diagnose and remedy these gaps, we propose the 3-Layer Alignment Model (3LAM), which nests IMS inside BIE and BIE inside PIE and specifies three alignment mechanisms: governance-congruence, orchestration density and capability-readiness pathways. Structural mappings to METRIC's ecosystem actor typology and ecosystem innovation process model operationalize the framework for practitioners, while three research propositions open a path for longitudinal testing.

Keywords: public innovation ecosystem; business innovation ecosystem; innovation management system; regional innovation ecosystem; ecosystem governance; ISO 56001; ISO 56002; METRIC framework; innovation process.

1 Introduction – research problem, importance, and scope

Across the innovation management literature, three distinct but inter-dependent arenas are routinely discussed: (1) the public-institutional innovation ecosystem that sets incentives, infrastructure, and regulation; (2) business-driven innovation ecosystems in which firms, suppliers, users, and complementors co-create value; and (3) the internal innovation management systems (IMS) of individual organizations that translate external opportunities into concrete offerings. Although each stream has developed rich insights of its own – including national- and regional innovation ecosystem studies for the public

layer (OECD, 2023), platform- and business ecosystem research for the market layer (Adner, 2016), and dynamic-capabilities/IMS scholarship for the firm layer (Teece, 2011), there is still no integrative model that explains where and how these three layers interact or drift apart. In terms of public-institutional innovation ecosystems, Menéndez-Sánchez et al. (2023) highlight how local innovation ecosystems interact with sustainability strategies within the oil and gas sector, emphasizing that coherent regulatory frameworks are essential for fostering public-private collaboration and driving innovation. Their findings illustrate the necessity for strategic alignment among stakeholders to generate improved outcomes, showing that public policy serves not only to incentivize innovation, but also to direct and structure the interactions between private, public, and community entities. On the business side, Glover et al. (2024) discuss how private healthcare partnerships benefit from coordinated efforts among stakeholders, reinforcing the idea that business ecosystems thrive on collaboration and value co-creation. Their research suggests that without a supportive ecosystem, which is often influenced by public policy, firms may struggle to innovate effectively. Additionally, Jacobides et al. (2018) elucidate how modularity within ecosystems allows distinct yet interdependent organizations to coordinate effectively, enhancing our understanding of inter-firm collaboration for innovation. Regarding internal innovation management systems, Silva (2021) elaborates on how standardized innovation management, particularly as outlined by ISO 56002, cultivates a holistic framework for organizations to translate external opportunities into internal innovation capabilities. The empirical evidence presented shows that the consistent application of systematic innovation system and process management enhances firms' capacity to adapt and respond to shifts in public policy and market conditions.

As a result, policy instruments are often designed without a clear view of firm-level absorption capacity, while companies struggle to map their internal roadmaps onto evolving public or market initiatives. The practical cost becomes visible as duplicate programs, under-used regional assets, and slower diffusion of breakthrough solutions, issues that the EU’s smart specialization agenda and many cluster strategies continue to highlight (Gianelle et al., 2016). Despite these valuable insights, an integrative model that captures the interplay among these three layers is absent. The literature reveals a research gap concerning the intersections and influence of these systems on one another. For instance, studies on public-private partnerships underscore the need for coordination frameworks, but rarely address how these frameworks accommodate internal organizational needs (Sogstad et al., 2020; Yunus, 2021). Furthermore, while the dynamics within business ecosystems are well-documented, the role of public policy in shaping firms’ innovation management systems is frequently overlooked, leading to a fragmented understanding of the interaction between these domains.

Responding to that gap, this study presents a three-layer alignment model that clarifies the interdependencies between public innovation ecosystems, business innovation ecosystems, and organizational innovation management systems. The contribution is primarily conceptual, grounded in a structured literature review, yet it is informed by longitudinal evidence from the METRIC program (2018-2025), which has assessed regional innovation ecosystem capacity across seven regions in northern Europe. Empirical vignettes from METRIC serve to illustrate the model’s propositions. The paper therefore targets scholars and practitioners who need a coherent starting lens for aligning policy mechanisms, ecosystem governance, and firm-level innovation systems and

routines, and it sets the stage for future empirical tests of the model in diverse regional contexts.

2 Background, methodology and definitions

2.1 Background

METRIC is a model and a methodology designed to measure and develop regional innovation ecosystems. It has been created throughout several projects since 2018 and was during 2024-2025 piloted in seven regions in three countries. METRIC (MEasuremenT of Regional Innovation Capacity) is a package of several integrated concepts, including a set of indicators representing data points for the quality of a public innovation ecosystem, an innovation ecosystem process that showcases the value creation in such systems, and an ecosystem actor model to visualize which actors create what value and how throughout the innovation ecosystem process and how that adds value to the indicators.

2.2 Methodology

The overall structure of the METRIC program has been evolving through several stages.

1. 2018-2019: We developed the theoretical foundation of a system of indicators based on international best practices, such as OECD, GII, GCI, etc. This created the first measurement model of the METRIC system.
2. 2021-2022: We extended the measurement model with a measurement methodology, including a method guide for how to collect the data for each indicator in the system.
3. 2022-2023: We ran a pilot in one Swedish region, testing out the indicators, the measurements, and the methodology, while making several improvements.
4. 2024-2025: We ran an extended pilot with five Swedish regions as a national initiative, further testing and improving the measurement model and methodology.
5. 2025: We have recently completed an international pilot, including regions from Ireland and Finland.

Throughout the pilots, we have gathered data from both secondary and primary sources as described in the METRIC methodology. To ground the conceptual framework empirically, we deployed a cross-sectional survey across five Swedish NUTS-3 regions that together account for 26% of Sweden's population. Sampling followed a stratified proportional design based on the national business register (2023 edition) and was sorted into three size strata (1–4, 5–19, ≥20 employees) and an equal number of firms were drawn in each region, yielding a gross sample of 10 000 firms (2 000 per region). There was a purposeful oversample of each region's "area of strength" based on SNI-code clusters. Fieldwork was executed between April and June 2024 by the independent ISO 20252 certified market research agency SIFO/Kantar Public/Verian to ensure procedural neutrality and GDPR compliance. A sequential mixed-mode protocol was used to maximize participation: (1) personalized cover letters with questionnaire booklets were sent via first-class post with a prepaid return envelope; (2) after one week, non-respondents received a reminder postcard; (3) a further two weeks later, an e-mail invitation containing a secure web-survey link was issued; and (4) in the final stage trained interviewers conducted computer-assisted telephone interviews with remaining non-respondents. The procedure achieved 1 682 usable responses, an overall response

rate of 17.1% (a regional range of 14.6%-22.0%). Questionnaire items were derived from the METRIC capacity model and pre-tested in the first survey in 2023 and then further developed together with research experts for clarity and face validity.

Because the paper's purpose is conceptual, the survey provides *illustrative evidence* only; inferential statistics are reported in a separate METRIC technical report.

2.3 Definitions

- **Business ecosystem**. Moore (1996) defines a business ecosystem as an economic community, supported by a foundation of interacting organizations and individuals, that produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles and tend to align themselves with the directions set by one or more central companies.
- **Innovation ecosystem**. ISO defines an innovation ecosystem as: "a system of interdependent persons or organizations collectively or collaboratively developing or enabling innovation" (ISO, 2025).
- **Public innovation ecosystem (PIE):** The OECD has conducted several studies analyzing public innovation ecosystems, particularly in municipalities, to help identify their strengths and weaknesses. They state it as "innovation ecosystems in the public sector that consist of a network of actors that work together to develop new technologies, products, or services to achieve common shared goals" (OECD, 2025). The view is from an overarching position incorporating the entire aspect of the ecosystem.
- **Business innovation ecosystem (BIE):** Adner (2016) describes a business innovation ecosystem as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize". This definition has then been further expanded by Hou and Shi (2021) that illuminate the perspective of the focal firm's position in "a modular structure of multilateral interdependences in a community of affiliated and interacting actors which keeps an open exchange with its environment". This definition declares the business innovation ecosystem to be a sub-system of one (or more) public innovation ecosystems, viewed from each individual firm's perspective.
- **Innovation management system (IMS):** ISO defines an innovation management system as: "an innovation management system is a set of inter-related and interacting elements, aiming for the realization of value. It provides a common framework to develop and deploy innovation capabilities, evaluate performance and achieve intended outcomes" (ISO, 2025). This is the view of the internal functions and processes within each individual firm.

3 Literature review

Our projects have emphasized three interdependent arenas of innovation management; public-policy innovation ecosystems (PIE), business-driven innovation ecosystems (BIE), and internal organizational innovation management systems (IMS), and suggests that although these streams have evolved independently, there is a lack of a comprehensive

model illustrating their interactions. They express a complex dynamic that has garnered increasing attention in contemporary research. Various studies and frameworks have articulated how these three arenas interconnect and influence one another in terms of fostering innovation against changing economic and policy landscapes. Our recent work has thus focused on looking at forming an integrative framework that illustrates the interactions among these three arenas, thereby addressing the growing complexity and dynamism of innovation ecosystems in today's interconnected world. As noted by Kiemtoré et al. (2022), understanding the mechanisms by which public procurement influences private-sector innovation could provide crucial insights into the systemic interactions across these layers. In short, while distinct bodies of literature enrich understanding within individual domains, the lack of an integrative exploration hampers a comprehensive understanding of how these systems interact and influence one another.

3.1 Public (sector) innovation ecosystems

Public sector innovation ecosystems play a crucial role in setting the stage for business innovation through strategic regulations, incentives, and infrastructural support. According to Menéndez-Sánchez et al. (2023), many innovation ecosystems evolve based on sustainability strategies employed by companies within public-private collaboration frameworks. This engagement highlights the necessity for businesses to align their innovation objectives with public policy goals, particularly in sectors sensitive to regulatory changes. Public innovation ecosystems encompass complex systems that facilitate innovation through collaboration among diverse stakeholders, including government entities, private sectors, civil society, and academia. Theoretical foundations typically derive from multiple disciplines, including economics and public administration. Recent studies show that collaborative innovation offers a viable strategy for addressing societal challenges, particularly in contexts requiring rapid responses, such as health crises (Morais et al., 2022). Research themes in public innovation ecosystems often focus on governance models, actors' roles, and mechanisms for value creation. For example, Morais et al. present that innovation ecosystem actors tend to engage in co-production processes that enhance public service delivery and foster resilience in society. Research by Santos et al. posits a triangular model in which co-creation among various stakeholders, including government, enterprises, and nonprofit organizations, facilitates innovation within public sector contexts, highlighting the necessity of establishing inclusive frameworks for stakeholder engagement (Santos et al., 2015). This model emphasizes mutual effects across innovation systems, suggesting that successful public sector innovation ecosystem management directly influences business ecosystems. By establishing a cooperative relationship, public sector initiatives drive private sector innovation, enhancing the latter's capacity to produce solutions that respond to collective societal needs. There is a strong consensus around the idea that collaborative governance can significantly enhance innovation outputs, although the empirical evaluation of these frameworks remains sparse.

Key findings from the literature reveal that the functional diversity present in public innovation ecosystems, where multiple actors contribute different capabilities, leads to enhanced socio-economic outcomes (Adner and Kapoor, 2009; Vargo and Lusch, 2011). However, debates persist regarding what constitutes effective governance structures and the extent to which public institution engagement needs to evolve to foster innovation better. The dynamic between centralization and decentralization remains a critical point of contention, with some scholars arguing for flexibility to accommodate local contexts while others advocate standardized frameworks for broader applicability (Suominen et

al., 2019). Boyer (2020) recommends future research to address several gaps, notably the need to refine the terminology and definitions surrounding public innovation ecosystems, as inconsistent usages lead to conceptual confusion. Attention should also be directed towards longitudinal studies that track the evolution of these ecosystems over time in varied sociocultural contexts, thus understanding their resilience and adaptability to changing circumstances (Xin et al., 2020). Ultimately, the ongoing development of public innovation ecosystems remains an essential area for scholarly inquiry as they promise potential solutions for tackling pressing global issues.

3.2 Business (private) innovation ecosystems

Turning to business-driven innovation ecosystems, Yaghmaie and Vanhaverbeke (2019) advocate for a holistic perspective, addressing how diverse actors in these systems interact. They point out that while large firms often lead innovation efforts due to their resources and network connections, the inclusion of small and medium enterprises (SMEs) becomes vital. SMEs can act as agile partners in co-creation, augmenting the innovation landscape when supported by effective public policies and frameworks that integrate knowledge sharing among various actors. Business innovation ecosystems are intricate networks where firms, suppliers, partners, and customers collaborate and compete to foster innovation. They serve as critical environments that facilitate the exchange of ideas, technologies, and market strategies (Gawer and Cusumano, 2013). The theoretical foundations of these ecosystems extend from strategic management and innovation theories, where they are often depicted as platforms that enable participants to co-create value through their interdependencies (Adner and Kapoor, 2009). Recent literature has emphasized the importance of digital transformation and technological integration in shaping the dynamics of these ecosystems, making the exchange between organizations more fluid and efficient (Nambisan et al., 2017). Core research themes focus on the roles of various actors, including lead firms, startups, and research institutions, as well as mechanisms for value creation, such as platform strategizing and resource orchestration (Clarysse et al., 2014). A salient finding from the current discourse suggests that successful business innovation ecosystems hinge upon aligning the interests of diverse actors and fostering collaborative relationships, thus creating a conducive environment for innovation trajectories to emerge (Ritala and Almpanopoulou, 2017). Notably, the impact of digital platforms presents contemporary challenges and opportunities for businesses, requiring firms to adapt their strategies to optimize engagement with external developers, essential to drive innovation and thus supporting the argument for more systematic innovation ecosystem management (Parker et al., 2017). Points of consensus accentuate that while private-sector business innovation ecosystems hold immense potential for facilitating technological advancements and market solutions, they also introduce challenges related to governance, competitive dynamics, and resource allocation. Literature has called for more sophisticated models to delineate the intricacies of these interactions and their implications for sustainable competitive progression (Bittencourt et al., 2021). The ongoing debate centers on the best practices for managing relationships within these ecosystems, particularly regarding the risks associated with reliance on shared resources and knowledge spillovers (Gu et al., 2021).

Identifying gaps in the literature, researchers have pointed out the need for comprehensive frameworks that can effectively represent the multifaceted nature of business innovation ecosystems, particularly in emergent technology sectors. Further exploration is warranted into how different ecosystems compare across industries, as well

as their adaptability to external shocks, such as economic downturns or technological disruptions (Yan et al., 2018). In conclusion, as private-sector innovation ecosystems continue to evolve, they remain a pivotal area for research, providing insights into enhancing firm resilience and performance amidst the complexities of modern markets.

3.3 Organizational (internal) innovation management systems

Regarding internal innovation management systems, Silva (2021) elaborates on how standardized innovation management, particularly as outlined by ISO 56002, cultivates a holistic framework for organizations to translate external opportunities into internal capabilities. The empirical evidence presented shows that the consistent application of structured innovation processes enhances firms' capacity to adapt and respond to shifts in public policy and market conditions. Organizational innovation management systems are frameworks that guide companies in systematically managing innovation processes, from opportunities and ideation through execution and evaluation. Theoretical discussions in this area root in resource-based views and dynamic capabilities, positing that structured innovation management is critical for sustaining competitive advantage (Zahra and Nambisan, 2011). Recent advancements in this literature underscore the repositioning of innovation as a core organizational capability, with emphasis on the interplay between structure, culture, and strategic orientation in promoting innovative outcomes (Sahasranamam and Soundararajan, 2021). Research themes within this domain currently revolve around various management practices, including leadership styles, employee engagement, and knowledge management strategies. Effective innovation management systems typically integrate mechanisms facilitating collaboration across departments and external partners to enrich the innovation process (Nambisan and Baron, 2013). Clearly, the application of agile and lean methodologies has gained traction, enabling organizations to respond swiftly to changing market conditions while minimizing waste and maximizing value creation (Vogl, 2020). Despite the rich discourse, gaps remain in assessing how various contextual factors, such as industry type and organizational maturity, affect the effectiveness of innovation management systems. Organizations seeking to thrive in today's volatile market environment must therefore continuously refine their innovation management systems, ensuring they are equipped to harness new technological advancements and respond to shifting ecosystem fluctuations (Zen et al., 2023). Regardless of if the firm is an entrepreneurial startup, an SME, or a large corporation, the internal innovation management system will need to declare the process of interacting with innovation partners in the business innovation ecosystem as well as understanding how to embrace stimulus from the public innovation ecosystem. Explaining the touchpoints of these systems is where the current frameworks are yet to reach consensus.

3.4 Integrative system interactions

The interaction between internal innovation management systems, particularly those oriented around the ISO 56000 series, and business innovation ecosystems is an emerging area of research focusing on how organizations can effectively leverage external collaborations to foster internal innovation. The ISO 56000 series provides organizations with a structured approach to managing innovation while aligning their internal processes with the broader innovation ecosystem external to them. This relationship is pivotal for creating value, especially in environments such as science parks, where collaborative innovation strategies are essential. One of the key aspects highlighted in recent literature is the necessity for companies to create internal structures that support external

innovation partnerships. In this regard, ISO 56003 (ISO, 2019), a standard dedicated to clarifying the management of innovation partnerships, becomes vital. According to Suominen et al. (2019), businesses that integrate ISO 56000 principles can systematically manage their engagement with external collaborators while ensuring that internal processes remain agile and responsive to external opportunities. This framework asserts that effective innovation management not only facilitates compliance with established standards but also enhances the organization's ability to adapt to innovative partnerships within business ecosystems.

Research by Spender et al. displays connections between internal innovation processes and the benefits derived from active participation in business innovation ecosystems, emphasizing the role of technology transfer and collaborative network governance (Spender et al., 2017). Such networks enable firms to share resources, knowledge, and technologies, which are crucial for advancing their innovative capabilities. This assertion aligns with findings from Yan et al. (2018), who explored how organizations interlink their internal innovation strategies with open innovation frameworks, effectively creating ecosystems where knowledge flows seamlessly between internal management and external stakeholders. Their research shows that the role of science parks as innovation ecosystems is particularly noteworthy and provides empirical evidence showcasing how companies situated within science parks benefit from robust collaborations with public and private entities, leading to enhanced innovation outcomes. For example, knowledge management, as discussed by Velu (2015), emphasizes the need for organizations to cultivate an environment in which knowledge can be effectively shared across both internal and external channels. This entails establishing practices that allow teams to assimilate and utilize insights gained from their partnerships swiftly, which in turn cultivates a culture of continuous improvement and innovation. Despite these insights, challenges remain regarding how finely to tune internal systems to benefit from the dynamics of external collaboration fully. Businesses need to carefully navigate the dependencies formed in innovation ecosystems, as relationships with other firms and research entities can become complex and may significantly influence the firm's strategic direction (Velu, 2015). To address this, scholars suggest employing a dynamic capabilities framework that allows organizations to adapt and strengthen their internal innovation practices based on external environmental shifts (Hariyati and Tjahjadi, 2018).

The influence of public innovation ecosystems on internal innovation management systems is an area of increasing importance, particularly as organizations seek to leverage external knowledge and resources in a structured manner. The ISO 56000 series provides a framework for organizations to effectively manage their innovation processes while remaining receptive to the dynamics of public innovation ecosystems. This includes access to external sources of funding, knowledge, and facilities that can enhance an organization's capabilities to innovate. One significant feature of public innovation ecosystems is the availability of an innovation support system that includes both public and private resources and capital for innovation. According to Ponsiglione et al. (2018), public policy frameworks play a critical role in incentivizing investments in research and development, both at public and private levels, leading to improved innovative performance in regional innovation systems. Organizations that align their internal IMS with such public supports are more likely to successfully navigate the complexities of the innovation landscape, thus enhancing their capacity to absorb external innovations, which may involve knowledge transfers and collaborations with research institutions or other entities. Friedmann and Pedersen (2023) contribute to this understanding by identifying

the influence of national innovation policies on firms' knowledge acquisition within international alliances, illustrating how public policy directly correlates with a firm's capacity to incorporate external knowledge. Public policies can create an environment conducive to collaboration and knowledge sharing, effectively linking internal strategies with external opportunities. Such alignment is enhanced when organizations actively take part in public innovation support programs designed to facilitate R&D efforts. The accessibility of proper infrastructure, such as modern office spaces, transportation networks, high-speed broadband, and energy supply, is another critical aspect of the public support framework. As articulated by Uyarra et al. (2020), governments that ensure adequate infrastructure enable innovative firms to operate more flexibly and effectively, thus supporting internal innovation processes. The presence of infrastructure that supports innovation not only assists firms in streamlining their internal processes but also fosters connectivity and collaborative projects within innovation ecosystems. It is also essential to consider the interaction between procurement policies and innovation. Public procurement can serve as a powerful tool for stimulating innovation within firms by offering them incentives to innovate. The role of public policies in enhancing enterprise innovation performance is significant, particularly when they are structured to promote ambidextrous learning within organizations (Wang and Lam, 2018). This approach allows firms to effectively balance exploratory and exploitative innovation, facilitating a more responsive IMS that aligns with the demands of the public innovation ecosystem.

In conclusion, an integrative approach that emphasizes the interplay between internal innovation management systems and business innovation ecosystems, underpinned by frameworks such as ISO 56000, can yield substantial benefits. Organizations that strategically align their internal structures with external collaborative efforts, especially within dynamic environments like science- or business parks, position themselves for enhanced innovation and competitive advantage. The management of public innovation ecosystems significantly influences and shapes the preconditions for internal innovation management systems. By leveraging public support systems, including funding, infrastructure, and education, organizations can enhance their capabilities to innovate. Integrating public policy frameworks with internal processes facilitates not only external collaboration but also the optimization of resources to drive innovation. As organizations actively participate in these ecosystems, they are likely to see enhanced innovation outcomes, which ultimately contribute to their long-term competitiveness and sustainability.

4 Empirical findings

4.1 Diagnostic patterns from the METRIC survey and their conceptual implications

The five-region METRIC survey discloses a set of interlocking deficits that explain why firm-level innovation routines, business ecosystems and public programmes often fail to reinforce one another. Each theme below weaves the quantitative evidence with extant theory, establishing the empirical foundations for the 3-Layer Alignment Model that follows.

— Internal systematization is a missing link
Only 17% of firms that innovate report applying "innovation management to a significant degree", i.e. follow a recognized system such as ISO 56002. This confirms Silva's (2021) observation that SMEs rarely institutionalize dynamic capabilities and resonates with the implementation gap in ISO 56002 adoption studies. Without a formal IMS, firms struggle to absorb external knowledge and to formulate credible value commitments that attract ecosystem partners (Adner, 2016). The survey further shows that systematic IMS use is correlated (+0.42, $p < 0.05$; not tabulated) with perceived usefulness of network events, suggesting that process maturity conditions whether firms can convert relational opportunities into outcomes.

— Governance fit between public instruments and firm needs remains thin
Just 22% of all respondents received regional innovation support during the preceding year; among the non-users, the most cited reason (43%) is that "the programs are not adapted to our business". OECD points to precisely this mismatch in its critique of regional smart specialization rollout (OECD, 2023). Our evidence indicates that support uptake is positively associated with membership in network organizations ($\beta = 0.71$, $p < 0.05$) but not with firm size or R&D intensity, underscoring the role of meso-level connectors in translating policy offers into actionable firm benefits. For the public innovation ecosystem (PIE) this signals inefficient resource allocation, while for individual businesses it means higher search costs and slower time-to-market.

— Sparse connective tissue in the business ecosystem
Collaborative density is low on three complementary indicators:

- Intermediary collaboration: only 18% of innovating firms report active work with intermediaries.
- Network event participation: 32% attended at least one event, yet just 39% derive substantial benefit.
- Research/innovation projects: a mere 13% engaged a university or RTO in the past 12 months, with stark center-periphery gaps (26% in "strength areas" vs 5% elsewhere).

In ecosystem terms (Adner and Kapoor, 2009), the respondents' responses point out structural holes in the innovation ecosystem setup. Weak bridging institutions also explain why testbeds are almost unused (≤4% at intensity 4–5), despite significant public investment. The data therefore reinforces the literature's call for orchestration roles (Yaghmaie and Vanhaverbeke, 2019) and motivates deliberate alignment mechanisms between the regional PIE and the business innovation ecosystems (BIE).

— Capability bottlenecks constrain ecosystem participation
A majority of the firms (61%) report difficulty recruiting key talent and the figure spikes to 73% inside the region's priority clusters. Parallel indicators of technological readiness are equally modest; on average only 13% of work tasks use advanced digital or high-tech tools and 16% have launched a product containing new technology in the past three years. Such capability gaps dovetail with the low IMS penetration noted previously and validate the dynamic capabilities literature's argument that absorptive capacity mediates ecosystem value capture (Teece, 2011). At the ecosystem level, chronic skill shortages may induce negative externalities: restricted partner options, slower diffusion of standards, and thus lower overall innovation velocity.

— Commercial outcomes point to under-exploited market potential
Due to strong domestic orientation, only 9% of total turnover among innovating firms comes from innovation sales abroad, and licence-based revenue is negligible (≤3%). Combined with the sparse participation in export-collaboration schemes (2%), this suggests that the alignment failures documented above translate into missed value capture on global markets, exactly the outcome predicted by Adner's alignment-structure theory when complements and institutional support are not synchronized. For the PIE, this represents forgone tax revenues and cluster signaling; for the BIEs, it weakens the region's positional advantage in platform constellations.

These findings, while derived from five Swedish regions covering 26% of the national population, exhibit dynamics analogous to those reported in regional innovation studies elsewhere (e.g. Thomas and Autio, 2020), enhancing the external relevance of the conceptual framework to follow.

5 Conceptual framework

5.1 The 3-Layer Alignment Model (3LAM)

Building on the empirical regularities uncovered in the METRIC pilots and the three streams of literature reviewed earlier, we propose the 3-Layer Alignment Model (3LAM) (Figure 1).

- **Layer 1 (Public Innovation Ecosystem—PIE)** comprises the policy, infrastructure and coordination functions that the METRIC ecosystem actor model groups under system-supporting functions such as orchestration, policy development and education.
- **Layer 2 (Business Innovation Ecosystem–BIE)** corresponds to the innovation-supporting functions (finance, advisory, networking, development, etc.) that enable focal firms to combine complementary assets.
- **Layer 3 (Innovation Management System—IMS)** is seated inside the focal organization and mirrors the fundamental functions (research, entrepreneurship) in METRIC, operationalized through ISO 56001 (or ISO 56002) routines.

The model treats the layers as nested, not parallel. Every IMS interacts with "its" BIE, and every BIE is embedded in one (or several) PIEs. Alignment problems therefore propagate upward and downward, generating the self-reinforcing loop observed in the survey.

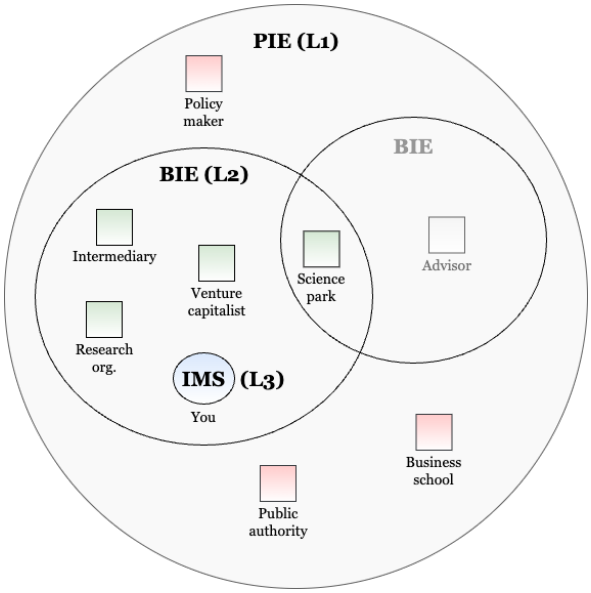

Figure 1 Schematic of the 3-Layer Alignment Model.

5.2 Structural mapping to METRIC's ecosystem actor model

Figure 2 translates 3LAM into the actor categories already familiar to regional practitioners. This ensures conceptual continuity with the ecosystem actor model used in METRIC capacity dialogues. Note, for instance, that incubators migrate from the "advisory" actor function inside the METRIC innovation support field to the BIE layer, whereas region and country administration actors remain in the PIE.

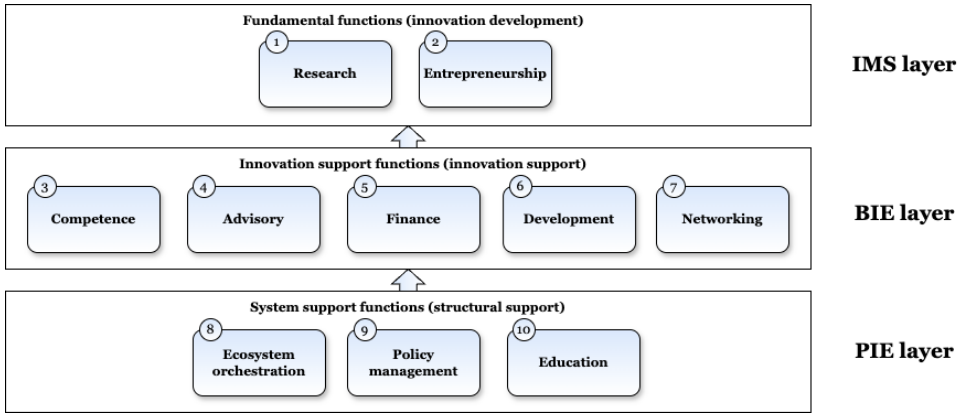

Figure 2 Concordance between 3LAM layers and METRIC ecosystem actor classes.

This mapping anchors 3LAM in an operational vocabulary that regional stakeholders already use when scoring indicator gaps.

5.3 Dynamic interfaces along the METRIC innovation ecosystem process

These examples overlay the three layers on the four-phase innovation process adopted in the conducted regional pilots, illustrating how value is created in each phase, and how actors and resources in each (eco)system add value throughout the progress.

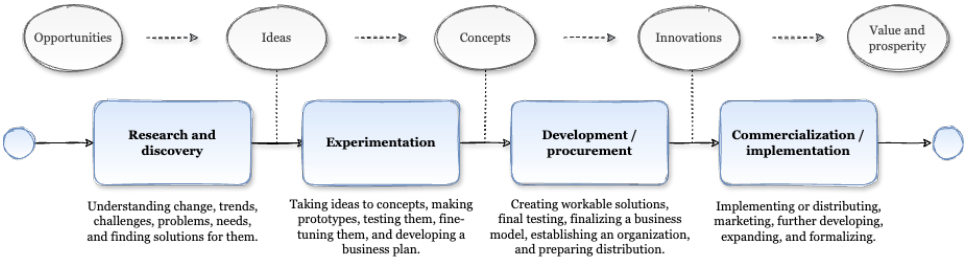

Figure 3 The METRIC innovation ecosystem process model (Ozan et al., 2024).

Examples of how PIE, BIE, and IMS are involved throughout the process:

1. **Research and discovery**. PIE actors supply foresight data and challenge-driven procurement, BIE intermediaries facilitate innovation events and curate problem briefs, IMS routines translate them into idea funnels.
2. **Experimentation**. Public testbeds (PIE) and specialized labs (BIE) reduce technical uncertainty, but only firms with systematic IMS learning loops absorb the results.
3. **Development/procurement**. Regional finance instruments (PIE) couple with venture investors (BIE) to bridge the "funding valley", IMS must comply with due diligence requirements. IMS collaborates with BIE to build draft solutions.
4. **Commercialization/implementation**. Export programs (PIE) and platform orchestration (BIE) scale innovations, IMS governs IP and production ramp-up.

5.4 Alignment mechanisms and research propositions

Drawing together theory, survey evidence and the process analysis, we posit three primary mechanisms.

Table 1 Alignment mechanisms and research propositions

Mechanism/proposition	*Description*
M1 Governance-congruence	Alignment improves when public instruments are co-designed with BIE intermediaries and mirror standard IMS phases.
Proposition P1:	The perceived usefulness of regional programs will be positively moderated by the firm's IMS maturity level.
M2 Orchestration density	A critical mass of bridging actors (science parks, cluster organizations) increases the probability that BIE compatible relationships are realized.

Proposition P2:	Regions with a higher ratio of orchestration actors to active firms will display greater cross-layer knowledge flows.
M3 Capability-readiness pathways	Targeted capability-building (innovation management training, digital upskilling, IP management) raises absorptive capacity and widens the selection set of viable complements.
Proposition P3:	Capability interventions that are sequenced to the METRIC process phases yield higher innovation-sales intensity than untargeted schemes.

5.5 Implications for regional innovation policy and IMS design

For regions, 3LAM suggests that smart specialization roadmaps should specify alignment checkpoints at each METRIC phase, assign lead intermediaries, and publish IMS-compatible templates (e.g. ISO 56002-aligned funding criteria). The METRIC method book already recommends integrating indicator follow-up with action planning, adding 3LAM checkpoints embeds dynamic alignment into that cycle.

For firms, adopting even a lightweight IMS, perhaps built on ISO 56002 with integration of ISO 56003 practices, sharpens their "docking points" to BIE offers and satisfies the documentation requirements of public PIE instruments, addressing the 83% non-systematic share seen in the survey.

6 Conclusions and discussion

This study set out to unravel *where* and *how* three frequently isolated arenas, public innovation ecosystems (PIE), business innovation ecosystems (BIE) and organizational innovation management systems (IMS), interact, align and, at times, misalign. Grounded in a structured literature review and illustrative evidence from the five-region METRIC pilot, we advanced the **3-Layer Alignment Model (3LAM)** as an integrative lens for researchers, practitioners, and policymakers.

6.1 Key findings in brief

Empirically, the METRIC survey revealed (1) low IMS institutionalization (17%), (2) thin governance fit for public instruments (22% uptake), (3) sparse connective tissue inside regional BIEs, (4) persistent capability bottlenecks, and (5) under-exploited market potential. These patterns combine into a self-reinforcing misalignment loop that depresses innovation velocity. Conceptually, 3LAM demonstrates that IMS, BIE and PIE are nested layers whose alignment hinges on three mechanisms: governance-congruence, orchestration density and capability-readiness pathways.

6.2 Discussion

The survey patterns are mutually reinforcing. Low IMS maturity reduces firms' ability to recognize or comply with public program requirements, governance misfit then lowers the uptake of support designed to build capability. The resulting collaboration gaps diminish learning and spillovers, further depressing the incentive to adopt systematic IMS practices. In short, the data portray a self-reinforcing misalignment

loop spanning all three layers. By mapping these empirical regularities onto the literature, we substantiated the need for a 3-Layer Alignment Model that specifies (1) governance-congruence levers, (2) network orchestration roles, and (3) capability-readiness pathways, elements that are conceptually proposed in the 3LAM structure.

Both public and business innovation ecosystem literatures converge on a multi-actor, value co-creation logic, yet diverge on governance levers and boundary definitions, a tension a stronger and more thorough concordance with the METRIC ecosystem actor model may help to resolve. The proposed 3LAM articulates layer-specific roles, dynamic interfaces along the innovation process, and three testable alignment propositions that together offer a roadmap for multi-level synchronization. Firms' internal IMS alignment with the two external layers is currently weak. IMS maturity predicts benefit from ecosystem engagement, but most firms have rudimentary systems, creating a structural bottleneck. Stronger external connectivity measures within the IMS would be a reasonable solution. Many of the METRIC indicators support this.

6.3 Contributions to theory and practice

This paper extends ecosystem research by nesting IMS inside BIEs and BIEs inside PIEs, addressing the "missing middle" flagged by Thomas and Autio (2020). It also operationalizes alignment constructs with METRIC indicators, paving the way for quantitative testing. Practically, the work equips regions with a diagnosis-to-action pipeline. METRIC indicators detect misalignment, while 3LAM prescribes governance, orchestration or capability remedies.

7 References

Adner, R. (2016) 'Ecosystem as Structure: An Actionable Construct for Strategy', *Journal of Management*, 43. Available at: https://doi.org/10.1177/0149206316678451.

Adner, R. and Kapoor, R. (2009) 'Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations', *Strategic Management Journal* [Preprint]. Available at: https://doi.org/10.1002/smj.824.

Bittencourt, B.A., Santos, D.A.G. dos and Mignoni, J. (2021) 'Resource orchestration in innovation ecosystems: a comparative study between innovation ecosystems at different stages of development', *International Journal of Innovation*, 9(1). Available at: https://doi.org/10.5585/iji.v9i1.18076.

Boyer, J. (2020) 'Toward an Evolutionary and Sustainability Perspective of the Innovation Ecosystem: Revisiting the Panarchy Model', *Sustainability*, 12(8). Available at: https://doi.org/10.3390/su12083232.

Clarysse, B. *et al.* (2014) 'Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems', *Research Policy*, 43(7). Available at: https://doi.org/10.1016/j.respol.2014.04.014.

Friedmann, J.-C. and Pedersen, T. (2023) 'National innovation policies and knowledge acquisition in international alliances', *Global Strategy Journal*, 14(1). Available at: https://doi.org/10.1002/gsj.1477.

Gawer, A. and Cusumano, M.A. (2013) 'Industry Platforms and Ecosystem Innovation', *Journal of Product Innovation Management*, 31(3). Available at: https://doi.org/10.1111/jpim.12105.

Gianelle, C. *et al.* (2016) *Implementing Smart Specialisation Strategies: A Handbook*.

Glover, W.J. *et al.* (2024) 'The ties that bind: innovation configurations in low- and middle-income healthcare delivery settings', *Journal of Health Organization and Management*, 38(9). Available at: https://doi.org/10.1108/jhom-09-2023-0275.
Gu, Y. *et al.* (2021) 'Innovation Ecosystem Research: Emerging Trends and Future Research', *Sustainability*, 13(20). Available at: https://doi.org/10.3390/su132011458.
Hariyati, H. and Tjahjadi, B. (2018) 'Contingent Factors Affecting the Financial Performance of Manufacturing Companies: The Case of East Java, Indonesia', *Asian Journal of Business and Accounting*, 11(1). Available at: https://doi.org/10.22452/ajba.vol11no1.5.
Hou, H. and Shi, Y. (2021) 'Ecosystem-as-structure and ecosystem-as-coevolution: A constructive examination', *Technovation*, 100, p. 102193. Available at: https://doi.org/10.1016/j.technovation.2020.102193.
ISO, T. (2019) *ISO 56003:2019*, *ISO*. Available at: https://www.iso.org/standard/68929.html (Accessed: 7 May 2025).
ISO, T. (2025) *ISO 56000:2025*, *ISO*. Available at: https://www.iso.org/standard/84436.html (Accessed: 28 April 2025).
Jacobides, M.G., Cennamo, C. and Gawer, A. (2018) 'Towards a theory of ecosystems', *Strategic Management Journal*, 39(8). Available at: https://doi.org/10.1002/smj.2904.
Kiemtoré, Z.L. *et al.* (2022) 'Public Procurement as a Demand-Side Innovation Policy in Burkina Faso: The Necessity to Search for Failure Sources', *International Journal of Management &Amp; Entrepreneurship Research*, 4(12). Available at: https://doi.org/10.51594/ijmer.v4i12.421.
Menéndez-Sánchez, J., Gómez, J.F. and Mata, A.A. de la (2023) 'Sustainability Strategies by Oil and Gas Companies, Contribution to the SDGs and Local Innovation Ecosystems', *Energies*, 16(6). Available at: https://doi.org/10.3390/en16062552.
Moore, J. (1996) 'The Death of Competition : Leadership and Strategy in the Age of Business Ecosystems / J.F. Moore.'
Morais, G.M., Martins, H.C. and Santos, V.F. dos (2022) 'Resilience in the Context of Pandemics and Disasters: A Framework for Public Governance, Ecosystem Innovation, Co-creation, and Co-production', *International Journal of Business Administration*, 13(1), p. 15. Available at: https://doi.org/10.5430/ijba.v13n1p15.
Nambisan, S. *et al.* (2017) 'Digital Innovation Management: Reinventing Innovation Management Research in a Digital World', *MIS Quarterly*, 41(1). Available at: https://doi.org/10.25300/misq/2017/41:1.03.
Nambisan, S. and Baron, R.A. (2013) 'Entrepreneurship in Innovation Ecosystems: Entrepreneurs' Self–Regulatory Processes and Their Implications for New Venture Success', *Entrepreneurship Theory and Practice*, 37(5). Available at: https://doi.org/10.1111/j.1540-6520.2012.00519.x.
OECD (2023) *OECD Science, Technology and Innovation Outlook 2023*, *OECD*. Available at: https://www.oecd.org/en/publications/oecd-science-technology-and-innovation-outlook-2023_0b55736e-en.html (Accessed: 28 April 2025).
OECD (2025) *How Innovation Ecosystems Foster Citizen Participation Using Emerging Technologies in Portugal, Spain and the Netherlands*. OECD Publishing (OECD Public Governance Reviews). Available at: https://doi.org/10.1787/2cb37a30-en.
Ozan, H., Ferry, J. and Bieblad, L. (2024) *Measuring and Developing Regional Innovation Ecosystems -The METRIC Approach*.
Parker, G., Alstyne, M.V. and Jiang, X. (2017) 'Platform Ecosystems: How Developers Invert the Firm', *MIS Quarterly*, 41(1). Available at: https://doi.org/10.25300/misq/2017/41.1.13.

Ponsiglione, C., Quinto, I. and Zollo, G. (2018) 'Regional Innovation Systems as Complex Adaptive Systems: The Case of Lagging European Regions', *Sustainability*, 10(8). Available at: https://doi.org/10.3390/su10082862.
Ritala, P. and Almpanopoulou, A. (2017) 'In defense of "eco" in innovation ecosystem', *Technovation*, 60–61. Available at: https://doi.org/10.1016/j.technovation.2017.01.004.
Sahasranamam, S. and Soundararajan, V. (2021) 'Innovation Ecosystems: What Makes them Responsive during Emergencies?', *British Journal of Management*, 33(1). Available at: https://doi.org/10.1111/1467-8551.12553.
Santos, H.R. *et al.* (2015) 'Collaborative Innovation in the Public Sector a Case of the Brazilian Federal Government', in A. Kő and E. Francesconi (eds) *Electronic Government and the Information Systems Perspective*. Cham: Springer International Publishing, pp. 132–145. Available at: https://doi.org/10.1007/978-3-319-22389-6_10.
Silva, S.B. da (2021) 'Improving the firm innovation capacity through the adoption of standardized innovation management systems: a comparative analysis of the ISO 56002:2019 with the literature on firm innovation capacity', *International Journal of Innovation*, 9(2). Available at: https://doi.org/10.5585/iji.v9i2.19273.
Sogstad, M., Lodgaard, E. and Magnussen, S. (2020) 'Public-Private Innovation in Health and Social Care: The Implications of Transaction Costs', *Nordic Journal of Social Research*, 11(1). Available at: https://doi.org/10.7577/njsr.2260.
Spender, J.-C. *et al.* (2017) 'Startups and open innovation: a review of the literature', *European Journal of Innovation Management*, 20(1). Available at: https://doi.org/10.1108/ejim-12-2015-0131.
Suominen, A., Seppänen, M. and Dedehayir, O. (2019) 'A bibliometric review on innovation systems and ecosystems: a research agenda', *European Journal of Innovation Management*, 22(2). Available at: https://doi.org/10.1108/ejim-12-2017-0188.
Teece, D.J. (2011) *Dynamic Capabilities and Strategic Management: Organizing for Innovation and Growth*. Reprint edition. Oxford, United Kingdom: Oxford University Press.
Thomas, L. and Autio, E. (2020) 'Innovation ecosystems in management: An organizing typology', in. Available at: https://doi.org/10.1093/acrefore/9780190224851.013.203.
Uyarra, E. *et al.* (2020) 'Public procurement, innovation and industrial policy: Rationales, roles, capabilities and implementation', *Research Policy*, 49(1). Available at: https://doi.org/10.1016/j.respol.2019.103844.
Vargo, S.L. and Lusch, R.F. (2011) 'It's all B2B…and beyond: Toward a systems perspective of the market', *Industrial Marketing Management*, 40(2). Available at: https://doi.org/10.1016/j.indmarman.2010.06.026.
Velu, C. (2015) 'Knowledge management capabilities of lead firms in innovation ecosystems', *AMS Review*, 5(3–4). Available at: https://doi.org/10.1007/s13162-015-0068-6.
Vogl, T.M. (2020) 'Theoretical Foundations for the Study of Social Innovation in the Public Sector', *Lecture Notes in Computer Science* [Preprint]. Available at: https://doi.org/10.1007/978-3-030-58141-1_5.
Wang, D. and Lam, K.C.K. (2018) 'Whether the Innovation Policy Will Really Improve Enterprise's Innovation Performance— Mediating Role of Ambidextrous Learning', *International Business Research*, 11(9). Available at: https://doi.org/10.5539/ibr.v11n9p96.
Xin, C. *et al.* (2020) 'The Role of Managerial Cognitive Capability in Developing a Sustainable Innovation Ecosystem: A Case Study of Xiaomi', *Sustainability*, 12(17). Available at: https://doi.org/10.3390/su12177176.

Yaghmaie, P. and Vanhaverbeke, W. (2019) 'Identifying and describing constituents of innovation ecosystems', *EuroMed Journal of Business*, 15(3). Available at: https://doi.org/10.1108/emjb-03-2019-0042.
Yan, M.-R. *et al.* (2018) 'Evaluating the Collaborative Ecosystem for an Innovation-Driven Economy: A Systems Analysis and Case Study of Science Parks', *Sustainability*, 10(3). Available at: https://doi.org/10.3390/su10030887.
Yunus, E. al M. (2021) 'The Impact of Public-Private Partnerships on Development of Tourism Infrastructure Destination and Tourism Service Innovation as Mediating Variable in Sinjai Regency, Indonesia', *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(11). Available at: https://doi.org/10.17762/turcomat.v12i11.6062.
Zahra, S.A. and Nambisan, S. (2011) 'Entrepreneurship in global innovation ecosystems', *AMS Review*, 1(1). Available at: https://doi.org/10.1007/s13162-011-0004-3.
Zen, A.C. *et al.* (2023) 'Exploring the theoretical foundations of innovation ecosystems between 2006 and 2020: an analysis at the different approaches', *International Journal of Innovation Science*, 16(3). Available at: https://doi.org/10.1108/ijis-11-2022-0223.