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Adams, Jack; Dedehayir, Ozgur; Makinen, Saku J.; Ortt, J. Roland

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Toward a Framework of Innovation Ecosystem Performance: A Case Study

Jack Adams, Ozgur Dedehayir, Saku J. Mäkinen, and J. Roland Ortt

Abstract—**The ability of innovation ecosystems to deliver desired economic output, particularly under conditions of uncertainty shaped by market shifts, competitive change, and regulatory pressure, concerns all ecosystem stakeholders. Understanding innovation ecosystem performance, therefore, emerges as an important topic for scholars, managers, and policymakers. The objective of this article is to propose a conceptual framework of ecosystem performance that builds on the inherent connection between system-level outcomes and the performance of all components that constitute the ecosystem. To this end, we apply a socio-technical lens to identify performance-deficient social or technical components known as "reverse salient" that influence the performance of the ecosystem as a whole. Our case study of a regional Australian food innovation ecosystem identifies numerous reverse salients that inhibit ecosystem performance as the system transitions from its current focus on high-quality produce to a future state characterized by increased output capacity and value-added offerings. We categorize these reverse salients as those associated with "actors" in the ecosystem, "connections" between actors, and "resources" flowing among them. While these categories align with the ecosystem-as-structure perspective, our findings additionally underscore the moderating role of ecosystem "leadership" and "rules of engagement" that can themselves act as reverse salients when misaligned. We present a conceptual model that integrates these insights and offer a set of propositions to guide future empirical research.**

Managerial Relevance Statement—**The findings of this study offer valuable insights for managers and policymakers, who play central roles in shaping ecosystem outcomes, aiming to understand and measure innovation ecosystem performance. Our proposed ecosystem performance framework assists stakeholders in systematically identifying ecosystem components (actors, actor connections, and resource flows) that are absent or underperform and, therefore, inhibit ecosystem performance. In turn, engineering managers and policymakers can deploy strategies to introduce missing ecosystem components, invest in performance-deficient components, strengthen interorganizational connections, and realign stakeholder roles to enhance ecosystem performance. Policymakers, who often assume an ecosystem-leadership role, can additionally deploy governance strategies through improved policy design and regulatory adjustments, which positively moderate the effect of actors, connections, and resource flows on innovation ecosystem performance. An interesting finding from our study is the influence of "rules of engagement" (i.e., the institutional framework within which ecosystem actors operate), which moderates how actors, connections, and resources influence ecosystem performance. Managers and policymakers can review and modify the rules of engagement (for example, through policies that promote innovation and entrepreneurial mindsets) to enhance innovation ecosystem performance.**

This article also contributes to the following SDGs: SDG 8, SDG 9, SDG 11, SDG 12, and SDG 17.

Index Terms—**Case study, food innovation ecosystem, innovation ecosystem, reverse salient, socio-technical transition.**

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Jack Adams and Ozgur Dedehayir are with the School of Management, Queensland University of Technology, Brisbane, QLD 4000, Australia (e-mail: j29.adams@qut.edu.au; ozgur.dedehayir@qut.edu.au).

Saku J. Mäkinen is with the Industrial Engineering and Management, University of Turku, FI-20500 Turku, Finland (e-mail: saku.makinen@utu.fi).

J. Roland Ortt is with the Faculty Technology, Policy and Management, Delft University of Technology, 2628 CD Delft, The Netherlands (e-mail: j.r.ortt@tudelft.nl).

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I. Introduction

INNOVATION ecosystems represent the constellation of organizations that interact and exchange resources in the creation of value. Understanding the performance of innovation ecosystems is complex yet has significant implications for policymakers and stakeholders, as it ultimately results in the quality of the value that is created [1]. Recent publications define ecosystem performance as borne from the interaction of system elements (such as interfirm interaction), although this performance is measured at the level of the firm that is innovating [2]. By contrast, we seek to understand performance at the level of the innovation ecosystem. As such, we define innovation ecosystem performance as a system-level outcome that reflects the ecosystem's capacity of creating and capturing value, sustaining innovative throughput, maintaining structural health (diversity and connectivity), and adapting to environmental changes. These dimensions encompass both economic outcomes (e.g., value-added growth, product and process innovation) and relational outcomes (e.g., actor alignment, resource reliability, and adaptive coordination). Earlier research has examined performance as emergent from component-level contributions [3], [4], although often limited to technical components. In this article, we continue this line of thinking by recognizing the systemic nature of ecosystems and evaluating (eco)system performance as reliant on the performance of a broader range of components.

Our starting premise is an understanding of the components that comprise the ecosystem. We address this by observing the innovation ecosystem as a socio-technical system [5], [6], [7], which captures both the technical and social nature of components. At the same time, the socio-technical lens allows us to introduce the notion of "reverse salience" (e.g., [8], [9]), referring to limitations in system-level performance caused by an underperforming component (i.e., a reverse salient). A reverse salient arises when the socio-technical system evolves or transitions to a new state, and a component fails to deliver the necessary performance level (trailing behind other components), thereby slowing or inhibiting system-level advancement due to component interdependence [9]. Given that innovation ecosystem performance is the system-level value that is created, the overarching line of inquiry driving this study is: what components comprise innovation ecosystems, and how do they influence ecosystem value creation when they emerge as reverse salients during ecosystem evolution? In addressing this line of inquiry, our article builds on the growing body of research examining the evolution of innovation ecosystems (e.g., [10], [11], [12]) and the measurement of ecosystem performance [13], introducing a nuanced conceptual lens on system-level constraints. Specifically, we show how reverse salients function as critical limitations within evolving ecosystems, offering both theoretical insight into structural lag and practical understanding of the nature of limitations requiring resolution for continued ecosystem development.

In our empirical work, we conducted a single case study of a food innovation ecosystem in Coffs Harbor, New South Wales, Australia. This ecosystem currently delivers value through agricultural production, coordinated across a diverse network of actors, including farmers, food manufacturers, retailers, restaurants and cafés, the airport, and the City Council. However, it is transitioning toward a new value proposition centered on value-added products and services. Our analysis focuses on identifying and interpreting the reverse salients—the lagging or underperforming components—that constrain this evolutionary shift and inhibit the realization of the ecosystem's intended value.

This article is structured to build a cumulative argument of the role of reverse salients in innovation ecosystem evolution. We first establish the theoretical foundations by critically engaging with existing literature on innovation ecosystems and the concept of reverse salients as system-level constraints. Next, we detail the qualitative method employed to examine a regional food innovation ecosystem in transition, followed by the empirical findings. In the final section, we synthesize these findings to develop a generalizable framework capturing the socio-technical dynamics of transitioning innovation ecosystems and propose a set of theoretically informed propositions to guide future research.

II. Theoretical Background

The ecosystem-as-structure perspective advanced by Adner [14], [15] conceptualizes innovation ecosystems as configurations of interdependent actors aligned around a focal, customer-facing value proposition. It further suggests that realizing this value depends on coordinated, complementary activity across the ecosystem, requiring coherence in roles, relationships, and resource flows. However, external pressures, such as changes in the competitive landscape, regulations, and market demand (e.g., [16], [17], [18]), as well as internal drivers, such as innovation and entrepreneurial activity (e.g., [19]), can destabilize existing configurations, often necessitating the formulation of a new value proposition [20]. Following Adner's framework, this requires structural reconfiguration, including the realignment of actors, redefinition of roles, and a revision of the ecosystem's value blueprint [21]. This process foregrounds the ecosystem's evolutionary character and opens a space for understanding where and why structural misalignments emerge.

Following Adner's [14] ecosystem-as-structure perspective, we adopt a teleological stance on innovation ecosystem evolution [22], viewing the ecosystem as a purposive system oriented toward achieving a customer-facing value proposition as its emergent end-state. In this framing, ecosystem development is not merely reactive but directed, driven by collective action toward a shared value goal. This trajectory is governed by a cyclical process, whereby the ecosystem formulates a value proposition (goal), mobilizes interdependent actors and resources to realize it (implementation), assesses system-wide alignment and performance (evaluation), and where necessary, modifies its goals and structure in response to feedback and contextual change (goal revision) [22, p.516]. This iterative cycle underscores the intentionality and adaptive capacity of innovation ecosystems as they evolve amid uncertainty and constraint.

Following Adner's conceptualization, we propose that the structure of innovation ecosystems comprise three vital, interdependent components: the actors that populate the ecosystem, the resources mobilized and transformed within it, and the connections of actors and flow of resources between them [20], [23]. At their core, innovation ecosystems comprise diverse actors, namely, organizations, teams, and individuals, whose coordinated activities collectively contribute toward value creation. These actors acquire, bundle, and process various resources, such as materials, capital, technology, knowledge, and human expertise. The value created from these activities manifests as products and services, which can, in turn, function as inputs for other actors, generating recursive cycles of resource transformation and value creation. This recursive dynamic underscores that a healthy innovation ecosystem relies on fluid resource exchange among actors. Thus, the capacity of evolving and generating novel value is mediated through both formal and informal connections, including contractual arrangements and emergent connections shaped by "nongeneric complementaries" [24].

Together, these components define the innovation ecosystem structure and ultimately establish the value that can be created by the ecosystem (i.e., ecosystem performance). From this view, new value propositions can materialize when one or more of these components are modified, resulting in new structural configurations. This may involve the introduction of new actors and resources, or the generation of new connections and resource flows among actors, thereby altering the system's architecture and enabling new modes of value creation (e.g.,

[25]). However, such transitions may expose or intensify reverse salients—components that fail to evolve in step with the system—thus constraining the realization of intended value.

To frame the evolution of the innovation ecosystem, we first adopt a socio-technical system view (e.g., [5], [6], [26]), which emphasizes the interplay between social and technical elements in shaping systemic structure and change. Within this perspective, we, second, introduce the concept of "reverse salient," a term rooted in military theory and later adapted within the sociotechnical system literature. Originally denoting the lagging section of an advancing military front [9], [27], [28], in the context of socio-technical systems, including innovation ecosystems, reverse salients describe the components within socio-technical systems that fall out of step with broader system advancement. Because system components are interdependent, even localized lags can inhibit system-level evolution and value delivery. Reverse salients consequently act as focusing devices [29], directing the attention and investments of ecosystem stakeholders to alleviate the problems and allow the ecosystem to continue along its evolutionary path.

The innovation ecosystem literature has previously addressed value creation and delivery-limiting components through the notion of "bottleneck" (e.g., [21], [30]). For instance, through a stylized schema of innovation ecosystems, Adner and Kapoor [31] have proposed that upstream bottlenecks "limit value creation by constraining the focal firm's ability to produce its product," while downstream bottlenecks "limit value creation by constraining the customer's ability to derive full benefit from consuming the focal firm's product" [31, p. 310]. These insights have proven valuable in diagnosing technical and transactional dependencies within ecosystems, particularly from the standpoint of the firm.

However, while the ecosystem-wide effects of such technical limitations are valuable, our purpose is to expand this conceptualization through the use of the reverse salient concept to capture social components in addition to technical ones as potential sources of systemic constraint [6]. While bottlenecks represent static capacity constraints, reverse salients capture dynamic, system-level misalignments that are temporal (emerging as some components progress faster than others) and relational (defined by interdependence rather than isolation) [9], [27], [28]. A classic example originates in the electrification of cities in the early twentieth century, where the rapid expansion of power generation outpaced the capacity of distribution infrastructure and end-use devices [9]. The lagging distribution network became a reverse salient, constraining system-wide advance until complementary technological and organizational adjustments restored alignment. This illustration underscores that reverse salients emerge not from isolated weakness but from uneven progress among interdependent components within a socio-technical system [6].

Importantly, reverse salients foreground the interdependent structure of innovation ecosystems, identifying the components that fall out of alignment with the system's advancing front, thereby impeding coordinated evolution [14]. This distinction allows social, organizational, and institutional dimensions to be treated as potential sources of systemic constraint, not merely technical ones [27]. By linking constraints to relative rather than absolute component performance, the reverse salient provides a more suitable lens for analyzing innovation ecosystem evolution and evaluating system-level performance, resting on the twin logics of interdependence and directionality—both foundational to the ecosystem construct and central to our empirical inquiry.

In innovation ecosystems, performance and evolution are interdependent phenomena. Evolution describes the process through which an ecosystem reconfigures social and technical components in response to changing conditions, while performance reflects the outcome of that evolutionary capacity [3]. An ecosystem performs well not simply when it produces outputs, but when it continually aligns its interdependent components to sustain value creation over time [12]. Evolution thus operates as both a mechanism and a manifestation of performance. When reverse salients are identified and resolved, the system advances along its evolutionary trajectory, and that advancement is itself a measure of system-level performance [4], [28].

III. Methodology

A. Empirical Context

Coffs Harbor, situated on the eastern coastline of Australia in northern New South Wales, is a region renowned for its Agrifood sector. Blueberries dominate local agriculture, accounting for approximately 80% of the region's output and contributing 55% of Australia's total blueberry production. The region's subtropical climate, fertile soils, and a mixture of cool and warm sea temperatures make it exceptionally well-suited to diverse and high-quality food production. These natural endowments, combined with its lifestyle appeal, have long underpinned its identity as a food-producing and food-living region.

Nevertheless, Coffs Harbor is facing growing competition from other Australian Agrifood regions and international markets. The region holds latent potential to transition from a largely commodity-based production model to one anchored in value-added food innovations. Realizing this potential entails reconfiguring the region's food innovation ecosystem to support a new, customer-facing value proposition centered not only on product quality but also on design, processing, distribution, and food-related experiences. This transition requires the coordinated evolution of the ecosystem's actors, connections, and resource flows in response to shifting competitive dynamics and emerging opportunities.

B. Research Design

We implemented an inductive research agenda given that the phenomenon and its conceptual understanding are underdeveloped [32], [33]. Given the complexity and novelty of the empirical case, we employed a qualitative, case study research design (e.g., [34]) well-suited to understanding the dynamics and interdependencies of innovation ecosystems. Grounded in the definition of innovation ecosystems as a constellation of diverse and interdependent actors, this study was purposefully designed to acquire data from an equally diverse set of participants focused on the transition of the Coffs Harbor food ecosystem from its present state to a new state. Aggregating insights from multiple perspectives enabled the construction of a holistic account while reducing bias from any single viewpoint.

The study follows an interpretivist epistemology, recognizing that understanding the ecosystem's evolution requires close attention to the meanings, interrelations, and framings provided by diverse stakeholders. To capture the structural and relational complexity of the Coffs Harbor food innovation ecosystem, we employed purposive sampling guided by theoretical constructs. Specifically, participants were selected to reflect a range of ecosystem positionalities—core, peripheral, bridging, and latent actors [5], [14]—thereby maximizing conceptual variation and facilitating thematic saturation. The sampling logic was informed by the ecosystem-as-structure perspective, which emphasizes the importance of actor diversity and interdependence in shaping systemic outcomes rather than quantifying within-role variation. Accordingly, one informed representative was selected for each structural position, capturing diversity across actor roles rather than redundancy within them [14].

Our qualitative design comprised 11 interviews with key actors directly involved in the regional food innovation ecosystem. Participants included farmers (2), a fisher, a restaurateur, the local council, a market and event organizer, a food manufacturer, a food hub, the airport, the Chamber of Commerce, and an educational institution. We employed a semistructured interview protocol designed to capture both organizational-level and ecosystem-level perspectives. The first two sections were designed to understand how individual organizations contribute to and interact with the broader ecosystem, addressing current and expected capacities, innovations, and perceived barriers and opportunities. The third section focused on the broader ecosystem, including its unique qualities, key actors, resources, and leadership, and prompted participants to envision the ecosystem's future state and identify critical actors, connections, and resources required for that transition. The protocol was piloted before data collection in collaboration with the City Council to ensure clarity, relevance, and reliability.

Close to 18 h of data were audio-recorded and transcribed for analysis. The researchers began by loading all transcription data and field notes into NVivo for systematic analysis. An initial round of open coding was performed, whereby each line of text was reviewed and assigned descriptive and interpretive codes. This resulted in 112 initial codes (e.g., funding, collaboration), which evolved through iterative coding, reflection, and analytical synthesis. The analytic process followed the established logic of inductive case research [34], incorporating open and axial coding to identify cross-actor patterns and theoretical categories. By allowing themes to emerge inductively, rather than through predefined categories, the analysis remained grounded in participants' lived experiences and language. To enhance rigor, coding was conducted independently by multiple researchers to mitigate individual bias. Differences in interpretation were systematically reviewed, discussed, and reconciled through team-based deliberation, ensuring alignment and coherence in the final coding structure. NVivo served as both a coding platform and an audit trail, supporting dependability and confirmability through transparent documentation of coding decisions and thematic refinement.

Triangulation of perspectives gathered from actors occupying diverse structural positions within the ecosystem further reinforces the study's credibility, and the deep contextual description of the Coffs Harbor food ecosystem supports the transferability of findings to similar regional innovation contexts. This inductive process culminated in the development of the Coffs Harbor food ecosystem value blueprint (see Fig. 1) [21], detailing core actors, their connections, and the resources exchanged. Based on this structural representation, we then identified and analyzed the reverse salients reported across actor groups, assessing their systemic implications for ecosystem evolution and value realization.

IV. Reverse Salients Hindering the Transition of the Coffs Harbor Food Ecosystem

We begin this section by presenting the value blueprint of the existing Coffs Harbor food innovation ecosystem (see Fig. 1). We then examine each actor group, outlining their core activities, notable connections and resource exchanges, and the observed reverse salients that limit ecosystem performance.

The Coffs Harbor food ecosystem map shown in Fig. 1 identifies a large number of actors populating the ecosystem. Value creation emerges from the interaction of these actors, their connections, and resource flows represented in the map. For ease of analysis, we position some of these actors on the direct path of value creation (i.e., a traditional supply chain)—farmers and fishermen, manufacturers, logistic companies, the airport, wholesalers, retailers, restaurants and cafés, market and event organizers, and consumers. Other actors exist off this direct line of value creation, including co-operatives (co-ops), educational institutions, utility companies, local council, Chamber of Commerce, and Government.

Our analysis proceeds by tracing the sequence of actors positioned along the value creation pathway, identifying the reverse salients that constrain ecosystem performance. The discussion is structured actor by actor to reflect the empirical structure of the ecosystem, and each vignette reveals one or more performance-limiting components that can be understood in terms of actors (organizations whose internal capabilities or orientations lag behind system needs), connections (interactions or linkages that fail to transmit resources effectively), or resources (inputs whose quantity or quality limits productive or innovative activity). Examining these in situ demonstrates how localized performance deficits accumulate into system-level constraints. This analysis sets the foundation for the synthesis of these three categories towards a framework of innovation ecosystem performance.

A. Analysis of Actors Lying on the Direct Path of Value Creation

At the start of the supply chain are primary producers, including farmers, hobby farmers, and fishers, who cultivate and provide produce for the local area. These products are then sold through retailers, restaurants, wholesalers, or directly to customers. Their diverse connections and resource exchanges

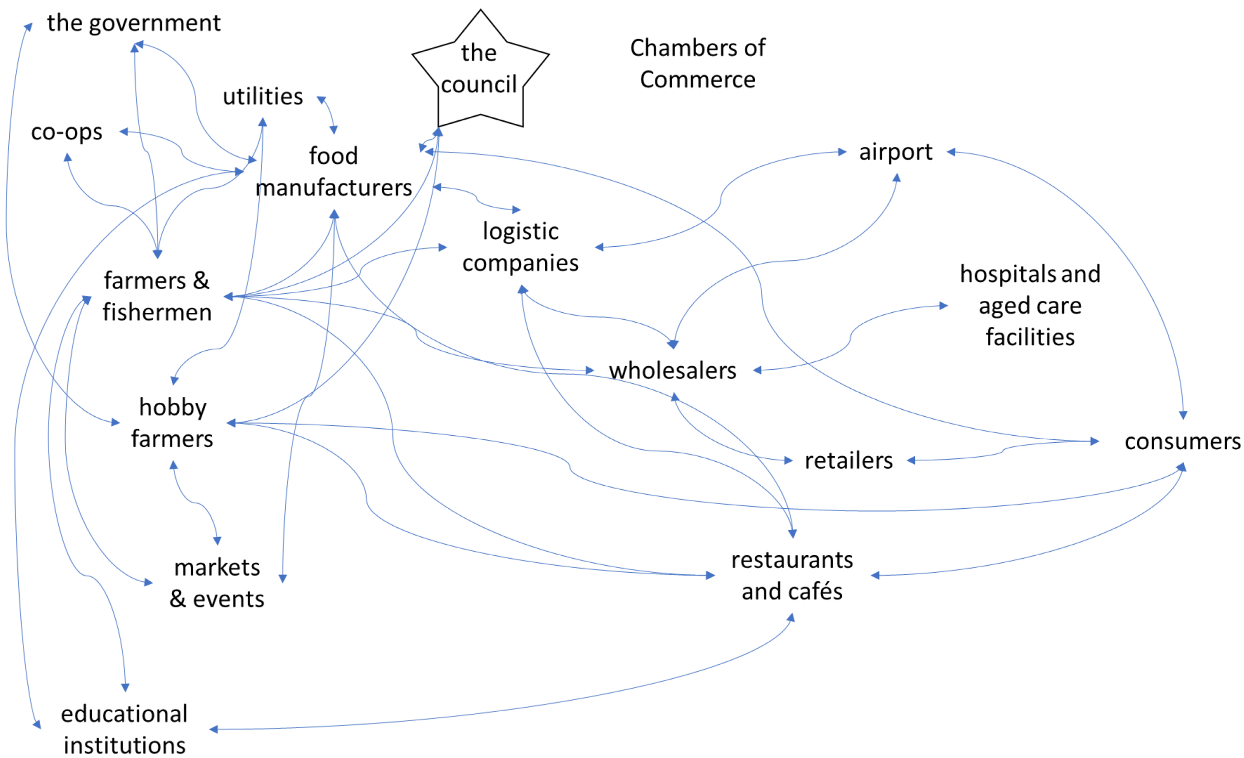

Fig. 1. Coffs Harbor food ecosystem value blueprint.

demonstrate that primary producers are highly central and indispensable actors within the current and future states of the Coffs Harbor food ecosystem. Constraints in capacity or connectivity, therefore, cascade across the entire value chain.

Hobby (small-scale) farmers share many traits with larger farmers but differ in their large numbers, propensity for ground-up innovation, and high-quality produce, positioning them as a potential driver of future ecosystem evolution. We observed that the limited resources available to hobby farmers motivate them to engage in bricolage (e.g., [35]), designing technologies that align with the scale of their needs more effectively than large-scale options.

We identified several reverse salients associated with these actors. The first stems from the small production capacity of hobby farmers, which limits their ability to utilize and adopt processing technology typically designed for larger scale production. Second, while some farmers and fishers innovate through new products and processes, others resist technological opportunities, which limits their output and innovation capability. This innovation resistance (e.g., [36]) often reflects practical barriers, including power costs and limited telecommunications. Several respondents additionally felt that the older demography of the region provided fewer innovative and entrepreneurial thinkers. Collectively, these factors represent capacity-based reverse salients, where technological and demographic limitations constrain the region's overall innovation potential.

A further factor inhibiting ecosystem evolution results from the limited interest some farmers have in growing their business. This is especially notable for hobby farmers, whose activities can be characterized as "lifestyle farming." Moreover, because of their relatively small output quantities, hobby farmers are often content with selling their produce at farmers' markets. This limits the formation of stable supply relationships with downstream actors.

Difficulty acquiring human resources was cited as a further reverse salient for many primary producers, including the recruitment of skilled workers (e.g., farmers, butchers) and unskilled workers (e.g., farm-based labor for picking and packing). Labor scarcity constrains both current output and the uptake of innovations that would support growth.

A lack of communication between key stakeholders has additionally isolated many primary producers, limiting their avenues for information gathering and product distribution. Importantly, producers emphasized that clearer signals about demand and pricing are essential for trialing new crops and reducing uncertainty around commercial viability.

Some respondents suggested that a digital communication platform could enhance information exchange on regional demand. However, unreliable telecommunication services, particularly on more remote properties, limit the feasibility of such solutions.

Lying further downstream in the value chain, food manufacturers in the region are primarily responsible for converting agricultural output into higher value products and experiences, linking production to consumption and anchoring the ecosystem's potential for diversification. Their centrality is reflected in the diversity of connections and resource exchanges shown in Fig. 1.

Food manufacturers claim responsibility for a number of innovations. These include direct-to-consumer delivery models, collaboration with online retail platforms, waste-reducing process innovations, and service innovations such as food education workshops. Collectively, these reflect early-stage experimentation rather than large-scale transformation.

Our study revealed several reverse salients that affect the growth and operation of food manufacturers in the region. First, the small number and variety of manufacturers diminish the region's capacity for value-added production. For example, opportunities for processing high-volume commodities, such as blueberries, remain unrealized due to the absence of midtier processors. This structural absence represents a capacity gap within the value chain.

A second reverse salient is the lack of established infrastructure in the region (e.g., freezers, physical manufacturing space, and manufacturing technology), which restricts output capacity and limits access to markets beyond the region. These deficits reduce scalability and constrain export readiness. A further reverse salient lies in the uneven entrepreneurial mindset among manufacturers. While some actively pursue new markets and technologies, others remain risk-averse and inward-looking, reducing the collaborative dynamism of the sector.

Poor connection to the City Council renders some manufacturers unable to access knowledge of developing market trends and new technologies. This limits their responsiveness to market change and future capacity planning. Connection to suppliers (i.e., farmers and fishers) is also limited and largely informal. This weak vertical coordination emerges as a second-order reverse salient, reflecting communication and information bottlenecks rather than technical scarcity. Manufacturing capacity is further limited by a lack of access to skilled workers in the region, with many local graduates choosing to leave Coffs Harbor to work in larger cities. The resulting skill shortage forces manufacturers to rely on informal training arrangements, increasing costs and reducing the pace of capability development.

One key actor situated between manufacturers and the final consumer is logistics companies, which are responsible for freighting produce and value-added products to final destinations, distribution centers or transport hubs. Our conversations revealed two reverse salients associated with logistics companies, namely, inadequate train services and a lack of significant freight operators in the region. These transport gaps generate high transaction costs and reduce supply chain reliability, limiting both market reach and export potential.

Another important intermediary in the region's food ecosystem is the airport in Coffs Harbor, which handles passenger transit and air freight. Existing and planned infrastructure give the airport latent potential to function as a multimodal logistics hub, which respondents viewed as a critical enabler for linking regional production to national and export markets.

Lying at the point of direct sale to the consumer, restaurants and cafés are central actors in the food ecosystem. Their primary responsibilities include serving culinary creations to consumers and hosting events. Many restaurants and cafés in the region highlight local products, translating regional produce into consumer-facing experiences and forming a critical interface between production and market demand.

Innovation takes several forms, including new services (e.g., home delivery), products (e.g., takeaway alternatives), and menu dishes. Respondents described emerging innovations such as zero-wastage practices and cross-sector collaborations with local educational institutions, signaling early but uneven progress toward sustainability and skills development.

Notwithstanding, creativity and passion were described as limited in the region's hospitality workforce. This skill gap constitutes a clear reverse salient, as existing education-industry connections do not produce graduates equipped for creative and innovation-oriented roles. Respondents also noted a limited commitment to sourcing and promoting local food, indicating a wider capability gap. Besides skill deficiency, the volume of available human resources is also insufficient across the industry, with many local graduates moving to larger cities. Labor mobility reduces both the quality and quantity of the local workforce, constraining the sector's ability to sustain innovation-led growth.

A lack of connectivity across the supply chain (e.g., to farmers, manufacturers, and logistics companies) was identified as a further reverse salient, hindering the growth of local produce and value-added products. Restaurants' weak vertical linkages with producers mirror upstream disconnections, reinforcing systemic inefficiencies in sourcing and product diffusion. Material infrastructure, such as cold rooms and shared preparation spaces, was likewise insufficient, constraining the region's hospitality and food innovation capacity.

Further points of contact with consumers include markets and food festivals, which provide community access to local food and give producers opportunities to test new products. These events create important feedback loops between producers and consumers. However, regulatory complexity, particularly licensing, emerged as a reverse salient that limits the frequency and diversity of local food events that could otherwise amplify innovation visibility.

At the concluding end of the value chain are consumers, whose primary activity is purchasing produce and value-added products. It was identified that consumers often have little knowledge of the origins of products they consume, as well as a broader lack of knowledge about what is grown, raised, caught or produced locally in the region. This limited awareness constrains demand for local products and weakens incentives for upstream innovation. Respondents consistently emphasized the need for regional branding and consumer education campaigns to stimulate local purchasing behavior and strengthen ecosystem identity. Compounding this is a lack of labelling transparency in processed foods, which obscures provenance and undermines consumers' ability to make informed local choices.

A second reverse salient is the insufficient number of foodies in the region. Foodies are an important consumer group in any food ecosystem, motivated by novelty and creativity. Comparable to early adopters in technology diffusion, foodie consumers act as cultural catalysts for innovation uptake. Their relative scarcity reduces feedback and market pull for experimental food ventures, weakening the system's adaptive momentum.

B. Analysis of Actors Lying Off the Direct Path of Value Creation

Conversations with participants indicate that the City Council undertakes many leadership activities in the food ecosystem (marked as a star in Fig. 1). It has been active in setting a vision for the current and future innovation ecosystem and facilitating its evolution through the creation of new connections and collaborations, opportunities for new value creation, and the exchange of resources within the ecosystem. In this role, the Council acts as a de facto ecosystem orchestrator, shaping coordination, knowledge diffusion, and collective direction.

The City Council assists growth in production and delivery capacities, provides a future-focused vision, and supports business needs wherever possible. Its activities include convening local events and knowledge exchange forums, delivering business support programs, and connecting actors across the ecosystem. Notwithstanding this impactful work, our conversations with a diverse set of ecosystem actors suggest that more resources would be needed if the Council is to guide ecosystem evolution and transition. Limited staffing constrains its ability to capture and disseminate market intelligence or maintain strategic foresight across the ecosystem. Thus, its leadership capacity emerges as a systemic reverse salient, as orchestration responsibilities exceed available human and financial resources.

Finally, the Council's connection to the food ecosystem, particularly with growers, fishers, hobby farmers, and manufacturers, is insufficient, with an estimated 50% of food actors remaining unknown. This limited connectivity provides an incomplete understanding of the region's production capacity, supply and demand, and barriers to growth and innovation. The resulting disconnect weakens feedback loops, leaving significant knowledge asymmetries unaddressed and reducing the reach of strategic interventions.

By comparison, the activities of the state and national government include the creation and enforcement of regulations and laws, which cascade to regional offices, including the local council. These higher level institutions shape the formal "rules of engagement" that define the operating boundaries of the regional food ecosystem. Three reverse salients derive from the activities of this actor, as perceived by the participants.

First, fishing quotas limit the quantity and variety of products that fishermen can deliver. These restrictions reduce competitiveness for some fishers while prompting others to experiment with less popular species, producing uneven adaptive responses. Second, export protocols limit the export potential of the region, as raw produce (e.g., blueberries) cannot be shipped abroad. This has encouraged some actors to pursue value-added forms, such as processed or nutraceutical products. Third, foreign labor laws limit the availability of backpacker workers, a vital resource for many local growers. The resulting labor shortage represents a direct resource-level reverse salient that inhibits production capacity and flexibility, especially for smaller producers. Taken together, these three policy-related constraints exemplify how macrolevel rules of engagement generate structural friction within the ecosystem, constraining inputs, output markets, and human resources simultaneously.

The primary activity of the Chamber of Commerce is determining the current and future economic activity of the region. In the ecosystem context, the Chamber functions as a coordinating intermediary, linking local firms, government, and industry networks. Its events convene business owners, officials, and industry representatives. Our study revealed three reverse salients associated with this actor. The first is the limited representation of a diverse community, which narrows the scope of decision-making and may result in missed growth opportunities, especially in underrepresented areas. Second, there is a lack of follow-up on recommended actions arising from meetings and events. This implementation gap means that identified opportunities rarely translate into tangible outcomes.

Finally, the Chamber's processes can be political in nature, limiting stakeholder representation and undermining its role as a neutral, trustworthy convener. While the activities of the Chamber of Commerce are intended to support the development of the Coffs Harbor food ecosystem, these reverse salients collectively inhibit the realization of this intent.

Utility providers, including energy, water, and telecommunications, deliver the infrastructure through which value can be created by other actors in the ecosystem. They thus constitute foundational enablers of ecosystem performance, shaping the operating costs, connectivity, and sustainability of production. Three reverse salients were identified.

First, utility services are expensive, especially for innovative farming techniques, which often require substantial power. Second, where solar power is installed, the buyback rates are considered too low to make it a feasible option for some farmers and manufacturers. High utility costs and unfavorable renewable-energy economics reduce margins and weaken incentives for sustainable innovation. Third, the unavailability or unreliability of telecommunication services in regional areas was identified as a reverse salient. The resulting disconnection isolates producers and manufacturers from online sales and coordination platforms that are increasingly central to competitive participation. Together, these constraints form a systemic resource-level reverse salient, limiting cost efficiency and technological modernization across the ecosystem.

Several large and small co-ops operate in the region. Their activities support businesses in the ecosystem, including assisting farmers, mediating supply, and processing activities (e.g., sorting and packing). They also provide auxiliary benefits, including discounted fuel, with larger co-ops also investing heavily in regional innovation. In principle, co-ops can stabilize markets and share risk; however, they also generate structural constraints.

While co-op activities provide many benefits, their control over supply restricts the quantity and variety of produce available locally, with much of it being shipped to metropolitan hubs. This centralization limits local value capture and weakens regional identity. Dependence on co-op contracts also encourages risk-averse behavior, with many producers prioritizing stability over experimentation or new product trials. Respondents also drew attention to the "ego of leaders," internal politics, and hidden agendas, especially in smaller co-ops, which limit progress, dissuade collaboration, and reduce trust among ecosystem members. Collectively, these factors curb the rate of product innovation and limit the region's output capacity.

Educational institutions, such as Technical and Further Education, provide training and education programs for skilled labor. These human resources are primarily absorbed by restaurants and cafés, manufacturers, farmers, and fishers. As workforce incubators, educational institutions directly influence the ecosystem's human-capital capacity and long-term adaptive potential.

Two reverse salients emerged from our analysis. First, the training and education programs often fall short of the expectations and demands of local industry. This misalignment inhibits employers' access to required skillsets and, by extension, their ability to adopt new technologies or pursue value-added innovation. Compounding this issue is the lack of connection between educational programs and industry, including agriculture. This disconnection limits students' exposure to industry through mechanisms, such as networking events, reducing alignment between training and employer expectations. The second reverse salient is the insufficient number of skilled workers being produced. This shortfall compounds the skills gap, collectively constraining the region's innovation and growth capacity.

V. Synthesis and Discussion

Our study of the Coffs Harbor food innovation ecosystem identified a large number of reverse salients that curb ecosystem performance as it transitions toward the delivery of a new customer-facing value proposition. Most of these reverse salients align with the ecosystem-as-structure view and can be grouped into three categories: 1) actors; 2) connections; and 3) resources. We categorically list these reverse salients in Table I.

As Table I lists, numerous actors, connections, and resources arise as reverse salients in the evolution of the food ecosystem. The table summarizes the characteristics that cause particular actors, connections, or resources to become reverse salients and the consequences of these constraints for ecosystem performance. Addressing these reverse salients is, therefore, essential for improving ecosystem performance.

We also identified several reverse salients that do not operate at the actor, connection, or resource level and, therefore, fall outside the above groupings. We classify these under two additional categories that operate as moderating institutional conditions, namely, leadership and rules of engagement, as elaborated in Table II.

Leadership is a central ecosystem role explicated in earlier literature (e.g., [37], [38], and [39]) and defines the vision and direction of ecosystem development (e.g., [40] and [41]. The ecosystem leader is generally depicted as an actor possessing prominence and power through a central position in the ecosystem structure, and undertaking activities such as attracting and gathering actors, designing actor roles, coordinating interactions and collaborations, orchestrating resource flows, stimulating investments, and building a platform (i.e., for platform-centric ecosystems) [42]. Moreover, leaders establish the evolutionary trajectory of the innovation ecosystem and align the diverse interests of ecosystem actors so the system can progress collectively. Given that leadership is not bound to a single actor and can be enacted by different actors [8], we observe reverse salients associated with leadership at the ecosystem level rather than being attributable to any one actor. Our study showed, for instance, that insufficient commerce orientation can become a reverse salient, limiting the motivation of ecosystem members to increase production output and innovation capability.

We also observed that the leader's relationship to the ecosystem can become a reverse salient when it is too integrated into the ecosystem and not sufficiently independent. This reduces the capacity of recognizing external trends and opportunities, constraining the vision guiding ecosystem growth. Meanwhile, inadequate member inclusion can jeopardize ecosystem development by narrowing decision scope. Furthermore, insufficient resources, including human and financial, inhibit leadership activities, including intelligence gathering for vision setting and the dissemination of knowledge to support strategic decision making. Finally, divided internal politics within the leader's organization can undermine trust among ecosystem members (e.g., [43], [44]) (potentially resulting in disconnections in inefficient operation), while excessive "ego" can redirect attention away from the activities of ecosystem participants.

The reverse salients we have grouped under rules of engagement are institutionalized rules, norms, and routines (e.g., [45], [46]) that define how ecosystem components (i.e., actors, connections, and resources) ought to behave, while sometimes constraining ecosystem development. At times, these rules are imposed by particular actors, such as City Council regulations governing event organization, co-op's control of supply and delivery, and government-mandated fishing quotas, export protocols, and foreign labor laws. Other rules emerge at the ecosystem-level, beyond the actions of specific actors, including prevailing mindsets toward business growth, innovation, and entrepreneurship [47]. Such institutionalized norms ultimately define the boundaries within which actors, connections, and resources can operate, and which can consequently have a debilitating effect on ecosystem performance.

Collectively, actors, connections, resources, leadership, and rules of engagement form five categorical components of the innovation ecosystem, whose performance determines the performance of the ecosystem at large. When these five components operate at desired performance levels, the innovation ecosystem can deliver its intended performance. However, when any of these components arise as reverse salients, system performance is hindered. To arrive at more generalizable conclusions, we synthesize the findings of our empirical work through a framework describing the relationship between component performance and overall ecosystem performance (see Fig. 2).

We first propose that innovation ecosystem performance depends on actors, the connections of actors, and the resources flowing between actors along these connections. Performance of the entire ecosystem is hampered when any of these components emerge as reverse salients, requiring their alleviation for the ecosystem to deliver its intended value. Our empirical work suggests that these components become reverse salients when they are unavailable to the ecosystem (or insufficient in

TABLE I
REVERSE SALIENTS CURBING COFFS HARBOR FOOD INNOVATION ECOSYSTEM PERFORMANCE

Reverse salient	Description	Ecosystem performance consequences
Actors		
farmers and fishermen	small production capacity (liability of smallness)	• limits adoption of processing technology (often made for large production)
	resist technological opportunities	• limits production output • limits innovation capability
	older demography	• limits appetite for innovation • limits entrepreneurial mindset
	limited interest in business growth	• limits production output • limits appetite for innovation
	revenue model geared for small-scale sales	• limits growth prospects • limits appetite for innovation
manufacturers	insufficient	• limits value-added production
	limited manufacturing capacity and equipment	• limits production output
	limited thinking beyond current specialization	• limits growth prospects • limits appetite for innovation
logistic companies	lack significant freight operator	• limits supply chain efficiency
	inadequate train services	• limits supply chain efficiency
airport	slow management processes	• limits production output
restaurants and cafés	limited manufacturing capacity and equipment	• limits production output
	limited creativity and passion	• limits innovation capability
consumers	limited education and awareness of local food	• limits demand for local produce
	insufficient number of foodies	• limits demand for innovative offerings • demotivates entrepreneurship
educational institutions	misalignment of training program with industry need	• limits delivery of needed skills for business growth
	insufficient graduates from training program	• limits innovation and production capacity of local supply chain
utilities	unreliable service	• limits connectivity within ecosystem
	expensive service	• reduces margin of local supply chain
	do not accept return of power to the grid	• reduces margin of local supply chain • reduces sustainable production
Connections		
to City Council (ecosystem leader)	inadequate	• limits knowledge exchange of trends in market and latest technologies • limits awareness and facilitation of technology adoption
between ecosystem actors	inadequate	• limits supply chain efficiency • limits knowledge exchange of supply chain
beyond the region	inadequate and costly	• limits export sales
transportation of materials	high cost	• reduces margin and competitiveness
Resources		
skilled and unskilled workers	insufficient	• limits production output • limits innovation capability • limits product and service quality
raw materials	insufficient and inconsistent	• limits production output

TABLE II
LEADERSHIP AND RULES OF ENGAGEMENT REVERSE SALIENTS

Reverse salient	Description	Ecosystem performance consequences
Leadership		
commerce orientation	insufficient	• limits motivation to increase production output and innovation capability
relationship to ecosystem	not independent from	• limits vision for ecosystem development (i.e., opportunities for growth)
inclusion of ecosystem members	inadequate	• limits decision scope and results in missed growth opportunities
resources (e.g., human and financial)	insufficient	• limits knowledge of trends to inform the ecosystem and set accurate vision
internal politics	divided	• reduces trust of ecosystem members
ego	excessive	• limits growth of local businesses
Rules of Engagement		
rules on event organization	too strict	• limits event capacity • limits appetite for innovation
control of supply and delivery	too tight	• limits quantity and variety of locally available resources
fishing quotas	too limited in number	• limit the quantity and variety of product fishermen can deliver
export protocols	too strict	• limit export potential of raw produce
foreign labour laws	too strict	• limit availability of workers for farms
business growth mindset	low	• limits production output • limits innovation capability
innovation and entrepreneurship mindset	low	• limits production output • limits innovation capability

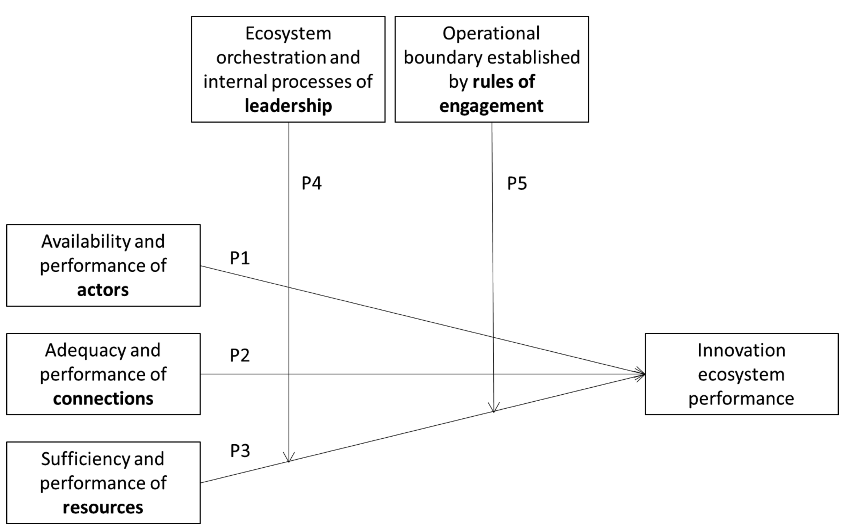

Fig. 2. Conceptual model of innovation ecosystem performance.

quantity) or underperform even when available (i.e., are unable to deliver what the ecosystem requires). We subsequently make the following propositions.

Proposition 1 (P1): Innovation ecosystem performance is hampered when necessary actors are unavailable to the ecosystem, or when they underperform due to limited capability (e.g., production, innovation), internal resources (e.g., human, financial), and mindset (e.g., entrepreneurial, innovation).

Proposition 2 (P2): Innovation ecosystem performance is hampered when necessary connections between actors are inadequate, or when they underperform in enabling the flow of resources (e.g., when too costly).

Proposition 3 (P3): Innovation ecosystem performance is hampered when necessary resources are insufficient, or when they underperform due to inconsistent flow between actors.

As our study suggests, however, the socio-technical transition of the innovation ecosystem resulting from actors, connections, and resources is reliant on the leadership and the rules of engagement under which the ecosystem operates. We capture these as moderating variables in our framework. Our empirical work suggests that leadership becomes a reverse salient when it is unable to undertake ecosystem orchestrating activities or is hampered by internal processes, while rules of engagement arise as reverse salients when they restrict the scope of value creation activities. We therefore make the following propositions.

Proposition 4 (P4): Innovation ecosystem performance is hampered by leadership that experiences problems in ecosystem orchestration or internal processes, inhibiting the activities of actors, connections, and resources required for transition.

Proposition 5 (P5): Innovation ecosystem performance is hampered by rules of engagement that restrict the scope of activities of actors, connections, and resources required for transition.

A. Theoretical Contributions

This study advances the conceptual understanding of innovation ecosystems in two important ways. First, it expands the existing theoretical discourse focusing on the structural composition of innovation ecosystems and their evolution by introducing the notion of reverse salients, a construct that refers to performance-limiting components in the evolution of technologies and technological systems, such as 3-D printing [48], lithium-ion battery [49], and numerical weather prediction [50]. By drawing on boundary-spanning theories, such as Hughes' technological momentum, we position reverse salients as addressing both technical misalignments and social coordination failures, reinforcing their relevance in ecosystem evolution studies [e.g., 51]. Through applying this lens, our findings help explain why attempts to establish new customer-facing value encounter obstacles. In doing so, we extend prior research that treats ecosystem constraints as technical bottlenecks by showing that misalignments also arise from social, organizational, and institutional lag. This shift matters because it reveals that ecosystem evolution stalls not simply from inadequate capabilities but from uneven progress across interdependent components.

A second key contribution is the influence of leadership and rules of engagement in the evolution and performance of innovation ecosystems. While previous research acknowledges the importance of ecosystem orchestrators and institutional logics, the manner in which leadership and institutionalized norms shape, constrain, and enable the activities of actors, connections, and resources has remained underexplored [12], [52]. Our article contributes to recent conversations on this important topic, including [53] exploration of how complementors can assume leadership roles, traditionally occupied by focal firms in innovation ecosystems, and subsequently determine the future trajectory of the ecosystem. By recognizing that leadership and rules of engagement are moderating variables that can themselves become reverse salients when they are too restrictive, our findings highlight the connection of microlevel actor practices and resource deployments to macrolevel ecosystem performance. This interesting insight provides reasoning as to why some ecosystems remain resilient and adaptive (e.g., [54]) despite internal frictions, while others fail to achieve desired innovation trajectories.

Although the literature on ecosystem leadership often focuses on orchestrating strategies and positional advantages [55], our framework demonstrates that ecosystem leaders and rules of engagement can either ameliorate or exacerbate system-level friction and performance. These findings align with [56] identification of regulatory compliance, stringent quality standards, and lack of design expertise as major barriers to the development of a 3-D printing ecosystem. Synthesizing these insights, our proposed conceptual model differs from prior studies by integrating structural components (actors, connections, and resources) with institutional moderators (leadership, rules of engagement), revealing how institutional conditions actively shape component performance rather than merely contextualizing it. This constitutes a conceptual shift from static structural mapping to a dynamic theory of ecosystem frictions and alignment. This distinction also complements recent evidence in [57] study of solar-energy ecosystems.

This advance in theory also resonates with debates on how socio-technical systems respond to external pressures, shocks, and opportunities for reconfiguration [58]. By demonstrating how leadership and rules of engagement influence the performance and availability of actors, connections, and resources, our findings show that innovation ecosystems are sites of strategic intervention [51] and institutional shaping. This provides scholars with a clearer account of where and how strategic interventions can be applied, showing that alleviating reverse salients requires not only technical or organizational improvements but often institutional adjustment.

B. Practical Contributions

Our findings also have significant implications for managers and policymakers who are tasked with measuring and enhancing innovation ecosystem performance. Going beyond gaps in actor capabilities, insufficient resource flows, or problematic connections, our findings outline system-level conditions that can guide targeted interventions for managers and policymakers. By understanding the structural sources of reverse salients, managers and policymakers can more effectively design strategies that align local capabilities, regulatory frameworks, and investment decisions to alleviate reverse salients and improve ecosystem performance. Resonating with [51] proposition of a strategy portfolio available to ecosystem actors, our findings show that strategic intervention must target not only technical capacity gaps, but the structural and institutional conditions that cause components to lag, such as absent actors, misaligned incentives, or restrictive rules of engagement.

Strategies may include encouraging new entrants to fill currently unoccupied ecosystem roles, contributing specialized expertise, or enabling actors to participate in emerging value propositions. Alternatively, actions may be geared toward increasing existing production and innovation capabilities and shifting innovation and entrepreneurial mindsets. For example, addressing weak digital connectivity may require coordinated investment in regional broadband infrastructure, digital marketplaces, or adoption subsidies for smaller firms. When human-capital gaps emerge, regional development agencies can codesign curricula with industry and educational institutions. In ecosystems constrained by fragmented leadership, public agencies can convene cross-sector steering groups to align incentives and coordinate investment. Thus, reverse salients can be action-guiding for policymakers by revealing where to intervene in the socio-technical structure, rather than acting solely on firm-level deficiencies.

Our findings further highlight that the simple availability of technical or financial inputs is not sufficient; what matters is their reliable and effective utilization. Strengthening relationships can reduce transaction costs, reinforce trust, and ensure that valuable information about technologies and market trends flows smoothly through the ecosystem. Investments in digital platforms can facilitate ecosystem-wide knowledge exchange, enhancing transparency and cohesion among stakeholders. Zhang and Williamson's [59] analysis of the emergence and growth of mobile payment ecosystems in China further demonstrates the central role ecosystem leaders play in driving such actions. In our case study, we observed efforts to close the skills gap, in collaboration with educational institutions, also emerge as critical. Tailoring curricula to ecosystem needs (e.g., agricultural technologies, creative culinary skills, and digital literacy for e-commerce) enhances labor market readiness. Supporting innovation hubs and incubation programs offers further pathways for entrepreneurial growth and value creation. Taken together, these findings refine managerial practice and show that ecosystem improvement arises from strengthening interdependencies, such as knowledge flows, coordination mechanisms, and institutional alignment, rather than merely augmenting isolated capabilities.

Policymakers can interpret these findings as a mandate to rethink the institutional frameworks that govern innovation activities and are well placed to modify rules of engagement to accelerate ecosystem evolution. Moreover, understanding that ecosystem leadership can itself be a source of reverse salience prompts a need to reconsider leadership structures. While leadership can be assumed by various organizations, policymakers often arise as de facto leaders, given their vested interest in regional growth. In this role, knowledge of connections and resources necessary for ecosystem performance is critical, along with the ability to facilitate their creation and flow. In the context of our case study, regional development agencies and local councils play pivotal roles by fostering interorganizational collaboration and resource sharing. Applying these findings in other contexts enables decision-makers to anticipate and mitigate system-level constraints, shifting practice from reactive problem-solving to proactive ecosystem stewardship.

C. Limitations and Opportunities for Future Research

Our study has several limitations that motivate future work to strengthen the evaluation of innovation ecosystem performance. The single case study presented in this article imposes a natural limitation on the generalizability of findings. While the Coffs Harbor case offers depth of understanding, its regional and sectoral specificity constrains direct transferability to other contexts. Future research could test the applicability of our framework across ecosystems with differing governance forms, industrial bases, or maturity levels to assess its broader relevance. Such work could also seek to identify converging or diverging patterns in ecosystem evolution and the emergence of performance-inhibiting components (i.e., reverse salients).

A further limitation of our work is that reverse salients are treated as the absence of an emergence sequence. Given the interdependence of actors, connections, and resources, a temporal series of reverse salients is likely, as the emergence and resolution of one reverse salient (e.g., an actor) may precipitate the emergence and resolution of another (e.g., a connection). Future longitudinal or comparative work could, therefore, trace these sequences empirically, offering insight into how performance constraints evolve and resolve over time. Clarifying these temporal patterns would help refine our proposed framework of ecosystem performance.

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