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Systems Analysis of Actor Perceptions on Collaborations Within a Philippine Regional Innovation System

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Abstract

This study examined the Regional Innovation System (RIS) of Western Visayas, Philippines, using a systems approach to address a persistent gap in Philippine innovation literature that has largely treated actor-level challenges through linear, institution-focused accounts rather than as interdependent, feedback-driven dynamics. Using a descriptive qualitative, multiple case study design, twenty purposively selected key informants across government, academe, industry, and community sectors were interviewed through semi-structured key informant interviews. Data were analyzed using a three-tiered systems-thinking framework: Social Network Analysis (SNA) mapped the structural relationships and centrality of actors; the Iceberg Model traced visible events to underlying institutional structures and mental models; and Causal Loop Diagramming (CLD) identified reinforcing and balancing feedback loops shaping innovation performance. Findings reveal a government-academe-dominant network, with DOST holding the highest eigenvector centrality and local government units functioning as critical structural brokers, while industry and community actors remain comparatively peripheral and weakly integrated into the commercialization pipeline. Iceberg Model analysis identified low research commercialization, weak academe-industry linkages, bureaucratic technology-transfer requirements, and a persistent dole-out mentality as symptoms of deeper structural and cultural roots rather than isolated performance failures. Causal loop analysis further revealed coexisting virtuous cycles—driven by visionary leadership, market-responsive research, and trust-building—and vicious cycles rooted in dependency and institutional silos. The study concludes that the Western Visayas RIS reflects a Quadruple Helix system in an early-to-intermediate stage of institutionalization, structurally imbalanced and not yet exhibiting the mutually transformative relationships characteristic of a mature innovation ecosystem, underscoring the need for interventions to strengthen industry and community integration.

1. Introduction

Innovation is widely recognized as the primary leverage for a country's competitive standing in the Global Innovation Index (GII), and the Philippines has pursued this through aggressive science and technology initiatives led by the DOST. These efforts are anchored in the Sustainable Development Goals—particularly SDG 9 (Industry, Innovation and Infrastructure), SDG 17 (Partnership for the Goals), and SDG 1 (Reduced Poverty)—reflecting the view that a functioning, multi-stakeholder innovation system is key to inclusive and sustainable development (United Nations, 2015; Leydesdorff, 2021). As of October 2025, the Philippines ranked in the top 50 of the GII (WIPO, 2025), a standing attributed to sustained investment in research, development, and commercialization, and to policies strengthening the National Innovation System (NIS) (Pinto, 2024). NIS is understood not as isolated enterprise success but as the coordinated interaction of governments and institutions in generating and transmitting knowledge and technology (Crespo & Crespo, 2016).

Because NIS alone is too broad to capture the diversity of sub-national ecosystems, scholarly attention has shifted toward Regional Innovation Systems (RIS) as the more immediate, actionable, and context-specific level of innovation governance (Doloreux & Porto Gomez, 2017). An effective RIS depends not

merely on stakeholder proximity but on the quality of synergy among academe, government, and industry—the prime actors in innovation (Etzkowitz & Leydesdorff, 1995). In the Philippines, this shift is institutionalized through the National Innovation Agenda and Strategy (DEPDev, 2023) and Republic Act No. 11293 (the Philippine Innovation Act), which established the National Innovation Council and an Innovation Alliance to embed a whole-of-nation, ecosystem-based approach (Republic Act No. 11293, 2019), alongside RA 11337 (Innovative Startup Act), which supports new enterprises through incentives and streamlined compliance (DOST, 2021). Despite these mandates, national and regional innovation systems remain understudied in the Philippines, with existing literature offering largely linear, one-sided accounts that overlook systemic interactions and feedback mechanisms (Patalinghug, 2021).

In Western Visayas specifically, several regional R&D consortia anchor multisectoral collaboration across agriculture, health, and industry/technology sectors, operating under national sectoral planning councils (DOST Region 6, 2025). These bodies report measurable outputs in incubation, technology commercialization, and job creation (PCAARRD, 2025; PCHRD, 2025), yet how these actors actually interact with one another—the structure, density, and feedback pathways of their collaboration—remains an established gap, as publicly accessible literature on the specific systemic dynamics of the region's RIS could not be readily found, thus prompting the need for this study. Analytically, the Triple Helix model—centering university, industry, and government (Etzkowitz & Leydesdorff, 1995; Xue, 2025)—remains the most stable and empirically tractable framework compared to the quadruple and quintuple helix extensions, which, despite incorporating civil society and the environment, continue to face methodological and definitional limitations (Hasche et al., 2019; Gutierrez et al., 2023; Medina et al., 2022; Cai & Lattu, 2022; Galvao et al., 2019).

A systems approach was adopted as the study's guiding theoretical lens because the RIS is not a collection of independently functioning institutions but an interdependent network whose components continuously interact, adapt, and produce feedback effects on one another (Leydesdorff, 2021). Where existing Philippine literature has largely treated actor-level challenges as isolated, linear problems (Patalinghug, 2021), a systems approach instead examines the RIS holistically — as a set of interrelated parts, functions, and feedback loops rather than discrete units of analysis (Arthur et al., 2023). This orientation is particularly suited to uncovering the circular causality, and reinforcing or balancing dynamics that conventional descriptive or institution-focused studies tend to overlook, allowing systemic barriers and drivers to be traced to their structural and cultural roots rather than attributed to the underperformance of any single actor.

Operationalizing this systems approach required a multi-tiered analytical framework capable of examining the RIS at successive levels of depth. Social Network Analysis (SNA) was first employed to map the structural relationships among key actors — identifying centrality, density, and betweenness to reveal patterns of connectivity, influence, and brokerage within the network (Borgatti et al., 2018). This structural mapping was then deepened through Iceberg Model Analysis, which moved beyond visible events and behavioral patterns to uncover the underlying institutional structures and mental models sustaining them (Goodman, 2018). Finally, Causal Loop Diagramming (CLD) synthesized these structural

and behavioral findings into reinforcing and balancing feedback loops, tracing how variables interact and compound over time to identify systemic leverage points for policy intervention (Sterman, 2000; Lane, 2008). Together, this three-tiered framework — moving from network structure, to institutional depth, to causal dynamics — enabled a multi-dimensional examination of the RIS that existing single-method, linear studies have yet to achieve.

Given the persistent gap between descriptive, institution-focused RIS studies and the need to understand non-linear, interdependent dynamics among core actors (Arthur, 2023; Bürscher et al., 2024), this study applies a systems approach to the RIS of Western Visayas, using key actors' perceptions as the primary input for identifying structures, drivers, barriers, and feedback mechanisms. Specifically, it employs Social Network Analysis to map sector-based actors and their interrelationships, the Iceberg Model to classify drivers and barriers of innovation outcomes, and Causal Loop Diagramming to interpret the feedback mechanisms that stabilize or amplify innovation performance in the region.

2. Methodology

The study used a descriptive qualitative design integrated with a systems approach, framed as a qualitative multiple case study of the Western Visayas RIS (Creswell & Creswell, 2018). Twenty purposively selected key informants —nine government personnel (G1-G9), five academe representatives (A1-A5), four industry partners (I1-I4), and two community actors (C1-C2) identified through snowball sampling and assigned with codes—were interviewed via semi-structured key informant interviews (KIIs) lasting 60–90 minutes, following a four-step process of recruitment, interviewing, document analysis, and validation consultation (Ayton et al., 2016; Hennink, 2022; Busetto et al., 2020; Kibuacha, 2024). Within-case analysis examined dynamics inside each sector, while cross-case analysis compared sectors to surface common patterns, drivers, and barriers.

Data were analyzed through three integrated systems-thinking tools applied in sequence: Social Network Analysis (SNA) mapped actors, ties, density, centrality, and structural holes to reveal who brokers or is peripheral to the network (Borgatti et al., 2018); the Iceberg Model then moved from observable events and patterns to underlying institutional structures and mental models to uncover root drivers and barriers (Goodman, 2018); and Causal Loop Diagramming (CLD) synthesized these findings into reinforcing and balancing feedback loops to identify systemic leverage points for policy recommendations (Lane, 2008). Sensitive or potentially identifying findings were aggregated, anonymized, or withheld entirely where anonymization could not protect participants.

3. Result and Discussion

3.1 Social Configuration of the RIS

Social Network Analysis (SNA) is a systems-based tool that examines structural relationships among actors within the network. It is well-suited to RIS analysis as it captures the network's relational

architecture — identifying central, peripheral, and bridging actors — providing the structural foundation for the subsequent Iceberg Model and Causal Loop Diagramming analyses.

Findings reveal a clearly stratified role structure among RIS actors, with government positioned as the most central and influential stakeholder, described by one participant as the actor that provides *"the technology and funding,"* while another characterized the ecosystem as a coordinated system where "*DOST acts as the enabler and funding source"* and academe serves as "*the technology generator."* Within government, DOST anchors the system through funding programs (GIA, SETUP, CEST, etc.) cascaded via provincial offices, while LGUs serve as the most visible ground-level partners, described as helping "*implement our projects in the communities."* Academe was identified as the primary knowledge-production node, with one participant naming it "*our strongest bond... as our primary technology generator,"* while industry converts university-developed technologies into market-ready products, *"handling the fabrication"* and mass production. Notably, community cooperatives are shown evolving beyond passive end-users into active innovation agents, exemplified by a weavers' cooperative that moved from being technology beneficiaries to now supplying *"international designers, schools, government officials, and top airline companies"* — a pattern the study frames as bidirectional, co-production innovation rather than the traditional linear cascade.

The Social Network Analysis confirms this hierarchy structurally: DOST holds the highest eigenvector centrality, reflecting its role as the most connected actor among other highly connected actors, while SUCs form the *"operational implementation backbone*" with the second-highest centrality through extensive multi-agency collaboration. LGUs emerge as the most critical structural broker, sharing top betweenness centrality with DOST, serving as the *"gateway"* connecting institutions to the community as end-users — removal of LGUs would sever much of the government-academe-community linkage. Industry occupies a moderately central position concentrated around commercialization and market linkage rather than broad system coordination, while the community shows the lowest centrality and density, functioning largely as *"terminal nodes in the innovation diffusion chain"* with weak horizontal ties among cooperatives themselves.

A further structural gap concerns peripheral and weakly connected actors across the network — including environmental, marine, fisheries, industry-support, and private-sector institutions — which show low centrality and betweenness, functioning as terminal nodes with only one to three ties and no bridging capacity, leaving them prone to knowledge lock-in and unable to diffuse innovation across the system. Chief among these gaps is the weak integration of private industry itself, which registers the lowest eigenvector centrality overall, reflecting a "technology push" rather than "demand pull" orientation in which research agendas are set without market input, leaving outputs poorly matched to industry needs *("most of our available technologies don't fit, they don't fit the need of the industry")* and commercialization rare. This is compounded by inconsistent local funding and prioritization for science and technology initiatives, where support depends more on individual political will than institutionalized policy, together placing the system at risk of becoming a closed loop that accumulates research outputs without translating them into enterprise or economic return.

Overall, the network exhibits strong government-academe collaboration but weaker integration of industry and community into the commercialization pipeline, creating what the findings describe as a risk of the RIS being *"research-intensive but commercially weak."* This structural imbalance undermines the quadruple helix model's premise of treating community and industry as equal innovation partners (Zhang & Leydesdorff, 2020). Communication across the network was nonetheless described as highly cohesive and low-bureaucracy, with participants noting that "*bureaucratic channels are minimal"* once rapport is built, and that institutions rely on both formal (MOAs, email) and informal (Messenger, Viber) channels — a pattern consistent with what Matatkova & Stejskal (2013) term a functional governance framework, reflecting high social capital and reciprocal resource exchange within the RIS (see Fig. 1).

3.2 Systemic Barriers and Enablers in the RIS

The Iceberg Model is a systems-thinking diagnostic framework that conceptualizes problems as having visible “events” at the surface and deeper, less observable layers of patterns, structures, and mental models that generate and sustain those events. Originating in the systems-thinking tradition popularized by Senge (1990), the model is used to avoid reactive, symptom-focused interventions and instead uncover root causes and leverage points for sustainable change. In this study, the model enables systematic identification of hidden systemic drivers and high-leverage interventions beyond isolated program effects (see Figure).

Level 1: Events (Visible Occurrences)

The findings indicate that the low commercialization of research and development (R&D) outputs is not an isolated deficiency but a systemic problem within the regional innovation system (RIS). At the events level, the most visible conditions are the accumulation of patents, utility models, and industrial designs without corresponding market adoption, the limited formation of start-ups and spin-offs, the abandonment of transferred equipment after project funding ends, the discontinuation of technology-based livelihood projects, and the wastage or undersupply of raw materials. These outcomes are intensified by lengthy technology-development cycles, rigid regulatory and documentary requirements, weak market validation, and limited returns on investment. Thus, the visible performance of the RIS is characterized by high research and intellectual-property activity but low commercialization, adoption, and sustainability.

Level 2: Patterns (Recurring Trends)

At the patterns-of-behavior level, the findings reveal recurring research–industry mismatches, low technology adoption, preference for proven solutions, cooperative conflicts, political and administrative discontinuity, and repeated project collapse after external funding ceases. Researchers commonly develop technologies without sufficient engagement with industries, farmers, or communities during the ideation and validation stages. Consequently, end users perceive some technologies as unsuitable, costly, or inconsistent with their livelihood requirements, while investors and MSMEs remain cautious because of uncertain returns, inadequate production capacity, and weak supply chains. The repeated

pattern is therefore a fragmented research-to-market process in which technologies are generated, transferred, and eventually discontinued without sustained ownership, adaptation, or commercialization.

Level 3: Underlying Structures (Systemic Causes)

At the underlying-structures level, these patterns are produced by weak academe–industry–government linkages, insufficient technology-transfer personnel, limited regional manufacturing and supply-chain infrastructure, inadequate value-chain analysis, and misaligned priorities between national government agencies and local government units. Institutional promotion systems, including criteria associated with NBC 461 and DBM–CHED Joint Circular No. 3, s. 2022, tend to reward publications and IP filing more directly than commercialization, adoption, and socioeconomic impact. In addition, the limited representation of science, technology, and innovation within LGU planning structures weakens post-project ownership and budgeting.

Level 4: Mental Models (Underlying Beliefs)

At the deepest level, the system is shaped by mental models that equate trust with personal relationships rather than institutional reliability, and success with visible, immediate financial gain rather than long-term R&D investment. At the mental-model level, actors operate within deeply embedded assumptions: researchers tend to prioritize scholarly identity, technical rigor, and risk avoidance; entrepreneurs prioritize speed, opportunity, and calculated risk; communities may view unfamiliar technologies as threats to established livelihood practices; and prolonged government assistance may reinforce dependency or a “dole-out” mentality. These assumptions reproduce siloed or *kanya-kanya* behavior, institutional competition, weak resource sharing, and limited collective accountability. Conversely, the findings identify co-creation with industry and communities, trust-based relationships, visionary leadership, visible commercialization success stories, value-chain orientation, market readiness, and a shared ecosystem vision as leverage points for transforming the RIS from a project-based system into a collaborative and sustainable innovation ecosystem.

Collectively, these findings identify six interrelated drivers and enablers propelling the RIS forward: demand-driven, co-created research that grounds technology development in industry need rather than pushing supply-side outputs; trust, open communication, and sustained relationship-building among stakeholders as the connective tissue enabling collaboration; visionary, innovation-oriented leadership that bridges institutional boundaries and mobilizes coordinated action; visible success stories that leverage the region's "*gaya-gaya"* (emulation) culture to overcome entrepreneurial risk aversion; a value-chain orientation that anchors technology development in market readiness and supply-chain realities from production through commercialization; and, most fundamentally, an ecosystem-wide shared vision in which government, academe, industry, community, and other support institutions function as coordinated parts of a single system rather than isolated actors — captured in the observation that impact becomes "*massive*" only "*when all these pieces align toward a single direction*." Taken together, these enablers function as direct counterweights to the barriers identified at the structural and mental-model levels, suggesting that strengthening the RIS depends less on additional funding alone than on

deliberately cultivating trust, shared purpose, and demand-oriented collaboration across all key actors in the system.

3.3 Reinforcing and Balancing Behavior in RIS

Causal Loop Diagramming (CLD) was employed to map the non-linear, interdependent feedback mechanisms within the RIS, using directional links of positive (reinforcing) or negative (balancing) polarity to trace how variables interact and compound over time (Sterman, 2000). This systems-thinking tool captures circular causality that linear models overlook, enabling the identification of systemic leverage points for targeted policy intervention (Lane, 2008) (see Fig. 3).

Six reinforcing loops and two balancing loops emerged from the causal analysis, illustrating both virtuous and vicious cycles shaping the RIS. The Commercialization Success Loop (R1) operates as a self-amplifying virtuous cycle: sustained patent filings and publications lead to market-viable technologies, which spawn startups and stronger market linkages that generate community employment and empowerment, in turn building stakeholder confidence that attracts further investment in research and IP protection — consistent with innovation ecosystem theory's claim that successful outcomes attract resources that further reinforce performance (Stam & Van de Ven, 2021). Similarly, the Visionary Leader Loop (R2) shows how a champion's open communication and trust-building unify sectoral goals into harmonized programs that improve technology adoption; successful adoption produces visible success stories that validate the leader's approach and motivate further participation, a dynamic supported by literature linking open communication, trust, and effective collaborative diffusion (Judijanto, 2025).

Two additional virtuous loops reinforce commercialization capacity from different angles. The Market Needs Knowledge Loop (R3) demonstrates that deeper engagement in value chain analysis improves researchers' understanding of industry and community demand, producing more market-aligned technologies that draw greater industry participation, which in turn expands researchers' access to market intelligence — a cycle in which "close interaction between knowledge producers from the academe and end users from the community enhances innovation performance" (Cohen et al., 2002. Complementing this, the Sustainability of Technology Adoption Programs Loop (R5) shows that adequate external funding raises the success rate of technology transfer, builds implementing agencies' credibility, and attracts further investment, with participants noting funding shortfalls limit their capacity even "to develop the most viable products" or "augment the readiness" of technologies — underscoring that sustained financial support is essential for capacity building and continuous technology deployment (Hermans et al., 2022).

By contrast, two loops function as vicious cycles that erode RIS performance. The Dole-Out System Loop (R4) shows that prolonged community dependency on external funding diminishes entrepreneurial initiative and risk tolerance, reinforcing a "dole-out mentality" and reluctance to assume project ownership once support ends (Kimmitt et al., 2020; Korsgaard et al., 2022). Likewise, the Silo or Kanya-Kanya Mindset Loop (R6) illustrates how institutional self-interest fuels exclusion, duplicated programs,

and withheld information — one participant observing that "some agencies are just doing their own thing... it is a 'kanya-kanya' manner of doing things" — a fragmentation pattern known to aggravate coordination failures in cross-sectoral networks absent mechanisms for collective action (Ansell & Gash, 2018).

Two balancing loops further temper these dynamics by introducing natural limits. The Internal Conflicts Loop (B1) shows that as cooperative membership grows, diverging interests and resource-allocation disputes increasingly threaten cohesion, since "beneficiaries... later face internal conflicts and disband," constraining further expansion despite initial diffusion gains (Stam et al., 2021). Meanwhile, the Dole-Out System Loop in Entrepreneurial Culture (B2) reveals that while external funding initially sustains technology adoption, continued reliance weakens beneficiaries' entrepreneurial skills and self-sufficiency over time — as one participant noted, recipients "developed a habit of being dependent forever" — ultimately limiting the long-term social and economic returns of technology-transfer programs (Korsgaard et al., 2022).

3.4. Strategic Intervention in Breaking Vicious Cycles

Effective interventions for the Regional Innovation System are recommended to directly target the vicious cycles that reproduce dysfunction: silo mentality, dole-out dependency, weak sustainability loops, internal conflict, and risk aversion.

For the “kanya-kanya” or silo loop, establishing a shared regional innovation platform with regular interagency coordination among DOST, DTI, DA, LGUs, universities, and cooperatives can align deliverables, reduce duplication, and incentivize joint outputs through shared performance indicators and cross-agency reporting. To break the dole-out dependency cycle, programs could require counterpart contributions (financial or in-kind), shared management responsibilities, and clear post-project transition plans, paired with entrepreneurship, leadership, and financial literacy training so beneficiaries view projects as livelihood systems rather than grants.

Strengthening the sustainable commercialization loop calls for embedding value-chain analysis and user validation at the research ideation and proposal stages, ensuring technologies are market-fit through active industry participation in problem identification, prototyping, and pilot testing. For the internal conflict balancing loop, cooperatives may be provided with leadership training, financial management, values orientation, and team building, alongside transparent bylaws, income reporting, and conflict-resolution mechanisms to prevent factionalism and organizational collapse. Finally, to reduce risk aversion, aggressive awareness campaigns featuring success stories, hands-on technology demonstrations, and co-investment schemes (e.g., LGU–adopter cost-sharing) can foster ownership and calculated risk-taking; within academe, reforming promotion guidelines to weight commercialization milestones (licensing, spin-offs, startups) equally with publications will align researcher incentives with applied impact.

Collectively, these interventions aim to dismantle systemic silos through shared vision and collaboration, diminish dependency via behavioral capacity building and co-ownership, and fortify commercialization by deepening market linkages, value-chain planning, and institutional reward reforms. This matrix condenses each vicious or balancing loop into its targeted intervention and the concrete steps needed to operationalize it (see Table 1).

Table 1
Intervention Matrix by Causal Loop

Causal Loop (Problem)	Core Intervention(s)	Key Actions / Components
Weak sustainable commercialization	Market-fit research & value-chain integration	- Embed value-chain analysis and user validation at proposal/workplan stage - Involve industry/adopters in problem identification, prototype testing, and pilot implementation - Train academe and industry on value-chain mapping and market-needs assessment - Ensure technologies address real market demand to reduce instability
Silo (“kanya-kanya”) mentality	Shared regional innovation platform & interagency coordination	- Create regular multi-agency forums (government line agencies, industry, universities, cooperatives) - Jointly map projects and align deliverables to one common outcome - Adopt shared performance indicators and cross-agency reporting - Incentivize collaboration (rewards for joint outputs, not isolated accomplishments)
Dole-out dependency	Behavioral conditioning and ownership-sharing mechanisms	- Require reasonable counterpart contributions (cash, in-kind, or labor) - Institute shared management responsibility and clear post-project transition plans - Provide entrepreneurship, leadership, financial literacy, and market-linkage training - Reframe projects as livelihood systems, not all-expense-paid programs

Causal Loop (Problem)	Core Intervention(s)	Key Actions / Components
Internal conflict (cooperatives)	Governance, transparency, and team-capacity building	- Conduct training on leadership, financial management, values orientation, and team building - Establish clear bylaws, transparent income/financial reporting, and conflict-resolution mechanisms - Orient members on roles, revenue shares, and shared sustainability responsibilities - Promote consistent communication and trust-building to deter factions
Risk aversion (community & industry)	Awareness, triability, and co-investment	- Run grassroots awareness/promotion campaigns featuring local success stories - Offer hands-on technology demos and gradual adoption (trial before full rollout) - Implement co-investment schemes (industry + adopter cost-sharing) to create shared ownership - Motivate communities as equity participants, not passive grant recipients

4. Conclusion

Guided by a systems approach, this study found that the Western Visayas RIS exhibits a government-academe dominant network structure, with DOST VI emerging as the most influential actor by virtue of its highest eigenvector centrality — reflecting both its extensive connections and its central position among other well-connected sectors — while LGUs function as principal brokers linking peripheral and disconnected actors to the network's core. Industry and community sectors, by contrast, remain comparatively weakly integrated: industry connections cluster around economic and manufacturing linkages rather than academe or government, while community actors are largely passive beneficiaries, with only isolated cases demonstrating the potential for evolving roles. SUCs, meanwhile, function less as equal partners than as financially dependent intermediaries channeling government-funded R&D, revealing a structurally imbalanced Quadruple Helix arrangement in which all sectors participate but do not share resources or influence equitably.

Iceberg Model analysis reframed the RIS's persistent challenges — low research commercialization, weak academe-industry linkages, bureaucratic technology transfer requirements, risk aversion, and dole-out dependency — not as isolated performance failures but as symptoms of deeper institutional and cultural structures requiring systemic intervention. Causal loop analysis further showed that virtuous cycles (visionary leadership, market-responsive research, successful commercialization) and vicious cycles (dependency, fragmentation, siloed "kanya-kanya" behavior) coexist and actively shape innovation

outcomes, with the RIS's core deficiency being not a lack of localized success but the absence of a mechanism to convert that success into sustained, systemic momentum. Taken together, these findings position the Western Visayas RIS as a Quadruple Helix system in an early-to-intermediate stage of institutionalization — structurally imbalanced and not yet exhibiting the overlapping, mutually transformative relationships that Etzkowitz and Leydesdorff identify as the hallmark of a mature Quadruple Helix.

5. Summary, limitations and implications

This study examined the Regional Innovation System (RIS) of Western Visayas through a qualitative, systems-based multiple-case approach. It drew on interviews with 20 key informants from government, academe, industry, and community sectors, then integrated Social Network Analysis, the Iceberg Model, and Causal Loop Diagramming to identify stakeholder roles, root causes of weak innovation outcomes, and feedback mechanisms shaping the system.

Findings show that government—particularly DOST—occupies the most central role in funding, coordination, and technology support, while state universities and colleges serve as the main knowledge-production and implementation backbone. LGUs act as critical brokers connecting government and academic institutions with communities. However, industry and community actors remain relatively peripheral, resulting in a research-intensive but commercially weak innovation system.

The study further found that low commercialization is driven not only by insufficient resources but also by weak market validation, limited industry involvement in research design, inadequate technology-transfer capacity, inconsistent local support, and incentive structures that prioritize publications and intellectual-property filings over adoption and socioeconomic impact. At a deeper level, siloed institutional behavior, dependence on external assistance, risk aversion, and limited shared ownership sustain these problems.

The causal analysis identified virtuous cycles involving commercialization success, visionary leadership, market-needs knowledge, and sustained funding. It also revealed harmful cycles related to the “kanya-kanya” mindset, dependence on dole-out systems, cooperative conflict, and weak entrepreneurial culture. Overall, the RIS can become more resilient when stakeholders co-create technologies, share a regional vision, strengthen value-chain orientation, and institutionalize collaboration beyond project-based arrangements.

Several limitations could be discerned in this study. The study relied on 20 purposively selected informants; therefore, the findings reflect the perspectives of participants and may not represent all institutions, firms, cooperatives, or communities in Western Visayas. Because the research used a qualitative design, the reported network relationships and causal loops are interpretive rather than statistically generalizable across all regional innovation systems. Industry and community actors were less represented due to their number in the RIS compared to government and academe participants, which may limit the depth of evidence on market conditions, enterprise decision-making, and end-user

experiences. The study focused on perceived relationships and system dynamics at one point in time; it did not measure long-term commercialization outcomes, startup survival, employment effects, or changes in stakeholder ties over time. Some sensitive institutional information was aggregated, anonymized, or withheld to protect participants, which may have reduced the specificity of selected findings.

The findings imply that improving innovation performance in Western Visayas requires more than increasing research funding or producing more patents. Policymakers and innovation actors should strengthen the full pathway from problem identification and technology development to adoption, market validation, enterprise growth, and post-project sustainability.

Universities and research institutions may need to revise incentives so that commercialization, licensing, startup creation, technology adoption, and measurable community impact receive recognition alongside publications and intellectual-property outputs. LGUs also have an important role in institutionalizing science, technology, and innovation priorities in local development plans and budgets, reducing dependence on changing political leadership.

For industry and communities, the results emphasize the value of early participation in agenda setting, prototype testing, value-chain analysis, and investment decisions. This can improve technology-market fit while shifting beneficiaries from passive recipients toward co-owners and active innovation partners.

Out of these findings, it is suggested to establish a formal Western Visayas regional innovation platform involving various sectors from government line agencies, universities, industry groups, cooperatives, and other support institutions. Research and innovation institutions could also require market-needs assessment, value-chain analysis, and user validation during research proposal development—not only after technologies are completed. Regional research and development consortium could create shared performance indicators for agencies and institutions, including joint projects, adoption rates, commercialization outcomes, startup formation, and community income effects. Universities are suggested to strengthen technology-transfer offices through training, dedicated personnel, industry linkage mechanisms, licensing support, and commercialization mentoring. Program implementing government agencies may introduce co-investment or counterpart-contribution arrangements so adopters develop ownership, accountability, and entrepreneurial commitment. For communities and cooperatives, they could build skills and capacity in governance, bookkeeping, leadership, conflict resolution, and transparent income-sharing practices. For innovation champions, advocates and leaders, they could use local success stories, demonstrations, and small-scale trials to reduce risk aversion among potential adopters and private-sector partners.

6. Future Directions

Future studies could use a longitudinal design to track how stakeholder networks, commercialization outcomes, and technology-adoption rates change over several years. They could also combine

qualitative findings with quantitative measures such as network density, investment levels, licensing revenue, business survival, employment generation, and return on public research investments.

Further research may compare Western Visayas with other Philippine regions to identify context-specific and transferable practices for strengthening Regional Innovation Systems. Focused studies on private-sector participation, women-led enterprises, fisheries and marine innovation, environmental actors, and the effectiveness of LGU science-and-technology governance would also deepen understanding of currently peripheral parts of the system.

Declarations

Author Contributions

OJGA: Conceptualization, Draft Preparation, Writing, Investigation, Study Administration; PGG: Methodology, Formal Analysis, Reviewing; MRV: Investigation, Validation, Reviewing; LMDR: Draft Preparation, Writing, Reviewing, Editing

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Ethical Approval

The Faculty of Management and Development Studies Research Ethics Committee (FMDS REC) of the University of the Philippines Open University granted ethical approval for this study (Protocol Number: 2026-001-GS-FMDS dated April 15, 2026). The ethics committee duly reviewed the protocol, and Informed Consent was obtained from all participants in this study.

Competing interest

The authors declare no conflicts of interest.

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Figures

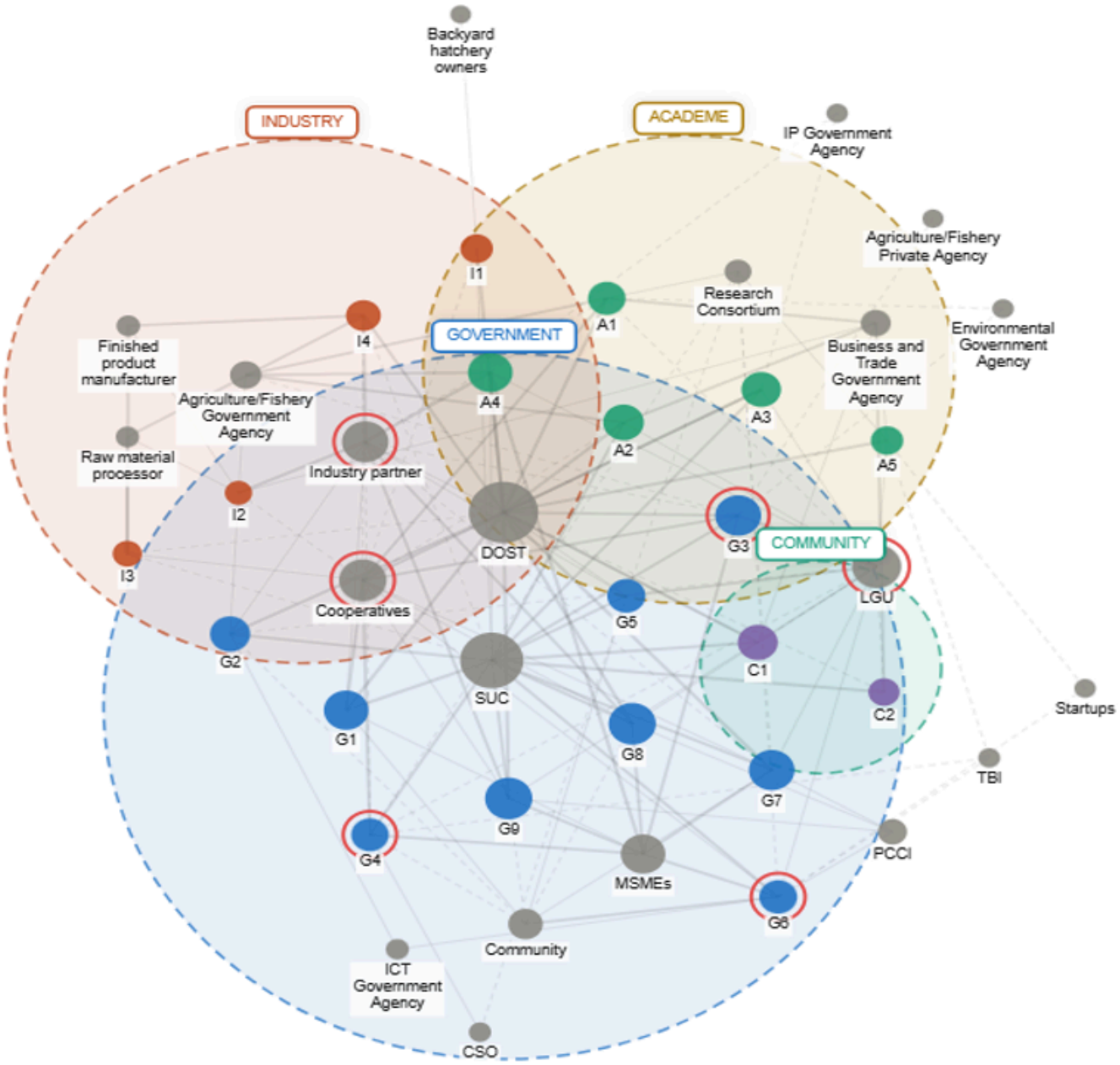


Figure 1

An illustration of the interaction of identified key actors and the strength of their relationships and communication with other stakeholders in the Western Visayas RIS. Actors are grouped by sector (Industry, Academe, Government, Community; dashed circles). Coloured nodes denote interviewed key informants (blue, government, G1–G9; green, academe, A1–A5; orange, industry, I1–I4; purple, community, C1–C2), and grey nodes denote institutions and organizations named by informants. Node size represents relative centrality and line weight represents tie strength.

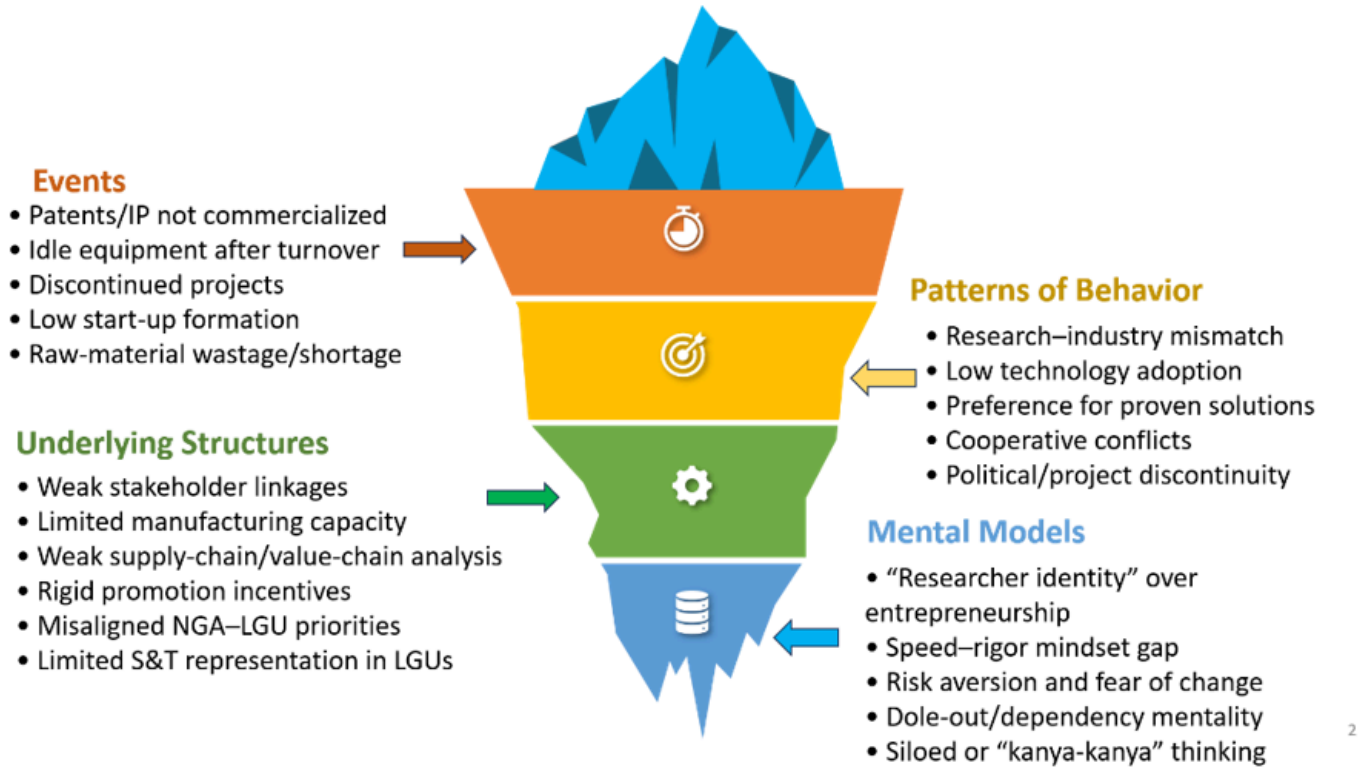


Figure 2

Iceberg Model analysis showing the tiered level of analysis identified in the RIS. Low research commercialization is traced from visible events (top) through patterns of behavior and underlying structures to the mental models that sustain them (bottom).

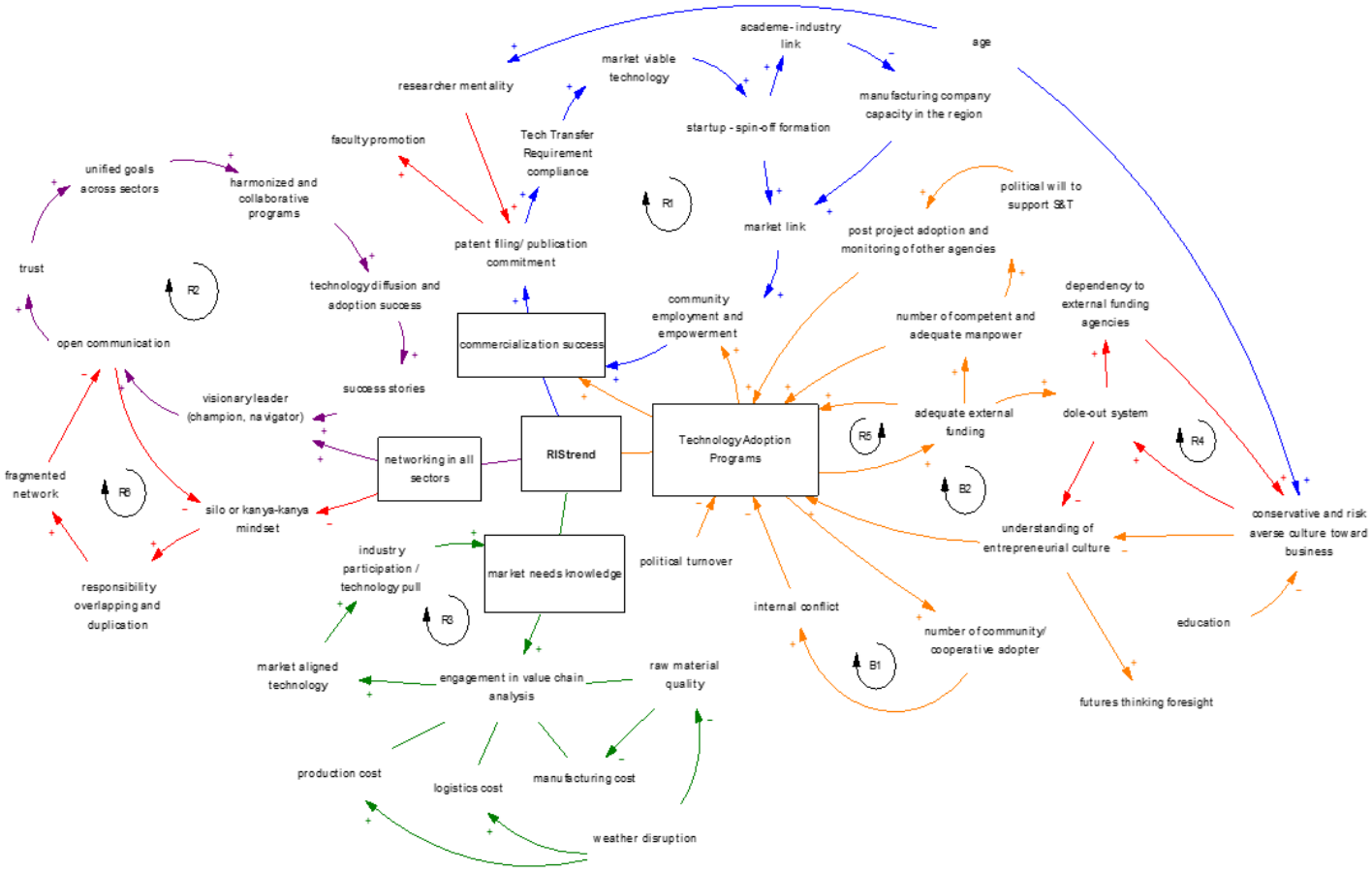


Figure 3

Causal Loop Diagramming showing causal relationships among reinforcing and balancing loops in the RIS. Arrows indicate the direction of causal influence; "+" denotes a change in the same direction and "−" a change in the opposite direction.