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Unlocking Innovation Traps: A Systems Thinking Approach to University–SME Collaboration

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ABSTRACT

Despite growing institutional interest, university–small and medium-sized enterprise (SME) collaborations often underperform, stalling before generating sustainable innovation. This study adopts a systems thinking perspective to diagnose such persistent failures as structural—rather than individual—challenges. Using OSTİM Technical University (OSTİMTECH) as a case study, the research employs participatory causal loop diagrams (CLDs) to visualize key feedback dynamics affecting trust, incentives, and knowledge flows. Central to the analysis is the "Success to the Successful" archetype, which explains how dominant academic incentives reinforce publication-oriented behaviors while marginalizing collaboration and applied innovation. The resulting model reveals why certain loops—like academic reputation—gain momentum while others—such as ecosystem learning—remain underdeveloped without intentional redesign. By identifying leverage points for institutional reform, including incentive recalibration and long-term partnership support, the paper offers actionable insights for third-generation universities. Ultimately, reframing collaboration through a systemic lens enhances understanding of complex innovation ecosystems and guides more credible, sustainable approaches to university–industry engagement.

KEYWORDS: Systems Thinking, University–Small and Medium-sized Enterprise (SME) Collaboration, OSTİM Technical University (OSTİMTECH), Causal Loop Diagrams (CLDs), Success to the Successful Archetype, Innovation, Third-generation Universities

KEY MESSAGES

- University–small and medium-sized enterprise (SME) collaboration has long been promoted as a catalyst for innovation and economic growth. However, despite strong policy backing and substantial financial support, many such partnerships do not lead to durable or scalable innovation.
- Traditional approaches often locate failure in individual actors or one-off project missteps. However, systems thinking encourages us to ask: what is it about the structure of the system that consistently generates these failures?
- Causal loop diagrams (CLDs) and archetypes help translate abstract systems' behavior into actionable insights and are particularly valuable for addressing complex institutional challenges like university–industry innovation collaboration.

Malgré l'intérêt croissant des institutions, les collaborations entre les universités et les petites et moyennes entreprises (PME) sont souvent peu performantes et patinent avant de générer une innovation durable. Cette étude adopte une perspective de pensée systémique pour diagnostiquer ces échecs persistants comme des défis structurels plutôt qu'individuels. En prenant l'université technique d'OSTİM (OSTİMTECH) comme étude de cas, la recherche utilise des diagrammes de boucles causales participatifs pour visualiser les principales dynamiques de rétroaction qui affectent la confiance, les incitations et les flux de connaissances. L'analyse s'articule autour de l'archétype « Success to the Successful » (le succès aux plus performants), qui explique comment les incitations académiques dominantes renforcent les comportements axés sur la publication tout en marginalisant la collaboration et l'innovation appliquée. Le modèle qui en résulte révèle pourquoi certaines boucles, comme la réputation académique, prennent de l'ampleur tandis que d'autres, comme l'apprentissage écosystémique, restent sous-développées sans une reconception intentionnelle. En identifiant les leviers de la réforme institutionnelle, notamment le recalibrage des incitations et le soutien aux partenariats à long terme, le document offre des perspectives concrètes pour les universités de troisième génération. En fin de compte, le recadrage de la collaboration à travers une lentille systémique améliore la compréhension des écosystèmes d'innovation complexes et oriente vers des approches plus crédibles et durables des collaborations entre universités et industries.

MOTS-CLÉS: *La pensée systémique, les collaborations entre les universités et les petites et moyennes entreprises (PME), l'université technique d'OSTİM (OSTİMTECH), les diagrammes de boucles causales, l'archétype « Success to the Successful » (le succès aux plus performants), l'innovation, les universités de troisième génération*

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A pesar del creciente interés institucional, las colaboraciones entre universidades y pequeñas y medianas empresas (Pymes) suelen tener un rendimiento inferior al esperado, estancándose antes de generar una innovación sostenible. Este estudio adopta una perspectiva de pensamiento sistémico para diagnosticar estos fracasos persistentes como desafíos de carácter estructural, más que individual. Utilizando a la Universidad Técnica OSTİM (OSTİMTECH) como estudio de caso, la investigación emplea diagramas de bucles causales participativos (CLD en inglés) para visualizar las principales dinámicas de retroalimentación que afectan la confianza, los incentivos y los flujos de conocimiento. El eje central del análisis es el arquetipo "Éxito para los exitosos", que explica cómo los incentivos académicos dominantes refuerzan los comportamientos orientados a la publicación, al tiempo que marginan la colaboración y la innovación aplicada. El modelo resultante revela por qué ciertos bucles, como la reputación académica, cobran impulso, mientras que otros, como el aprendizaje del ecosistema, permanecen subdesarrollados sin un rediseño intencional. Al identificar los puntos de apalancamiento para la reforma institucional, incluyendo la recalibración de los incentivos y el apoyo a las asociaciones a largo plazo, el artículo ofrece ideas prácticas para las universidades de tercera generación. En última instancia, replantear la colaboración desde una perspectiva sistémica mejora la comprensión de los complejos ecosistemas de innovación y orienta hacia enfoques más creíbles y sostenibles para la colaboración entre la universidad y la industria.

PALABRAS CLAVES: *El pensamiento sistémico, las colaboraciones entre universidades y pequeñas y medianas empresas (Pymes), la Universidad Técnica OSTİM (OSTİMTECH), los diagramas de bucles causales (CLD en inglés), el arquetipo "Éxito para los exitosos", la innovación, las universidades de tercera generación*

尽管机构兴趣日益浓厚，高校与中小企业 (SME) 的合作往往成效不彰，在尚未产生可持续创新前便陷入停滞。本研究采用系统思维视角，将此类持续性失败归因于结构性挑战而非个体因素。以OSTİMTECH 大学为案例，研究运用参与式因果循环图 (CLDs) 视化关键反馈机制对信任、激励与知识流动的影响。分析核心聚焦"成功者再获成功"原型，揭示主导性学术激励机制如何强化以论文发表为导向的行为，同时边缘化合作与应用创新。由此构建的模型揭示了特定循环 (如学术声誉) 得以强化，而其他循环 (如生态系统学习) 在缺乏刻意重构时仍处于欠发达状态的原因。通过识别制度改革的杠杆点——包括激励机制重构与长期伙伴关系支持——本文为第三代大学提供了可操作的建议。最终，以系统视角重构协作模式，既深化了对复杂创新生态系统的认知，也为构建更可信、可持续的产学合作模式提供了行动指南。

关键词: 系统思维、大学与中小企业合作、OSTİM科技大学 (OSTİMTECH) 、因果循环图、成功者再获成功原型、创新、第三代大学

1. Introduction

University–small and medium-sized enterprise (SME) collaboration has long been promoted as a catalyst for innovation and economic growth. However, despite strong policy backing and substantial financial support, many such partnerships do not lead to durable or scalable innovation. Consistent with OECD (2019) evidence, the limited progression of many university–industry partnerships beyond the pilot stage cannot be explained solely by insufficient funding or lack of intent. Rather, the primary constraint lies in structural and governance misalignments among universities, industry actors, and policy frameworks, including misaligned incentives, fragmented policy mixes, and weak coordination mechanisms.

The motivation behind this paper is to diagnose this persistent underperformance through a systems lens. Traditional approaches often locate failure in individual actors or one-off project missteps. However, systems thinking encourages us to ask: what is it about the structure of the system that consistently generates these failures?

The significance of this inquiry lies in its implications for policy and institutional reform. If systemic misalignments are driving underperformance, then interventions must target those underlying structures—not just surface-level symptoms. This paper proposes that systems thinking offers the tools to understand, diagnose, and redesign these structures, especially within the socio-technical environment where trust, culture, incentives, and learning intersect.

2. Background

The evolution of university models provides critical context for understanding the growing imperative of university–SME collaboration. Wissema (2009) conceptualizes this evolution in terms of three generational shifts. First-generation universities focus primarily on teaching, serving as knowledge transmitters. Second-generation institutions emphasize research alongside teaching, producing new knowledge but largely remaining siloed from market application. In contrast, third-generation universities integrate a third mission—entrepreneurship—beyond teaching and research. This third generation is marked by deeper engagement with innovation ecosystems. Startups, spinouts, and SME partnerships are no longer peripheral activities but core to institutional identity and strategy. Universities invest in technology transfer offices, innovation districts, and embedded PhD programs that connect academia with industry. Faculty members serve not only as scholars but also as mentors, entrepreneurs, and system connectors, helping to translate academic knowledge into societal value.

In this context, traditional linear models of innovation appear increasingly insufficient. Instead, third-generation universities require more dynamic, systemic models to understand and improve their innovation performance.

From Linear Models to Collaborative Complexity

Historically, the dominant framework guiding innovation was the "linear model," popularized by Vannevar Bush (1945). In this model, basic research in universities flows in a unidirectional manner toward applied research, development, and finally commercialization. While elegant in theory, this model fails to reflect the recursive, interactive, and transdisciplinary nature of real-world innovation (Etzkowitz & Leydesdorff, 2000).

Subsequent models—such as the Triple Helix (Etzkowitz & Leydesdorff, 2000), Mode 2 knowledge production (Gibbons *et al.*, 1994), and National Innovation Systems (Lundvall, 1992)—have emphasized co-creation, contextual relevance, and institu-

tional interplay. These models promote mutual learning among universities, industries, and government actors, highlighting the importance of trust, knowledge circulation, and system-wide feedback mechanisms.

However, many institutions still structure their incentives and evaluation systems around linear assumptions. Research funding often prioritizes theoretical novelty over practical application. Academic careers depend largely on publication metrics, not on partnerships with industry or societal impact (Tijssen, 2012).

This disconnect creates a structural mismatch: SMEs typically seek rapid, applicable solutions that align with business cycles, while universities are driven by depth, theory, and long research timelines. Consequently, many collaborations collapse after a single engagement, citing unmet expectations or misaligned timelines (Bruneel *et al.*, 2010).

International studies further reinforce this trend. For example, research from Germany, the United Kingdom, and South Korea shows that while innovation vouchers and tech transfer initiatives can spark initial engagement, they rarely produce sustained innovation unless backed by ecosystem-level support (Eickelpasch & Fritsch, 2005; D'Este & Patel, 2007; Lee & Kang, 2007). The problem is not that universities or SMEs lack motivation—it is that the architecture of collaboration remains brittle and overly episodic.

Previous Applications of Systems Thinking and Causal Loop Diagrams (CLDs)

While systems thinking is increasingly applied in public health and sustainability domains, its use in SME–university collaboration remains underdeveloped. Iqbal *et al.* (2015) used CLDs to explain how constraints in university–industry research collaboration feed back into Malaysia's national innovation system, highlighting reinforcing and balancing loops (and delays) that can undermine innovation performance. Dhukaram *et al.* (2018) highlight a rising interest in systems methodologies in innovation contexts globally but find few robust, CLD-based models specifically addressing SME–university partnerships. Crabolu *et al.* (2023) used CLDs to evaluate the effectiveness of policy instruments in innovation governance, showing how feedback loops reveal unintended consequences and systemic barriers.

Health systems studies by Cassidy *et al.* (2022) and Ashby *et al.* (2023) provide best practices for participatory CLD construction and validation, highlighting stakeholder engagement as a critical factor. Similarly, Barbrook-Johnson and Penn (2021) and The Systems Thinker (2014) offer foundational guidance on CLD modeling for complex systems, including feedback loop labeling and variable definition. These studies confirm the value of CLDs in diagnosing and visualizing system-level dynamics, though few extend these methods to SME–university collaborations.

This paper contributes to the literature by filling that gap through a systems-informed diagnostic and design approach: using triangulated CLD modeling to map university–SME innovation systems, identify leverage points for institutional redesign, and ground these insights in both existing literature and the lived practice of OSTİM Technical University (OSTİMTECH).

3. Methodology: The Systems Thinking Approach

Systems thinking, rooted in general systems theory (von Bertalanffy, 1968), provides a robust methodology to analyze complex socio-technical challenges. It emphasizes the interplay between parts of a system, focusing on patterns of relationships, feedback loops, delays, and leverage points (Meadows, 2008). This approach is uniquely suited to understand university–SME collaboration because it accounts for interdependencies between actors, institutions, cultures, and incentives. Unlike linear models, systems thinking accommodates unpredictability, iteration, and reflexivity. It also shifts the question from "Who is at fault?" to "What systemic dynamics led to this result?"

System Archetypes

A key strength of systems thinking lies in its use of system archetypes—recurring structures of behavior that appear across different domains. Archetypes serve as diagnostic templates for identifying persistent patterns and systemic traps that contribute to underperformance or stagnation. In the context of university–SME collaboration, where interactions are shaped by multiple institutions, policies, and cultural expectations, archetypes provide a way to conceptualize common dynamics such as reinforcing inequalities, delayed impacts, and unintended consequences.

Several common archetypes are particularly relevant to institutional and innovation contexts. The Limits to Growth archetype describes a situation where reinforcing processes are eventually slowed or reversed by internal constraints, such as resource depletion or institutional fatigue (Senge, 2006). Shifting the Burden involves a tendency to rely on symptomatic solutions—such as one-off collaborative projects or external consultancy—while neglecting fundamental causes like strategic misalignment or cultural disconnects between academia and industry (Kim, 1992). The Success to the Successful archetype illustrates how early advantages in one domain (e.g., academic publishing) attract increasing resources, creating reinforcing inequalities that limit growth in other domains (Braun, 2002). Fixes that Fail highlight the unintended consequences of short-term solutions that ultimately worsen the original problem, such as incentivizing surface-level cooperation without nurturing trust (Goodman, 1997). Additionally, the Tragedy of the Commons archetype reveals how individual actors, in pursuing short-term benefit (e.g., focusing only on their key performance indicators (KPIs)), may collectively degrade shared institutional resources and collaborative potential (Hardin, 1968).

Rather than offering one-size-fits-all answers, system archetypes prompt deeper reflection on how feedback mechanisms operate within a given context. They are not predictive formulas, but rather heuristic models that support learning and adaptation. Their value lies in highlighting leverage points—places within the system where small, well-designed interventions

may yield disproportionate impact (Maani & Cavana, 2007; Anderson & Johnson, 1997).

When surfaced through tools like CLDs, archetypes help translate abstract systems' behavior into actionable insights. This enables practitioners and policy designers to move beyond reactive fixes and instead target systemic redesign (Sterman, 2000; Morecroft, 2015). As such, the method is particularly valuable for addressing complex institutional challenges like university–industry innovation collaboration, where linear, symptomatic interventions have repeatedly fallen short.

Methodologic Evidence for CLD Design

CLDs have been widely applied in problem structuring methods (e.g., Cavana & Mares, 2004; Checkland, 1981), particularly in domains like healthcare and sustainability. They are increasingly constructed using triangulated inputs—literature review, expert knowledge, and stakeholder workshops—to enhance their reliability and validity (Dhirasasna & Sahin, 2019). In health system contexts, CLDs are now regarded as powerful tools for participatory diagnosis and co-design of interventions (Cassidy *et al.*, 2022; Ashby *et al.*, 2023).

For this paper, the CLDs were developed through a triangulated process involving document analysis, semi-structured faculty interviews, SME feedback, and workshop validation sessions conducted between 2021 and 2024 at OSTİMTECH. This aligns with best practices for building stakeholder-relevant, actionable system models.

Systems thinking is not only diagnostic but prescriptive. By identifying leverage points—places where a small shift can produce large changes—institutions can realign their strategies and policies. For instance, revising academic evaluation criteria to include industry impact or launching student-embedded innovation hubs can unlock collaboration potential. Examples from sustainability science, public health, and technology adoption further affirm the utility of systems thinking in complex environments. In each of these fields, CLDs have enabled stakeholders to visualize bottlenecks and co-create system redesigns that reflect lived realities.

4. Application of Systems Thinking and CLDs in University–SME Collaboration

The systemic analysis of university–SME collaboration at OSTİMTECH reveals a dynamic network of reinforcing and balancing feedback loops that either support or inhibit sustained innovation. These feedback structures were identified through a triangulated methodology involving stakeholder workshops, SME interviews, and document analysis conducted between 2021 and 2024. At the center of this approach is the CLD—a visual tool that not only illustrates concepts but exposes the interdependent feedback structures shaping institutional and actor behaviors over time. As shown in Figure 1, the CLD consolidates the systems narrative into a single model, encapsulating recurring patterns of trust breakdowns, incentive misalignments, and project fatigue. It maps three critical loops—one reinforcing and two balancing—alongside regulatory constraints that shape the system's trajectory. Together, these elements provide a system-level understanding of why university–SME collaboration either evolves into resilient innovation ecosystems or falters into episodic, transactional engagements.

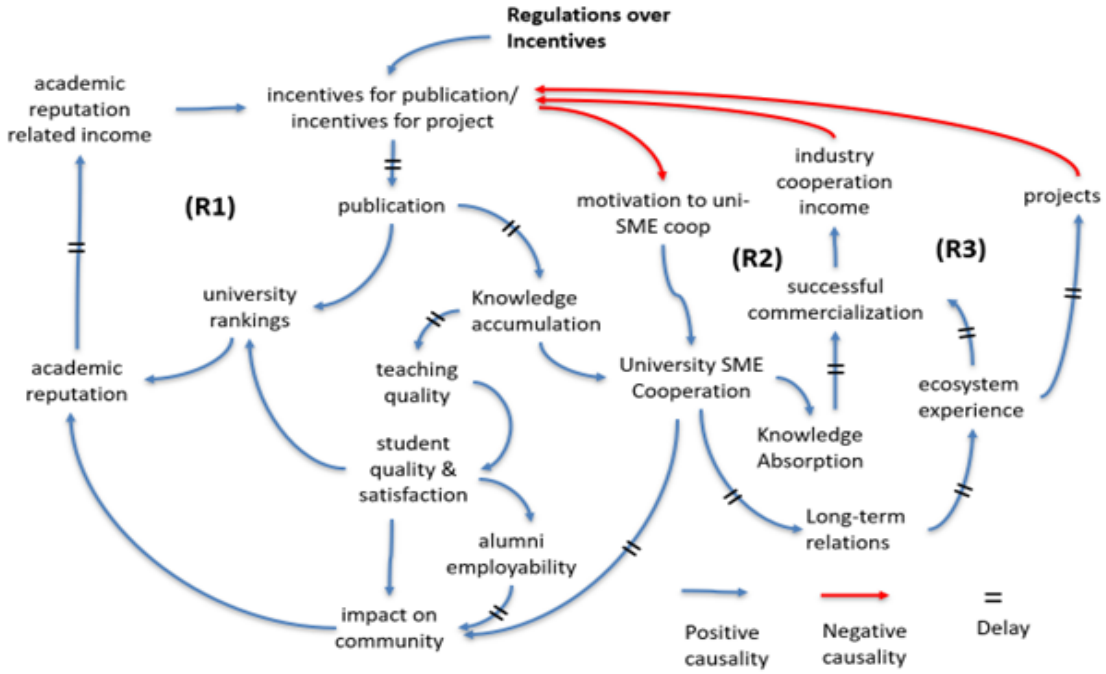

Figure 1 CLD depicting the interrelations among variables

R1: Reputation–Publication Loop (Reinforcing)

The first loop (R1) illustrates how institutional incentives focused on academic publication can generate a self-reinforcing cycle. When incentives prioritize publication, academic output increases. More publications enhance university rankings, contributing to greater institutional reputation. This reputation, in turn, attracts higher-quality students and faculty, improving teaching quality and graduate employability. As successful alumni impact their communities, the university's societal legitimacy grows, which then circles back to bolster its public image and academic prestige. What is often perceived as intangible—reputation—is shown here to be structurally embedded in the academic reward system. However, as D'Este and Patel (2007) argue, such dynamics may unintentionally deprioritize activities with real-world impact, including SME engagement.

R2: Collaboration–Commercialization Loop (Reinforcing)

Loop R2 models the process through which SME engagement can drive innovation and income—but also highlights where systemic underutilization tends to occur. When institutions actively incentivize SME collaboration, more academics engage with industry. This engagement builds absorptive capacity on both sides, laying the groundwork for sustained, trust-based relationships. Over time, these ties can enable successful commercialization of ideas, leading to industry-derived income and new entrepreneurial initiatives. This income, if reinvested, has the potential to catalyze further collaboration—completing the loop. However, in the absence of sustained support structures or aligned expectations, the system may stall at the engagement phase. Bruneel *et al.* (2010) describe this as a "valley of death" for partnerships—where intention does not translate into impact due to structural misalignments.

R3: Ecosystem Experience Loop (Reinforcing)

The third loop (R3) focuses on the importance of ecosystem familiarity and shared learning. As actors—academics, SMEs, and government entities—gain more experience collaborating, they initiate additional joint projects. With each successful project, mutual trust increases and transaction costs decrease, making future engagements easier and more adaptive. This loop suggests that learning-by-doing is not merely operational but strategic. Over time, the experience embedded in the ecosystem reinforces innovation resilience, echoing Mode 2 knowledge production (Gibbons *et al.*, 1994) and more recent insights from participatory innovation systems (Cassidy *et al.*, 2022). Yet, this loop too is vulnerable to interruption—especially in systems where short-term outputs are valued over long-term relational capital. If ecosystem actors face fatigue or repeated failures without systemic feedback mechanisms, the loop may degrade into episodic, low-trust interactions.

This model reflects a classical systems thinking archetype known as **"Success to the Successful"** (Kim, 1992; Senge, 2006), wherein competing feedback loops vie for institutional attention and resources. In this context, Loop R1 (Reputation–Publication) consistently draws reinforcement due to its alignment with established academic metrics and incentive structures, thereby accumulating institutional prestige and funding. Conversely, Loops R2 and R3, which represent collaborative engagement and ecosystem learning, often remain underdeveloped unless specifically supported through policy or design interventions. The archetype suggests that without intentional realignment, the system tends to amplify success in the dominant loop (academic publication) while marginalizing alternative, socially impactful pathways (such as SME engagement). Recognizing this dynamic is critical for designing leverage points that rebalance institutional priorities and prevent long-term systemic lock-in.

Systemic Leverage and Design Considerations

The most critical insight is that none of these loops self-activate; they depend on how institutions design and balance incentives, policies, and organizational infrastructure. If performance metrics reward only academic publications, R1 will dominate, crowding out collaboration and narrowing innovation pathways. In contrast, if universities and policy makers actively support R2 and R3—by reconfiguring institutional norms, funding timelines, and partnership support mechanisms—then more inclusive, mutually beneficial systems may emerge. Indeed, systems thinking does not just describe reality; it offers leverage to redesign it (Meadows, 2008).

Equally important are the negative causal relations, represented in Figure 1 by red arrows. These illustrate how regulatory overemphasis on publications or income generation targets without relational support can dampen motivation and shorten the temporal horizon of partnerships. Over time, such emphasis may reduce intrinsic motivation, narrow academic roles, and sideline experiential learning opportunities. A particularly salient leverage point across all loops is the role of knowledge accumulation. This variable is shaped both by scholarly activity and by embedded collaboration. Institutions face a pivotal choice: Will this knowledge be retained primarily as a symbol of prestige, or will it be mobilized to advance mutual learning and long-term transformation?

This CLD does more than diagnose the system; it opens design space for institutional reform. It shows that sustainable university–SME innovation is not only a matter of alignment—it is also a function of how actors interpret and respond to delayed feedback, system structure, and perceived success. This visualization helps pinpoint leverage points such as adjusting academic KPIs, enhancing SME absorptive capacity, and embedding students in innovation projects. Systems thinking enables institutions to reframe failures not as one-off misalignments but as recurring structural outcomes produced by delayed feedbacks and siloed governance.

Policy interventions can influence these trajectories. Examples include revising how faculty performance is evaluated, recognizing co-publication with industry, embedding students in SMEs

for experiential learning, and rewarding long-term relational impact alongside traditional outputs. Such interventions—while context-dependent—can help redistribute energy across the system and activate underutilized loops.

An important *exogenous* factor influencing this dynamic is regulation over incentives—namely, national or higher-education policy frameworks that dictate what constitutes academic success. These top-down regulations are not modeled as endogenous variables within the CLD because they operate largely outside the university's immediate decision-making scope. However, their effect is profound as they shape internal incentive structures, academic cultures, and administrative priorities. For instance, if national funding bodies or accreditation agencies continue to emphasize publication quantity over industry impact, universities have limited room to reform internal KPIs without risking institutional standing. Conversely, regulatory shifts that recognize collaborative outputs, patents, and commercialization activities as valued academic achievements could unlock broader systemic change. Thus, regulations act as boundary conditions for institutional adaptation and must be considered in any systemic redesign.

5. Discussion and Conclusion

The systemic analysis of university–SME collaboration at OSTİMTECH reveals a network of reinforcing feedback loops that either support or inhibit innovation. CLDs constructed through stakeholder workshops, SME interviews, and document analysis show recurring patterns of trust breakdowns, mismatched incentives, and one-off project fatigue. These dynamics are not random but reflect deeper structural feedbacks that reproduce predictable outcomes across institutions.

One key reinforcing loop illustrates that when SMEs experience early wins from academic partnerships, their trust and willingness to collaborate increase. This leads to repeat engagement, richer knowledge sharing, and improved innovation outcomes. However, this loop can easily be disrupted by bureaucratic friction or by universities' inflexible academic reward systems, which deprioritize collaboration. A corresponding reinforcing loop highlights a common bottleneck: when university incentives overvalue publications over impact, faculty engagement with SMEs decreases. This weakens mutual understanding and limits the transfer of tacit knowledge, making collaborations transactional rather than relational. The tension between reinforcing momentum and balancing constraints is a hallmark of complex adaptive systems and illustrates why many partnerships struggle to achieve long-term sustainability.

This overall dynamic closely mirrors the *"Success to the Successful"* archetype in systems thinking, where one feedback loop dominates institutional attention and resources, while others remain underdeveloped unless deliberately supported. In this context, the R1 loop (academic reputation and publication) draws increasing reinforcement due to its alignment with existing incentive structures. Meanwhile, collaborative loops (R2, R3) stall at early stages without structural enablers, leading to a concentration of success in a narrow domain—academic output—at the expense of broader innovation engagement.

Recognizing this archetype offers targeted leverage points. As illustrated in Figure 1, systems thinking becomes not only diagnostic but prescriptive, pointing to specific interventions. These include adjusting academic KPIs to value co-creation and long-term partnerships, enhancing SMEs' absorptive capacity to sustain collaboration, and embedding students into real-world innovation projects. These interventions address the root structure of the system rather than applying surface-level fixes.

More concretely, the following recommendations emerge from the systemic model. To promote sustainable university–SME collaboration, several system-oriented interventions can be considered based on the insights from the CLD analysis. First, institutional incentive structures should be recalibrated by broadening promotion and evaluation criteria to encompass the quality of collaboration, co-authored outputs with industry partners, and demonstrable innovation outcomes. Second, underutilized feedback loops—particularly those linked to mutual engagement and trust-building—can be activated by introducing counterbalancing institutional mechanisms, such as SME–academic liaison offices or seed grant programs tailored for joint projects. Third, universities should work to construct alternative narratives of success, highlighting the long-term value of partnerships and relational capital through both internal storytelling and external dissemination strategies, thus reducing overreliance on publication metrics. Fourth, embedding structured feedback processes—such as collaboration audits or periodic stakeholder retrospectives—would support organizational learning and adaptive governance, especially in managing the R2 and R3 loops. Lastly, the non-linear and delayed nature of innovation outcomes necessitates that funding mechanisms and performance evaluation systems be reconfigured to reflect longer innovation cycles, acknowledging that meaningful impact often materializes over extended time horizons.

OSTİMTECH's systems-based approach offers a compelling model of institutional innovation within the third-generation university paradigm (Wissema, 2009). While not universally generalizable, its use of feedback visualization and participatory CLD design helps reframe recurrent partnership failures as outcomes of systemic structures—rather than individual errors. Its curriculum, organizational design, and governance mechanisms are explicitly oriented toward innovation, ecosystem integration, and applied problem-solving. The CLD approach renders visible key systemic elements—trust, incentives, knowledge flows, and regulatory barriers—that shape collaboration dynamics.

Nevertheless, OSTİMTECH's case warrants academic caution. Systems models are context-dependent and probabilistic, requiring careful local adaptation and empirical validation. Still, the case illustrates how viewing innovation collaboration as a systemic challenge can reveal new diagnostic and design opportunities.

Ultimately, CLDs move beyond mere description; they make the university–SME ecosystem structurally actionable. By identifying leverage points and anticipating unintended outcomes, institutions can co-create more resilient, inclusive, and adaptive systems. This shift from a mechanistic to a systemic institutional perspective enables more credible and sustainable innovation outcomes.

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