

Kanagawa University of Human Services
Graduate School of Health Innovation

【Doctoral Dissertation】

Summary

-Tentative until all sub-papers are published-

"Evaluation and Application of Redundancy
in Promotion of Health Innovation Ecosystem"

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I Introduction

The COVID-19 pandemic, officially recognized in March 2020, has highlighted the critical role of Health Innovation in ensuring public health resilience. The rapid development of mRNA vaccines and PCR testing demonstrated the importance of a robust and sustainable Health Innovation Ecosystem. While innovation in this field has been actively promoted worldwide, Japan has taken a unique approach by establishing government-led initiatives, such as the "Keihin Coastal Area Life Innovation International Strategic Comprehensive Special Zone" (hereinafter, "Special Zone") in the Greater Tokyo Area. However, despite these efforts, Healthcare Innovation in Japan remains constrained by high costs, prolonged regulatory processes, and inherent uncertainty.

A crucial concept in managing uncertainty is redundant design, a principle from natural sciences that enhances system reliability by incorporating backup elements. While redundancy is often perceived as inefficiency, it serves as a vital mechanism in high-risk fields such as aerospace and healthcare, ensuring continuity and resilience. However, its application in social sciences, particularly in policy and ecosystem research, remains underexplored. This dissertation investigates whether a similar redundancy mechanism exists in Health Innovation Ecosystems and examines its role in mitigating uncertainty and fostering innovation.

In addition, overlapping policies among local governments have raised concerns about cost-effectiveness and policy fragmentation. Financial departments often demand short-term results, making sustained policy support challenging. This research explores whether multilayered governance structures incorporating redundancy can foster innovation despite budget constraints. By applying Redundant Administration Theory and integrating insights from Innovation Ecosystem research, this study aims to evaluate how redundancy contributes to long-term ecosystem sustainability.

II Literature Review

This chapter consolidates existing research on redundancy in Health Innovation Ecosystems and identifies research gaps through a scoping review. While redundancy has been extensively studied in natural sciences, its role within social sciences—particularly in the context of Innovation Ecosystems—remains underexplored. This chapter systematically examines prior studies to clarify theoretical and empirical gaps, thereby providing a foundation for the research.

A scoping review was chosen over systematic reviews or meta-analyses due to the limited number of studies on redundancy in social sciences. Given the emerging nature of this research area, a scoping review allows for a broad exploration of existing studies and identification of gaps. The PCC (Population, Concept, Context) framework was employed to structure research

questions, ensuring a comprehensive analysis of how redundancy is conceptualized within Health Innovation Ecosystems.

The findings support theoretical models such as the Triple Helix Theory, which emphasizes the interaction between academia, industry, and government in driving innovation. However, existing research has not sufficiently examined how redundancy operates within these interactions, particularly in the context of post-pandemic ecosystem evolution. There is a need for further research that integrates both quantitative and qualitative methods to assess the impact of redundancy across different sectors. This dissertation contributes to addressing these gaps by systematically analyzing how redundancy functions as a stabilizing mechanism within Health Innovation Ecosystems.

III Single Case Study of the Health Innovation Ecosystem in the Greater Tokyo Area: Questionnaire Survey

This chapter investigates how multilayered policies influence the formation of Health Innovation Ecosystems in the Greater Tokyo Area, with a particular focus on the healthcare and life sciences sectors. By employing Redundant Administration Theory and the Triple Helix Model, this study evaluates whether overlapping policies and inter-organizational collaboration contribute to innovation creation. Specifically, a web-based survey targeting members of LIP.Yokohama, a major Academia-Industry-Government platform, is conducted to analyze the relationship between platform membership and innovation activities.

While previous studies on regional innovation have utilized the Triple Helix Theory to illustrate the roles of universities, industry, and government in driving innovation, they have not sufficiently examined how redundancy within these networks impacts innovation outcomes. Additionally, although Redundant Administration Theory has been discussed in the context of policy inefficiencies, its role in fostering innovation remains underexplored. This study integrates insights from information theory to assess whether redundancy in Innovation Ecosystem policies serves as a stabilizing force that fosters sustainable innovation.

Japan's approach to fostering innovation follows a top-down model, where national and local governments collaborate in strategic initiatives to support ecosystem formation. Two key examples of such initiatives are the Keihin Coastal Area Life Innovation International Strategic Comprehensive Special Zone (Special Zone) and the Greater Tokyo Biocommunity (GTB).

The Special Zone, established in 2011, serves as a policy-driven innovation hub focused on the pharmaceutical and medical device sectors, offering regulatory and financial incentives to attract industry players. Similarly, GTB, designated as a Global Biocommunity in 2022, comprises multiple regional innovation clusters that promote collaboration between academia,

industry, and government. These initiatives have resulted in the development of multiple overlapping innovation platforms, creating a layered ecosystem where public and private actors interact dynamically. However, the extent to which this redundancy facilitates or hinders innovation remains unclear. This study examines whether multilayered policies create an environment conducive to innovation by reducing uncertainty and fostering synergies.

Prior research on regional innovation frequently employs the Triple Helix Theory to illustrate how universities, industry, and government interact to drive innovation. This theory highlights the importance of role-sharing and collaboration, suggesting that mutual redundancy—where actors assume overlapping roles—can enhance synergy and reduce uncertainty. However, empirical studies assessing the impact of redundancy within Innovation Ecosystems remain scarce, particularly in the post-pandemic context.

Similarly, while Redundant Administration Theory has been discussed in the context of overlapping administrative functions, its application to innovation policies is still underdeveloped. Critics argue that redundant policies may lead to inefficiencies and increased costs, yet little research has examined whether these policies contribute to sustainable innovation. This study integrates insights from information theory, particularly Shannon's entropy model, to assess whether redundancy within Innovation Ecosystem policies functions as a stabilizing mechanism that enhances innovation sustainability.

This study confirms that redundant innovation platforms contribute to ecosystem development by facilitating cross-sectoral collaboration and reducing uncertainty. The survey findings reveal that organizations participating in multiple innovation platforms exhibit higher engagement in innovation activities. Additionally, network analysis indicates that redundant structures create additional opportunities for knowledge exchange.

However, to generalize these findings, comparative analyses across different regions are needed. Future research should employ big data-driven network analyses to track long-term ecosystem evolution. Moreover, integrating qualitative research will help capture tacit knowledge held by key ecosystem actors. The next chapter delves deeper into these qualitative aspects through an interview-based investigation.

IV Single Case Study of the Health Innovation Ecosystem in the Greater Tokyo Area: Interview Survey

The formation of Health Innovation Ecosystems in the post-pandemic era has attracted significant academic interest, particularly in global innovation hubs such as Silicon Valley and Boston. However, research on Japan's ecosystem development during and after the COVID-19 pandemic remains scarce. Given the critical role of Health Innovation in addressing public health

challenges and advancing medical technology, understanding the mechanisms that support ecosystem formation in Japan is essential. This chapter examines the formation process of Health Innovation Ecosystems in the Greater Tokyo Area, focusing on key structural and behavioral factors that contribute to their sustainability.

To explore this issue, semi-structured interviews were conducted with Key Figures from organizations that play a central role in local government-led platforms. These individuals provide valuable insights into the strategic initiatives, collaborative frameworks, and policy interventions that shape the ecosystem. The analysis is grounded in the Modified Grounded Theory Approach (M-GTA) and supplemented by Text Mining techniques to identify recurring themes and conceptual patterns. Through this methodological approach, the study elucidates the dynamic interactions among ecosystem stakeholders and highlights the structural conditions necessary for sustainable innovation.

The findings suggest that multi-layered, trust-based networks are integral to ecosystem resilience. The presence of Key Figures who facilitate inter-organizational collaboration, leverage cross-sector expertise, and maintain long-term commitments to ecosystem development emerges as a defining characteristic. Furthermore, redundancy—traditionally viewed as inefficiency in administrative contexts—appears to play a constructive role in reducing uncertainty and fostering adaptability. Balanced redundancy, where multiple stakeholders perform complementary roles without excessive overlap, contributes to ecosystem stability and enhances innovation potential.

While government-led initiatives provide a foundational support structure, this study indicates that the long-term viability of Health Innovation Ecosystems depends on mechanisms that extend beyond policy cycles. Self-sustaining networks, characterized by interdependent yet autonomous actors, are crucial in maintaining momentum and fostering innovation continuity. As the innovation landscape evolves, strategies that integrate government support with market-driven and academic collaboration will be essential in sustaining ecosystem growth.

Future research should expand on these findings by incorporating big data-driven network analyses to map the evolving structure of innovation ecosystems over time. Additionally, comparative studies across different regional ecosystems in Japan and internationally could provide further insights into best practices for ecosystem sustainability. Understanding the balance between government intervention, private-sector engagement, and academic collaboration will be key to optimizing the ecosystem's resilience and innovation capacity in the post-pandemic era.

V Result and Discussion

This dissertation investigates the key factors influencing the formation of Health Innovation Ecosystems, with a particular emphasis on redundancy and its role in reducing uncertainty in innovation processes. The COVID-19 pandemic has led to profound changes in societal structures and behavioral patterns, necessitating an examination of how these transformations have shaped innovation creation in Japan. Focusing on the Greater Tokyo Area, this study analyzes the intricate interplay between overlapping public and private support mechanisms, which collectively contribute to a multi-layered and complex ecosystem.

While redundant design has been widely acknowledged in the natural sciences as a fundamental principle for enhancing system reliability, its application within the social sciences—particularly in policy frameworks and ecosystem research—remains underexplored. This dissertation investigates whether intentional redundancy can serve as a strategic driver in the formation and sustainability of Health Innovation Ecosystems, providing a novel interdisciplinary perspective.

The findings of this research offer empirical evidence supporting the hypothesis that redundancy plays a constructive role in fostering Innovation Ecosystem. The results suggest that rather than being perceived solely as inefficiency, redundancy can be strategically leveraged to enhance ecosystem stability and adaptability. Future research should expand upon these insights by conducting comprehensive network analyses, exploring the long-term policy implications of redundancy, and refining strategies for its effective implementation within Innovation Ecosystems.

VI Conclusion

This dissertation contributes to the understanding of Health Innovation Ecosystem formation by applying the concept of redundancy, a principle widely utilized in the natural sciences, to the study of innovation systems. By adopting an interdisciplinary approach, this research bridges the gap between natural sciences and social sciences, offering novel insights into how redundancy enhances ecosystem stability and long-term sustainability.

A key finding of this study is that redundancy plays a crucial role in fostering a stable and adaptive Health Innovation Ecosystem. While redundancy has traditionally been perceived as a source of inefficiency in public administration, this research demonstrates its potential to enhance innovation sustainability by mitigating uncertainty and enabling continuous adaptation.

Future research should expand upon these findings by investigating optimal policy designs that incorporate redundancy, network structures that facilitate ecosystem stability, and longitudinal analyses that track the evolution of redundancy-driven innovation ecosystems. A

more refined theoretical framework for Innovation Ecosystem formation will enable policymakers and industry stakeholders to develop more effective, adaptive, and sustainable innovation strategies.

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