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## 論文の要旨 Abstract of Dissertation

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題 目 Title of Dissertation	Evaluation and Application of Redundancy in Promotion of Health Innovation Ecosystem
要 旨 Abstract <p>This dissertation examines the factors promoting the sustainable formation of a Health Innovation Ecosystem in fields such as drug discovery and medical devices. It argues that innovation ecosystem policies promoted by national and local governments, along with the infrastructure of the ecosystem comprising neutral intermediary support organizations, may undermine the overall optimization of the ecosystem if the design focuses solely on the cost-effectiveness and economic rationality pursued by individual actors. To address this issue, the research question focuses on identifying the factors that facilitate the ecosystem's development. Utilizing the framework of Redundant Administration Theory—which applies the concepts of redundancy and redundant design, often used in natural sciences to mitigate uncertainty and enhance success rates—this study explores the identification and applicability of redundancy in the ecosystem from the perspectives of Triple Helix Theory and Social Network Theory, complementing the limitations of Redundant Administration Theory.</p> <p>This dissertation is composed of six chapters, each addressing key aspects of the study. Chapter 1 outlines the context of the research, emphasizing the heightened expectations for realizing a Health Innovation Ecosystem following the COVID-19 pandemic. The chapter also notes that prior research focusing on behavioral changes during the pandemic remain limited. It highlights the distinct challenges in pharmaceutical and medical device development, where time and cost requirements increase uncertainty. Under the hypothesis that redundant design principles, established in natural sciences, may provide a useful approach to reducing such uncertainty, the research questions explore how the Health Innovation Ecosystem is formed and what factors promote its development.</p> <p>Chapter 2 of this dissertation conducts a literature review focusing on prior research that incorporates the concept of redundancy and redundant design within innovation ecosystems. The concept of redundant design, which originated in the information and communication technology sector, has since found numerous applications in natural sciences. To begin, a</p>	

preliminary survey using academic literature databases was carried out to capture an overview of the existing research across various fields. Following this, a scoping review was employed to specifically investigate prior research that applied the concept of redundancy within Health Innovation Ecosystems. The review found that research in social sciences is relatively limited, especially research conducted during the COVID-19 pandemic. The findings from the literature include key insights, such as the Triple Helix Theory, which illustrates how interactions between academia, industry, and government can reduce uncertainty and promote innovation. Other studies emphasize the importance of maintaining a balanced ecosystem, which includes redundancy, to achieve overall harmony. Furthermore, the review highlights the potential of using social network analysis to identify redundancy within ecosystems. These insights provided a framework for the ongoing research and revealed gaps in the current literature that the research aims to address

Chapter 3 focuses on a case study in the Greater Tokyo Area to examine how the multi-layered and polycentric network of the Health Innovation Ecosystem influences innovation creation. A survey was conducted targeting actors involved in innovation across academia, industry, and government, including intermediary support organizations. The survey classified participants into two groups based on their membership in innovation platforms: those belonging to a single platform and those belonging to multiple platforms. The relationships between platform membership and the participants' innovation activities and achievements were analyzed. To visualize the network relationships among actors in the Greater Tokyo Area, Social Network Analysis (SNA) was used. This analysis illustrated the network connections between participants. The survey specifically targeted participants in the Yokohama city industry-academia-government platform, revealing that participants who were members of multiple loosely connected platforms demonstrated more altruistic behavior and had higher potential for innovation creation. This chapter highlights the positive effects of diverse and layered networks in fostering innovation through collaboration and altruism within the ecosystem.

In Chapter 4, an interview survey was conducted with key figures involved in the formation of the Health Innovation Ecosystem in the Greater Tokyo Area. The analysis was performed using the M-GTA (Modified Grounded Theory Approach), which examines the formation process. The semi-structured interview method was chosen as it effectively captures both explicit and tacit knowledge held by key figures in relation to ecosystem development. "LIP.Yokohama" was selected for its close ties to special economic zones and public-private platforms. The interviews targeted participants from organizations that contribute to the ecosystem's growth. The M-GTA, a qualitative research method for theorizing human practices, was utilized in the analysis. The generated theory is expected to be applied and verified in practical settings. Additionally, text mining of interview transcripts was performed to provide a quantitative overview, assisting the concept generation process in M-GTA. Key shared themes

included the overall importance of the ecosystem, the value of trust-based multi-network structures, the necessity of trial and error, and the role of physical "places." These elements were identified as contributing factors in facilitating ecosystem formation.

Chapters 5 and 6 discuss the quantitative and qualitative research findings from the previous two chapters through the lens of Redundant Administration Theory, integrating insights from the Triple Helix Theory, Social Network Theory and Complex Adaptive Systems Theory as identified in the Scoping Review. The results indicate that the overlaps created by multiple platforms act as mutual redundancies in accordance with the Triple Helix Theory, mitigating uncertainty. Moreover, loosely connected networks formed by multiple platforms constitute complex adaptive systems, and redundancy in the innovation ecosystem was identified through the "strength of weak ties" in Social Network Theory. This study conclusively shows that multilayered, polycentric networks fostering mutual redundancy play a critical role in the formation of an effective Health Innovation Ecosystem. Furthermore, it suggests that approaches based on the Triple Helix Theory, Social Network Theory and Complex Adaptive Systems Theory hold promise for advancing Redundant Administration Theory. (937 words)

(Note) Please describe the abstract within approx. 2,000 letters in Japanese or 1,000 words in English.