

Loose Connections for a Co-creative Regional Society: A Framework and an Implementation System

Maho Hoshiai

Social informatics, Chuo University, 742-1 Higashinakano, Hachioji, Tokyo, Japan

maho.hoshiai@gmail.com

Abstract— To realize a co-creative regional society, it is essential to advance initiatives such as regional innovation and digital transformation (DX), regional platform development, sustainable community building, interdisciplinary collaboration, and cross-industry networks. Through an analysis of these initiatives, this study demonstrates that the concept of *loose connections* constitutes the essence of realizing a co-creative regional society. To formulate loose connections, we propose a seven-layer framework. Furthermore, to operationalize loose connections, we present an implementation system that leverages Web 3.0 and AI technologies.

Keywords— Co-creative regional society, Loose connections, P2P, Seven-layer framework, Innovation, DX, Platform, Sustainable community, Interdisciplinary collaboration, Cross-industry networks, Implementation system, Web 3.0, AI

I. INTRODUCTION

Driven by the overconcentration in Tokyo and the nationwide population decline, local regions in Japan are facing severe labor shortages and fiscal constraints. Under these conditions, realizing a co-creative regional society that balances self-help and mutual aid has become an urgent challenge.

To address this issue, several initiatives are crucial, including the promotion of regional innovation and DX, the development of regional platforms, the formation of sustainable communities, and the facilitation of interdisciplinary collaboration and cross-industry networks.

Through an analysis of these initiatives, it was clarified that realizing a co-creative regional society requires *Yokogushi*—a concept originating in Japan that denotes horizontal linkages among diverse regional activities and resources—for which loose connections are particularly effective. Therefore, one of the essential elements in realizing a co-creative regional society is the concept of loose connections.

In problem-solving contexts, actors who share the same problem awareness, issue recognition, and value tend to be connected with one another. Such connections are referred to as vertical connections. These connections are characterized by strong connections resulting from shared values and perspectives.

In contrast, initiatives aimed at regional innovation and DX emergence, regional platform construction, and interdisciplinary or cross-industry collaboration inevitably connect actors with different problem awareness, issue recognition, and value. Such connections are referred to as horizontal connections. These connections are characterized by loose connections that bridge heterogeneous values and perspectives, rather than strong connections.

Loose connections require a common language, as they must be constructed across disciplines and industries with distinct languages.

Accordingly, to concretize the concept of loose connections, we propose a new seven-layer framework (Layers 1–7) based on P2P theory as a novel method for verbalization [1][2].

Finally, to operationalize loose connections in practice, we propose an implementation system that leverages Web3.0 and AI technologies [2].

II. ISSUES IN CURRENT INITIATIVES

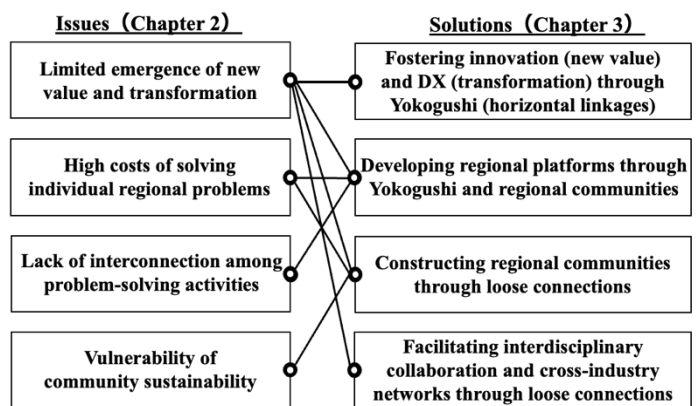


Figure 1. Issues and solutions in initiatives for realizing a co-creative regional society

Although initiatives aimed at realizing a co-creative regional society have been undertaken across Japan, the following issues remain, as shown in Figure 1.

- Limited emergence of new value and transformation: Activities addressing local problems or “troubles” rarely lead to the emergence of new value.

- High costs of problem-solving: Such activities often require substantial human, financial, and time resources, leaving numerous issues unresolved.
- Lack of interconnection among activities: Problem-solving activities frequently operate in isolation, with only limited collaboration or interoperation.
- Vulnerability of community sustainability: Regional communities are prone to collapse once governmental subsidies are withdrawn or key individuals are no longer engaged.

III. CONSIDERATIONS AND PROPOSALS TO ADDRESS THE ISSUES

A. Problem-Solving Approach vs. Innovation Approach

Conventional activities for regional revitalization have generally followed a problem-solving approach. Activities under this approach have not readily led to the emergence of new value or transformation because their primary purpose is to resolve specific issues. As shown in Figure 2, the problem-solving approach assembles the resources required for each issue and utilizes them to undertake activities that produce outputs such as goods and services, resulting in the intended effects as their goals.

This approach requires *Tategushi*—a concept originating in Japan that denotes vertical linkages—for which strong connections, characterized by top-down and centralized structures, are effective, as shown in Figure 3. However, strong connections rely on uniformity and homogeneity based on shared values. It is widely acknowledged that such connections are limited in their ability to generate new value or facilitate regional and societal transformation. In short, the seeds of innovation and DX do not lie in the extension of *Tategushi* [1][2].

By contrast, the emergence of regional innovation and DX requires cross-cutting deployment that fosters *Yokogushi*, for which loose connections are considered effective [3]–[6]. Loose connections are bottom-up, autonomous, and decentralized cooperative linkages characterized by diversity and heterogeneity based on differing values. For example, Reference [7] describes individuals capable of facilitating cross-cutting deployment, referred to as *Yokogushists*, and discusses initiatives to cultivate them as innovative human resources.

Therefore, to foster the emergence of new value and transformation through regional revitalization initiatives, it is crucial to design an appropriate combination of both types of connections: strong connections for the problem-solving approach and loose connections for the innovation approach.

B. Monolithic Architecture vs. Platform-based Architecture

A further issue with the problem-solving approach is the high costs, such as labor, budget, and time, that arise throughout the entire process from the input to the outcome phases, as well as the difficulty of collaboration among activities. This issue is illustrated in Figure 4 by an example from the IT industry. Before 1964, it was common in the IT industry to develop each system from scratch. This is referred

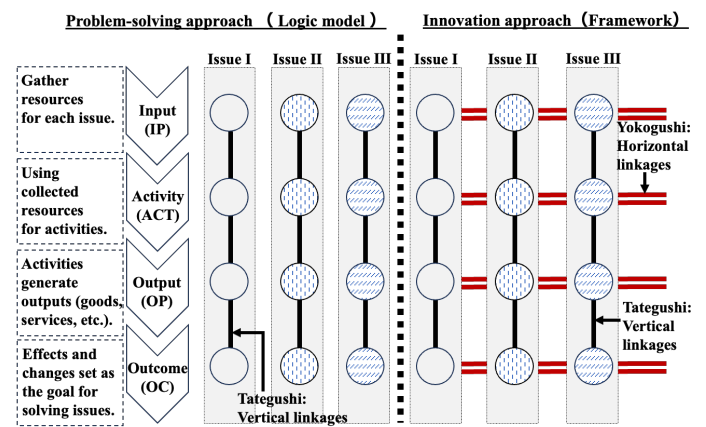


Figure 2. Problem-solving approach vs. Innovation approach

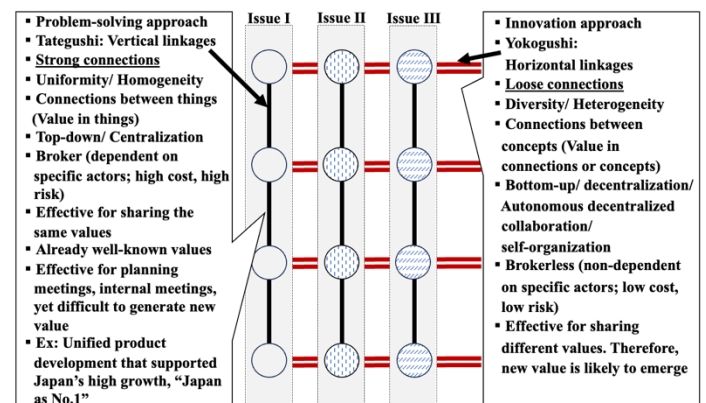


Figure 3. Strong connections vs. Loose connections

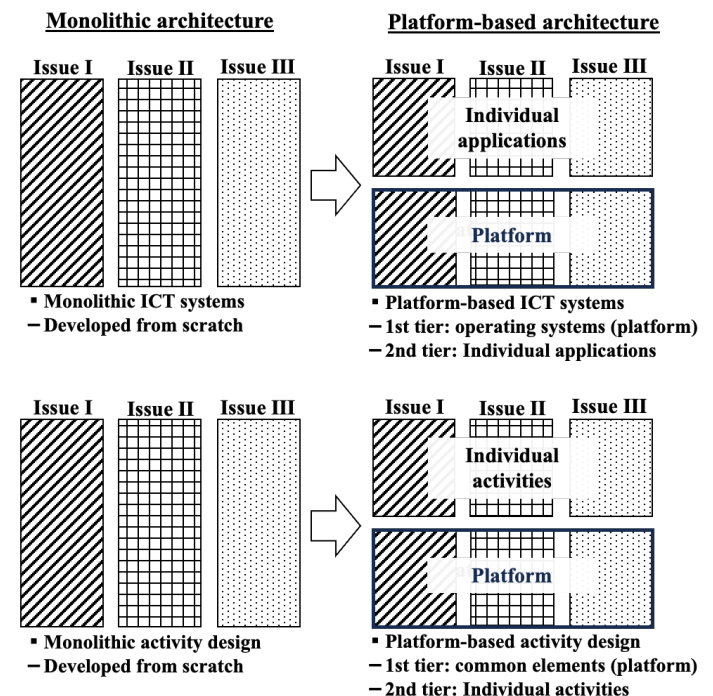


Figure 4. Monolithic architecture vs. Platform-based architecture

to as a monolithic architecture. In such monolithic ICT systems, large development teams, high costs, and long project durations were required, which became serious problems. In addition, interoperability among systems was difficult because new gateway systems had to be developed, adding a further burden.

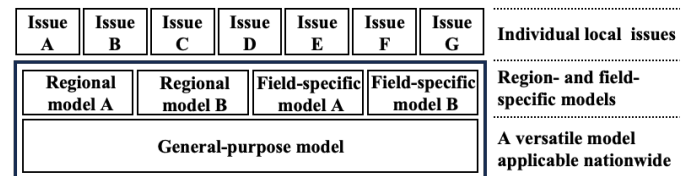
As a solution, in 1964 IBM introduced a novel concept, a platform-based architecture, which decomposed monolithic ICT systems into two tiers: operating systems (OSs) as a common platform and individual applications (apps). These are referred to as platform-based ICT systems. For example, by delegating data storage to the OSs' file management functions, redundant development of common system functions was eliminated. As a result, development time was shortened, the number of developers was reduced, and costs were lowered. Furthermore, by delegating interoperability to the OSs' inter-process communication (IPC) functions instead of developing individual gateway systems, applications were able to interoperate more easily. More recently, the platform in platform-based ICT systems has evolved from operating systems to cloud computing.

In view of such successful cases, the field of regional revitalization should also adopt a platform-based architecture. In other words, platform-based activity design should be implemented, separating the conventional monolithic activity design into two parts: common elements that serve as a platform shared by all activities and components specific to each activity. Based on this idea, this study proposes a *three-tier regional revitalization platform model* (Figure 5), which can be applied to various regional platform constructions. This model can reduce the costs of traditional monolithic activity design while enabling the realization and visualization of relationships among activities deployed on the platform.

For instance, under the Aso City Regional DX Promotion Council, led by Aso City, SCB Lab, and the Sojo University IoT/AI Center, a demonstration project is being planned to form a local government collaboration platform through the loose connections among about 30 local governments, including Aso City, Shimanto City, and Yatsushiro City in Japan, as well as several universities and businesses [8]. Here, the three-tier regional revitalization platform model is applied, as illustrated in Figure 5, and is composed of the following three tiers:

- The first tier serves as a common platform for all regional institutions, such as local governments.
- The second tier is a shared platform for specific regions or fields.
- The third tier consists of individual local issues and activities deployed on the platform.

Through this local government collaboration platform, problem-solving activities deployed on the two-tier platform become loosely connected to one another. To ensure that the operation of the platform does not become a burden, it is also important that the platform itself be built through loose connections. For example, the platform should be formed through loose connections among regional resources, local communities, and across activities.



Regional Revitalization Platform

※ Building a platform by loosely connecting regional resources.

Figure 5. Three-tier regional revitalization platform model (e.g. local government collaboration platform)

C. Establishing Sustainable Regional Communities

The following issues are anticipated in relation to the so-called “2040 problem” in Japan [9]. With population decline and a weakening economic base, it will become difficult to maintain functions that support daily life. In particular, as neighborhood-based organizations are losing their capacity, spaces for mutual aid will be lacking, increasing the fiscal burden on local governments. Accordingly, local governments must adjust the balance among self-help, mutual aid, and public assistance. In addition, they must create new spaces for mutual aid to support residents' lives. As such spaces, it is necessary to build sustainable regional communities, for which loose connections are indispensable.

For example, Ashiya City in Japan has promoted the concept of “Just-Right Learning,” which refers to personalized learning tailored to individual needs, and aims to realize “school where people learn together through loose collaboration.” To achieve this, it is essential to build sustainable regional communities constructed through “articulated loose connections” [10][11]. This is because regional communities based on strong connections, or even on loose connections that are not articulated, tend to exhibit low sustainability.

The reason for the unsustainability of conventional regional communities can be examined from the perspectives of strong connections and loose connections, as follows.

For example, the client-server model constitutes a community formed by connecting clients to one another through a server. In this model, the client is the actor that issues requests, with the server as the actor that responds to those requests and their respective roles clearly defined. Such a community presupposes the existence of the server and is constructed through strong connections between the server and the clients. Consequently, if the server fails or withdraws, the operation of the community cannot be sustained. In addition, the cost of maintaining the server is a significant burden.

More specifically, this client-server model can be examined by drawing an analogy to the Japanese board game Shogi, often referred to as Japanese chess. In the game, Shogi pieces are placed on the board from the outset, and each piece is assigned a predetermined role. Since all pieces but King are tasked with both protecting its own king and capturing the opponent's king, the pieces form strong connections (or a strong community). In other words, this community is

predicated on the existence (and survival) of the king. In this analogy of the client–server model, the king corresponds to the server, while the other pieces correspond to the clients. Consequently, once the king is captured, the community collapses, resulting in the loss of the match. This is why defending or capturing the king requires substantial costs.

Thus, maintaining strong connections inevitably entails high risks and costs. Conversely, connections that involve such high risks and costs are strong connections.

On the other hand, in the game of Go, play begins from a blank state where no stones are placed on the board. Unlike Shogi pieces, Go stones are not assigned predetermined roles. Rather, the role of each stone is determined by when and under what circumstances it is placed on the board. Indeed, the Japanese Go term *Fuseki* denotes that a stone playing only a minor role at the time of placement may later assume a crucial function. Furthermore, in Go, stones placed after preceding ones, in agreement or resonance with them, gradually form loose connections that constitute a community (territory). In other words, even if one territory is lost, it is sufficient to secure another elsewhere, because the existence of a specific stone such as a king is not presupposed.

In this way, since a community constructed through loose connections does not depend on intermediaries (brokers) such as servers, that is, *brokerless*, it can be sustained without incurring high risks or costs. As a result, connections that enable sustainability at low risk and low cost are defined as loose connections.

Therefore, in the construction of regional communities where it is difficult to bear high risks and costs, the method of community formation through loose connections becomes effective. However, the reliance on strong connections for community building in the past has made ensuring sustainability difficult.

From these considerations, it has also become evident as a secondary effect that Go is effective as a simulation or

training tool for constructing loose connections, whereas Shogi is effective as a simulation or training tool for constructing strong connections.

D. Interdisciplinary Collaboration and Cross-Industry Networks

By constructing a platform for regional revitalization through loose connections among regional resources across different fields, the activities developed on the platform can also be loosely interconnected. This, in turn, promotes not only the emergence of new value but also interdisciplinary collaboration and cross-industry networks.

From these considerations, it can be understood that loose connections are effective for emerging innovation, constructing platforms, establishing sustainable communities, and facilitating interdisciplinary collaboration and cross-industry networks. Moreover, loose connections constitute an essential element for realizing a co-creative regional society.

IV. A FRAMEWORK FOR LOOSE CONNECTIONS

In Section 3, it was pointed out, based on case studies, that loose connections are the key concept for realizing a co-creative regional society. In this chapter, we propose a framework to embody this concept of loose connections. This paper focuses on P2P theory [3]–[6], which aims to clarify the question “What is the essence of connections?”. P2P theory, which adopts connection types based on loose connections, has given rise to innovative services such as Skype [12], SNS [13], P2P insurance [14], P2P electricity [15], virtual supercomputers [16], and blockchain [17].

Therefore, by integrating the concept of P2P Theory with sociological perspectives such as Social Network Theory (e.g. the Strength of Weak Ties) [1][2] and Self-Determination Theory [18], this study extends the applicability of P2P beyond the Internet to real-world society. These ideas are organized into seven hierarchical layers (Layer 1 through

Table 1. The framework of loose connections

Layer	Layer name	component elements of each layer
Layer 7	Applicability (Applications)	Services that require loose connections: innovation, platform (visualization), sustainable community, interdisciplinary collaboration, cross-industry networks, and organization design
Layer 6	Principles	<u>Principles</u> : autonomy (self-determination), brokerless (connections that do not depend on specific actors; as a result, low cost and low risk), diversity, valuable “connections” and “concepts” rather than “objects,” effective for horizontal and diagonal linkages <u>Autonomy</u> : a cycle of existence, connection, learning, creation <u>Recommended connections</u> : connections with existing resources, user resources, well-known resources, resources from successful or growing fields, and new connections
Layer 5	Incentives	Non-material incentives: empathy, rights, capability complementation
Layer 4	Trust	The use of well-known resources, use of resources from successful or growing fields, connection multiplicity, connection transparency, connection history
Layer 3	Property categories and their lifetimes (Virtualization)	Function / object / activity / concept / connection, lifetime, virtualization (encapsulation / interface) e.g. parent–child, friendship, colleague, and superior–subordinate relationships
Layer 2	Ensuring connection persistence	Brokerless (serverless), servant, self-organization (failover function), neighborhood memory (“a friend of a friend is a friend.”), role (user/ provider/ operator), determinants of social non-dependence
Layer 1	Connections types (systematization)	Pure / Hybrid / Semi-pure / Chain, from a zero (“gather around this finger.”), a peer group is a peer, self-organization (grouping: a group emerges as a result of connection)

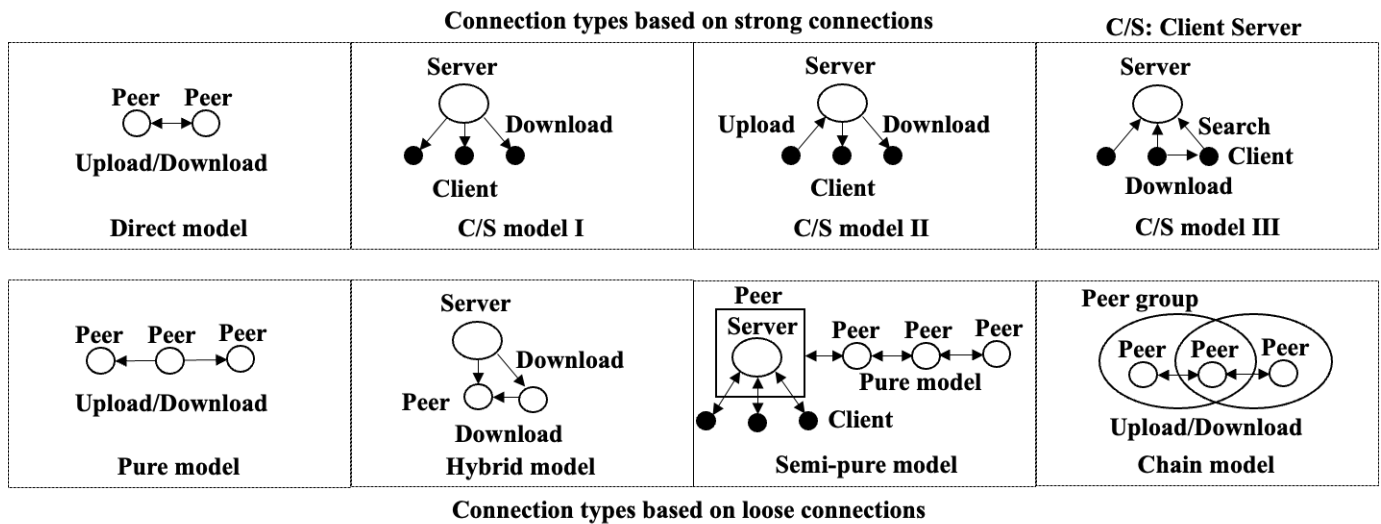


Figure 6. Connection types

Layer 7), and we propose a new framework in which each layer is defined by its component elements (Table 1).

1) Layer 1 Connection Types:

Layer 1 specifies the connection types for realizing physical connections (e.g. Figure 6). These eight types are broadly classified into strong connections and loose connections [19]. In this framework, a client is defined as the actor that makes processing requests, a server as the actor that responds to such requests, and a peer as the minimal unit capable of autonomous distributed cooperation. To construct loose connections, peers begin from a zero (blank) state and sequentially connect with others who share resonance, following the “Kono yubi tomare!” approach, a Japanese expression meaning “Gather around this finger.” At this stage, individual peers do not join an existing group, but they form a self-organized group as a result of multiple peers becoming connected—a function called *grouping* (e.g. Figure 7). The set of connected peers is called a peer group, which itself can be regarded as a peer. In this way, autonomous and scalable connections can be established.

2) Layer 2 Ensuring Connection Persistence:

Layer 2 defines the components that ensure connection persistence from two perspectives. From the physical networks aspect, it specifies brokerless connections, servant, and self-organization (*failover function*), *neighborhood memory*; and from the social networks aspect, it defines the determinants of social non-dependence.

The essence of loose connections lies in constructing brokerless connections that do not depend on specific actors, thereby enhancing flexibility, reducing risk and cost, and increasing scalability. These effects, in turn, contribute to sustaining connections. To realize brokerless connections, each actor assumes both the role of requester and responder, a dual role referred to as a servant. When a peer withdraws from a connection, other peers self-organize to maintain stability by performing *failover function*. For this purpose, peers must

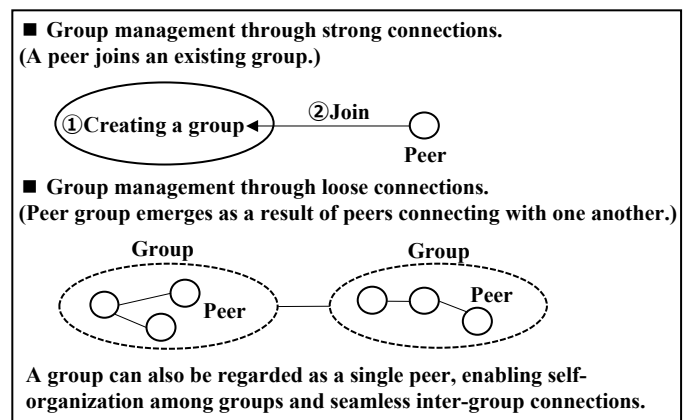


Figure 7. Grouping within self-organization

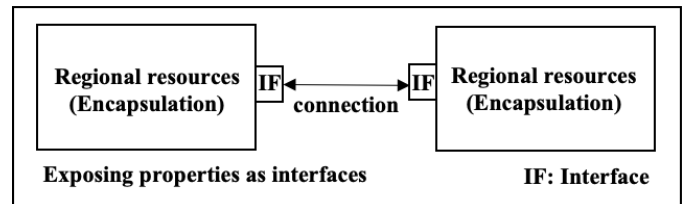


Figure 8. Virtualization of regional resources

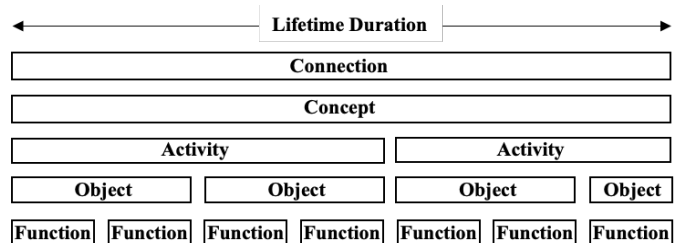


Figure 9. Property categories and their lifetimes

maintain records of each other—a mechanism referred to as *neighborhood memory*.

On the other hand, to establish social non-dependence on specific actors, this study adopts the four components determining the strength of a tie, as proposed by Granovetter [1][2]. Specifically, these components are the amount of time spent in contact, emotional intensity, intimacy (mutual confiding), and reciprocal services, each of which is quantified. When the values of these components are low, the relationship is regarded as a weak tie characterized by low dependency on others. Conversely, when the values are high, it is regarded as a strong tie characterized by high dependency.

3) Layer 3 Property Categories and their Lifetimes:

Layer 3 specifies interface design that takes into account the lifetime of properties, based on the virtualization of regional resources (e.g. Figure 8). Properties are the metadata of peers and are classified into five categories: functions, objects, activities, concepts, and connections. The higher the level of abstraction, the longer the lifetime (e.g. Figure 9).

For instance, relationships such as those between parents and children or between superiors and subordinates in a company can be described as properties that represent the purpose or reason for connection. Furthermore, this parent-child relationship is classified into the property categories shown in Figure 9.

From a developmental psychological perspective, in the parent-child relationship, the father fulfills the function of socialization (conveying the external world to the family), the mother plays the role of protection (maintaining stability within the household), and the child embodies acceptance and growth (internalizing parental influences and extending them into society). When the father, mother, and child each form their relationships through specific functions, these function-based relationships tend to collapse once the child leaves home and no longer requires the parental functions. In other words, connections formed through functional properties as interfaces are role-fixed, making them vulnerable to change and less sustainable.

In contrast, a parent-child relationship connected through conceptual properties, such as shared understandings of “what is valued” and “what kind of future to realize together,” tends to have a strong and lasting influence throughout life. Even when the child leaves home and establishes a new family, such a parent-child relationship is less likely to collapse, as such connections are not dependent on specific functions or roles but are supported by shared concepts and values. Consequently, they exhibit high flexibility and are capable of long-term sustainability.

As shown in Figure 10, the concept of properties can be explained by using the construction of “a loose learning space” as a platform. For example, once the “concept” such as purpose or vision of “providing cutting-edge learning at low cost” is established, the “activities” to be undertaken in order to realize this concept are determined. It should be noted that connections among activities are more important than the activities themselves. This is because, first, new value is more likely to emerge from the loose connections among activities or resources than from the activities themselves. Second, connections among activities tend to have a longer lifetime

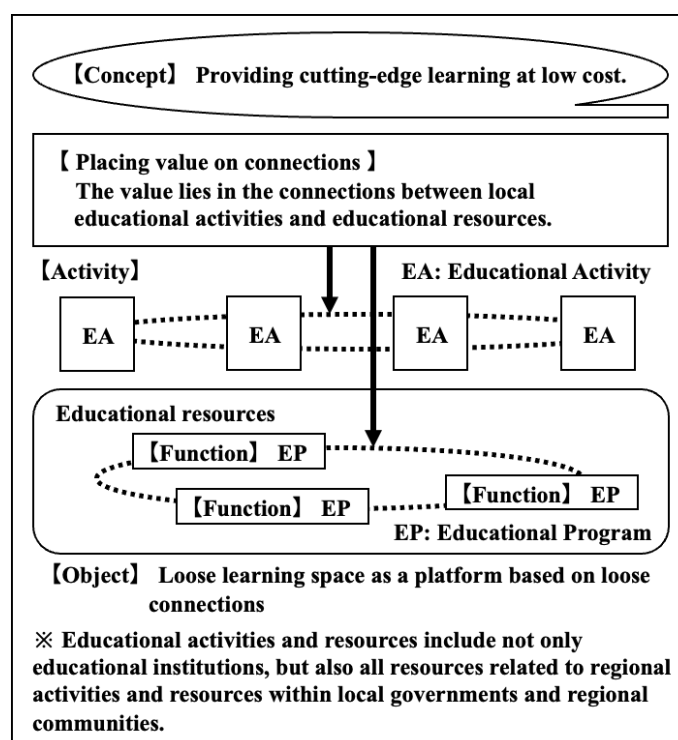


Figure 10. Loose learning space as a platform based on loose connections

than the activities themselves. From the connections among activities or resources, the “object” of a loose learning space is generated. Furthermore, from this loose learning space, numerous educational programs are provided as “functions.” The idea that “connections themselves are more valuable than objects” will be discussed in Layer 6.

4) Layer 4 Trust:

Layer 4 defines the use of well-known resources, the utilization of resources from successful fields, connection multiplicity, connection transparency, and connection history in order to ensure the reliability of connections. Connecting with well-known resources or those from successful domains helps to secure the safety of connections.

Connection multiplicity is a critical factor that directly contributes to the stability and reliability of connections. By constructing multipath connections, interactions among peers are activated, thereby enhancing the sustainability of the network. For example, in decentralized autonomous organizations (DAOs), structures with high connection multiplicity make the connection falsification impossible and strongly guarantee the technical reliability of the entire system [20].

Connection transparency is an indispensable component that supports peer trust and peer-to-peer cooperation. In DAOs, operational rules, decision-making processes, and program codes are fully exposed on the blockchain, allowing anyone to verify the information and the history of decisions. Such transparency ensures trust in the system and contributes to the stability of the entire network as well as to peer-to-peer cooperation. Reference [21] points out that the disclosure of

information and processes generates natural trust relationships, while Reference [22] notes that the visualization of decision-making processes enhances cooperation and stability in organizations and networks.

Connection history is an important criterion of trust. It can be defined as the duration connections with a clear vision are maintained. Therefore, connections that are maintained with a clear vision and in alignment with this vision can be regarded as worthy of trust.

5) Layer 5 Incentives:

While Layer 2 specified mechanisms for ensuring the sustainability of connections, Layer 5 defines incentives for constructing and maintaining loose connections.

Strong connections typically require incentives that rely on a strong sense of obligation, coercion, or high-cost rewards. For example, material incentives are typically provided, with objects such as money serving as the medium.

In contrast, incentives in loose connections presuppose low-cost and low-risk conditions, so that non-material incentives are effective [23][24]. Non-material incentives for loose connections can be classified into three categories: empathy, rights, and capability complementation.

The first incentive is empathy. When an actor feels empathy toward a concept or vision, the motivation is not to obtain external rewards but rather to connect with those who share that empathy. In this way, empathy-based incentives enable low-cost connections while ensuring high effectiveness. Moreover, as noted in Layer 3, empathy toward a concept has a longer lifespan as a property than material objects such as money. Therefore, empathy based on concepts or values contributes to the sustainability of connections.

The second incentive is rights. Providing rights, such as decision-making authority or opportunities for participation in initiatives, functions as an incentive that fosters the autonomy of actors, particularly their capacity for self-determination. These rights ensure brokerless connections in Layer 2. Conversely, in the absence of such rights, the autonomy of actors is undermined, potentially resulting in high-cost connections that depend on specific actors.

The third incentive is capability complementation. In this case, actors are incentivized to connect with each other by complementing their respective deficiencies in capabilities. For instance, a virtual supercomputer [16] enables individual computers to realize a high-performance system by interconnecting and pooling their resources, such as CPUs, primary memory (RAM), and secondary storage (hard disks or SSDs).

6) Layer 6 Principles:

Layer 6 defines the fundamental principles of loose connections. The essence of loose connections is as follows:

- Autonomy: autonomous and decentralized cooperative connections
- Diversity
- Brokerless: connections that do not depend on specific actors

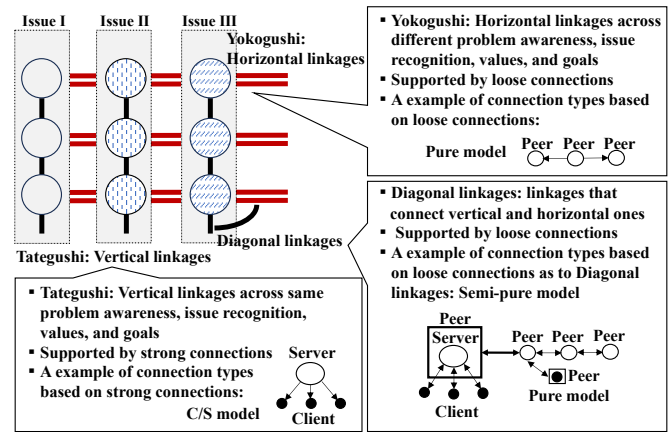


Figure 11. Diagonal Connections

- Valuable “connections” and “concepts” rather than “objects”
- Effective for horizontal linkages (Yokogushi) and diagonal linkages—linkages that bridge vertical and horizontal ones (e.g. Figure 11)

The first principle, Autonomy, in this context, presupposes the right of self-determination [18]. The right to self-determination comprises three elements: “Why to connect?” (purpose of connection = property), “How to connect?” (connection types), and “For what to connect?” (rewards of connection = incentive). When determining these elements, it is essential to place value not on tangible entities but on connections and concepts, to construct brokerless connections that are independent of specific actors, and to ensure diversity in connections.

The fourth principle, valuing connections and concepts, will be illustrated in the following. For instance, a supercomputer is an extremely expensive object, requiring development costs of hundreds of billions of yen and annual operating costs of several billion yen. Consequently, value tends to be placed on the object itself, for example, aiming to achieve the top ranking in supercomputer performance competitions.

In contrast, a virtual supercomputer [16] is constructed through the bottom-up interconnection of users’ personal computers (user resources) that already exist on the internet (existing resources). As a result, compared with a traditional supercomputer, it can be built at lower cost and risk. In this case, value is placed not on each personal computer as an object worth hundreds of thousands of yen, but rather on the connections among them.

Thus, interconnecting personal computers in a bottom-up manner embodies the fourth principle of loose connections, namely prioritizing connections and concepts over objects. In other words, loose connections are defined as those that place value on connections and concepts rather than on objects.

7) Layer 7 Applicability:

Layer 7 specifies the practical applications and services that require loose connections. For instance, they include regional innovation and DX, the construction of regional platforms, the

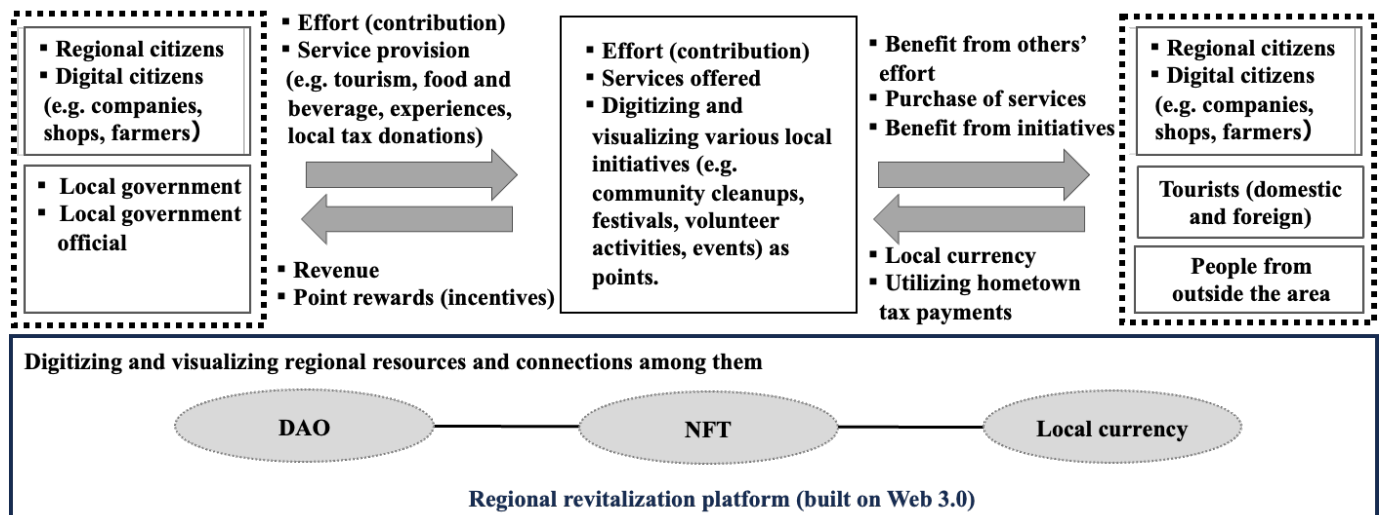


Figure 12. Regional resources collaboration system

building of sustainable communities, and the promotion of interdisciplinary collaboration and cross-industry networks.

V. IMPLEMENTATION SYSTEM

This chapter describes the implementation method of a regional revitalization platform, which represents one example of the social implementation of loose connections. This platform consists of two core systems: a regional resource collaboration system (e.g. Figure 12), which utilizes Web 3.0 technologies to link regional resources, and a data interoperability system (e.g. Figure 13), which applies AI technologies to promote loose interoperability among data. Consequently, a regional revitalization platform based on loose connections can be implemented through these two systems.

A. Regional Resource Collaboration System

This section describes the systematization of regional resource collaboration based on Web 3.0 technologies, which implements loose connections to interlink regional resources (e.g. Figure 12). Web 3.0 technologies enable decentralized systems based on blockchains [17], with DAOs [20], non-fungible tokens (NFTs), regional tokens, and decentralized identifiers (DIDs) serving as their core components. These technologies are highly suited to constructing loose connections, and they help create new collaborative environments that engage not only local residents but also external participants, such as visitors, migrants, foreign tourists, and digital citizens.

For instance, DAOs can make decisions and allocate funds transparently and automatically by means of smart contracts, realizing distributed governance by stakeholders both inside and outside the region. In addition, NFTs make it possible to visualize and share regional culture and tourism resources as digital assets, thereby promoting the co-creation of regional brands and the establishment of sustainable relationships. For instance, such digital assets can also contribute to revitalizing *Furusato Nozei*, the Japanese hometown tax donation system. These technologies, unlike conventional centralized systems,

are characterized by structures that support the autonomous participation of citizens and stakeholders.

Moreover, the introduction of regional tokens makes it possible to implement mechanisms that revitalizes the regional economic cycles by providing token-based rewards for the activities of citizens and visitors, such as volunteering or participating in community events. DIDs further facilitate the visualization of individuals' activity records, skills, and regional contributions, thereby promoting greater human resource mobility and the establishment of trust.

Furthermore, the concept of regional tokens can also be extended as a mechanism to steadily broaden loose connections. Based on the principle that "connections themselves are of the highest value," the following algorithm is presented to activate connections.

- When A and B connect for the first time, both are awarded a certain number of tokens.
- When A introduces B to C, both B and C are awarded tokens, while A is awarded a greater number of tokens.
- Sustained connections are rewarded with tokens that represent sustainability and trust.
- Connections with high diversity are awarded higher tokens.
- When B connects with others as result of connecting with A, A also receives tokens.
- Accumulated tokens can be utilized as resources to promote further connections.

In this way, systems employing Web 3.0 technologies are not merely information infrastructures but can function as components of a regional revitalization platform that supports the sharing of connections and values. The introduction of such systems, however, requires both digital literacy education and incentive design for local citizens, local government staff, and regional businesses, as well as advanced technical support for token design and the development of smart contracts.

Therefore, the implementation of Web 3.0-based systems in local regions should proceed in stages. It should begin with limited pilot experiments using DAOs and NFTs, and

subsequently expand into citizen-participatory co-creation systems building on the outcomes of these trials. Decentralized IT systems should not be regarded merely as “tools to use,” but rather as “co-created assets” jointly developed by all participants.

B. Data Interoperability System

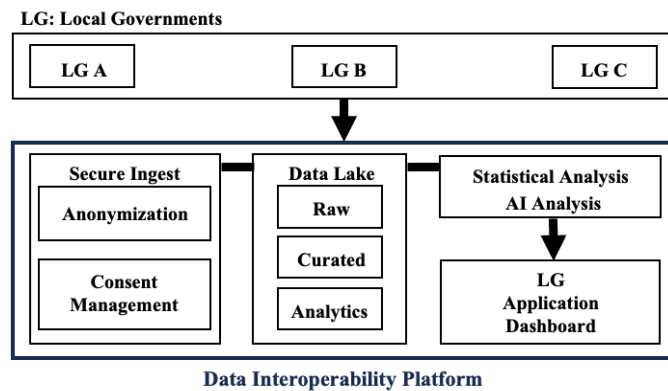


Figure 13. Data interoperability system (e.g. local government collaboration platform)

This section explains the data interoperability system designed to construct the regional revitalization platform, using collaboration among local governments as an example (e.g. Figure 13). The system aggregates digital data held by each local government (LG) into a data lake. By applying data science and AI technologies, it generates new insights and values through regional data interoperability. In this way, the system contributes to the resolution of various regional issues. The system consists of the following components:

1) Secure Ingest (secure data collection): Data uploaded from each local government is anonymized to protect personal information and operated appropriately in compliance with operational rules.

2) Data Lake (data storage): The aggregated data are classified into local government-specific formats (Raw), common formats shared among local governments (Curated), and analytics datasets for statistical or AI-based analysis (Analytics). This enables metadata processing that facilitates data discovery and sharing among local governments.

3) Statistical and AI Analysis (data utilization): Data are utilized for statistical analysis, machine learning training, and inference.

4) Application Dashboard (visualization of analysis): The results of statistical analysis and AI inference are visualized for both local governments and citizens.

In this way, through these mechanisms, it becomes possible to address challenges and generate new value that would be difficult for individual local governments to achieve independently.

VI. CONCLUSION

This study has demonstrated, through case analysis of initiatives toward a co-creative regional society, that loose connections constitute a key concept for its realization. Furthermore, we proposed a seven-layer framework to formulate the concept of loose connections and discussed the implementation system for the practical application of this concept.

In the future, as part of the social implementation of loose connections, we plan to construct a local government collaboration platform centered on Shimanto City, Yatsushiro City, and Aso City in Japan. Through this platform, we will conduct quantitative evaluations of the effectiveness of the proposed framework and implementation system, as well as foster innovation and DX human resources based on this theory.

REFERENCES

- [1] M. S. Granovetter, “The strength of weak ties,” *American Journal of Sociology*, vol. 78, no. 6, pp. 1360–1380, May. 1973.
- [2] M. S. Granovetter, “The strength of weak ties: a network theory revisited,” *Sociological Theory*, vol. 1, pp. 201–233, 1983.
- [3] T. Hoshiai, *Social Community Brand*, KIRAKUSHA, Inc., 2018. (in Japanese)
- [4] T. Hoshiai, “Innovation emergence—new values save regions—,” *The Sankei Shimbun*, serial column (8 parts), Apr.–Jun. 2020. [Online]. Available: <https://scblab.jp/document/112-sankei-column.html> (in Japanese)
- [5] M. Hoshiai, S. Hoshiai, T. Uemura, Y. Naito, and T. Hoshiai, “A method for emerging innovation and DX by using P2P and Go,” in *Proc. ICACT’25*, Feb. 2025, pp. 205–211.
- [6] M. Hoshiai, Y. Kutsuna, S. Hoshiai, A. Okusawa, H. Hayata, and T. Hoshiai, “Proposal for ‘Loose Connections’ for a Co-creative Regional Society and the Implementation Systems,” *IPSI SIG Technical Report*, vol. 2025-EIP-109, no. 27, pp. 1–8, Sep. 2025. (in Japanese)
- [7] Miwako Ino, Yokogushist website. [Online]. Available: <https://yokogushist.com/> (in Japanese)
- [8] Aso City Regional DX Promotion Council website. [Online]. Available: <https://www.cis.sojo-u.ac.jp/index.php/topix-of-iot-ai-center/275-dx-6.html> (in Japanese)
- [9] Ministry of Internal Affairs and Communications, Japan, Council for Local Government Strategy 2040, report website. [Online]. Available: https://www.soumu.go.jp/main_content/000571691.pdf (in Japanese)
- [10] (2025) Kumamoto Education Week website. [Online]. Available: <https://kumamoto-ew.jp/event/2025/113special-dialogue/> (in Japanese)
- [11] (2025) Ministry of Education, Culture, Sports, Science and Technology (MEXT), Monthly Report of Boards of Education, p. 13. [Online]. Available: https://www.mext.go.jp/content/20250509-mxt_syoto01-000042261_2.pdf (in Japanese)
- [12] S. A. Baset and H. Schulzrinne, “An analysis of the Skype peer-to-peer Internet telephony protocol,” *arXiv arXiv:cs/0412017*, 2004. [Online]. Available: <https://arxiv.org/abs/cs/0412017>
- [13] S. Buchegger, D. Schiöberg, L. H. Vu, and A. Datta, “P2P social networking – early experiences and insights,” in *Proc. ACM EuroSys Workshop on SNS’09*, pp. 46–52, 2009.
- [14] VentureBeat, P2P insurance firm Lemonade launches out of stealth, powered by chatbots, morals, and big bucks, 2016. [Online]. Available: <https://venturebeat.com/mobile/lemonade-insurance-social-good-p2p/>
- [15] S. Wang, A. F. Taha, J. Wang, K. Vaternik and A. Hahn, “Energy Crowdsourcing and Peer-to-Peer Energy Trading in Blockchain-Enabled Smart Grids,” *IEEE Transactions on Systems*, vol. 49, no. 8, pp. 1612–1623, Aug. 2019.
- [16] NTT West, “Computer-Resource Intermediary System: Grid Computing System,” Information Sharing Platform Technologies, 2004. [Online]. Available: <https://www.ntt-west.co.jp/news/0512/051221a.html>
- [17] Z. Zheng, S. Xie, H. Dai, X. Chen and H. Wang, “An overview of blockchain technology: Architecture, consensus, and future trends,” in *Proc. IEEE Int. Conf. Big Data’17*, 2017, pp. 5573–5580.

- [18] E. L. Deci and R. M. Ryan, "The 'what' and 'why' of goal pursuits: human needs and the self-determination of behavior," *Psychological Inquiry*, vol. 11, no. 4, pp. 227–268, 2000.
- [19] M. Hoshiai, "A study on technologies for enabling 'loose Connections' toward a co-creative regional society," *IEICE Technical Report*, NS2025-117, p.114, 2025.
- [20] Law Commission (England and Wales), "Decentralised autonomous organisations (DAOs)," 2024. [Online]. Available: <https://lawcom.gov.uk/project/decentralised-autonomous-organisations-daos/>
- [21] F. Fukuyama, *Trust: The Social Virtues and the Creation of Prosperity*, Free Press, 1995.
- [22] L. G. Zucker, "Production of trust: institutional sources of economic structure, 1840–1920," *Research in Organizational Behavior*, vol. 8, pp. 53–111, 1986.
- [23] E. L. Deci, *Intrinsic Motivation*, Plenum Press, 1975.
- [24] E. L. Deci, A. H. Olafsen, and R. M. Ryan, "Self-determination theory in work organizations: The state of a science," *Annual Review of Organizational Psychology and Organizational Behavior*, vol. 4, pp. 19–43, 2017.



Maho Hoshiai was born in Japan in 2003. She is currently a junior student at Chuo University, Tokyo, Japan. Her research focuses on social systems and network theory, particularly on the concept of loose connections and its application to building a co-creative regional society. In addition, she is a high-ranked Go player and applies the game of Go to regional revitalization and innovation initiatives.