

Coexistence Community Development for Sustainable Local Communities

Initiatives by Hitachi Hokkaido University Laboratory

Hitachi Hokkaido University Laboratory is working to solve some of the issues of public concern facing Hokkaido through demonstration testing and exploratory activities being done with local governments. The lab has identified factors influencing childhood growth and development from healthcare and lifestyle data gathered from mother-child health surveys carried out in the city of Iwamizawa. It has also uncovered regional characteristics from data such as an analysis of medical bills, and developed a health data integration platform that enables healthcare measures to be proposed in collaboration with local governments. To help bring about a decarbonized economy and stimulate local economic growth, the lab has proposed a local energy system composed of multiple DC nanogrids enabling local production for local consumption. It is being put into operation for the community of Iwamizawa. This article looks at the work being done by Hitachi Hokkaido University Laboratory. The lab is building communities of coexistence driven by a community-based cycle of healthcare, human capital development, industrial creation, and environmental improvement. The aim is to create sustainable local communities that ensure a healthy and secure lifestyle for each resident.

Takashi Takemoto, Ph.D.

Takahiro Nakamura, Ph.D.

1. Introduction

Hitachi Hokkaido University Laboratory (Hitachi Hokudai Lab) is working with Hokkaido University and other stakeholders to build communities of coexistence driven by a community-based cycle of healthcare, human capital development, industrial creation, and environmental improvement. The aim is to help ensure sustainable local communities and to solve some of the issues of public concern facing Hokkaido such as depopulation, falling birthrates, and the aging population (see **Figure 1**). The COVID-19 pandemic has led to workplaces becoming independent from living environments as the result of changes such as the rise of working from home through telecommuting. These changes have sparked a wave of renewed interest in living in regions with abundant natural

environments. Growing decentralization caused by migration from cities to outlying areas is expected in the coming years, so it will be important to build safe and secure living platforms and to ensure a stable power supply capacity that can accommodate growing regional energy demand.

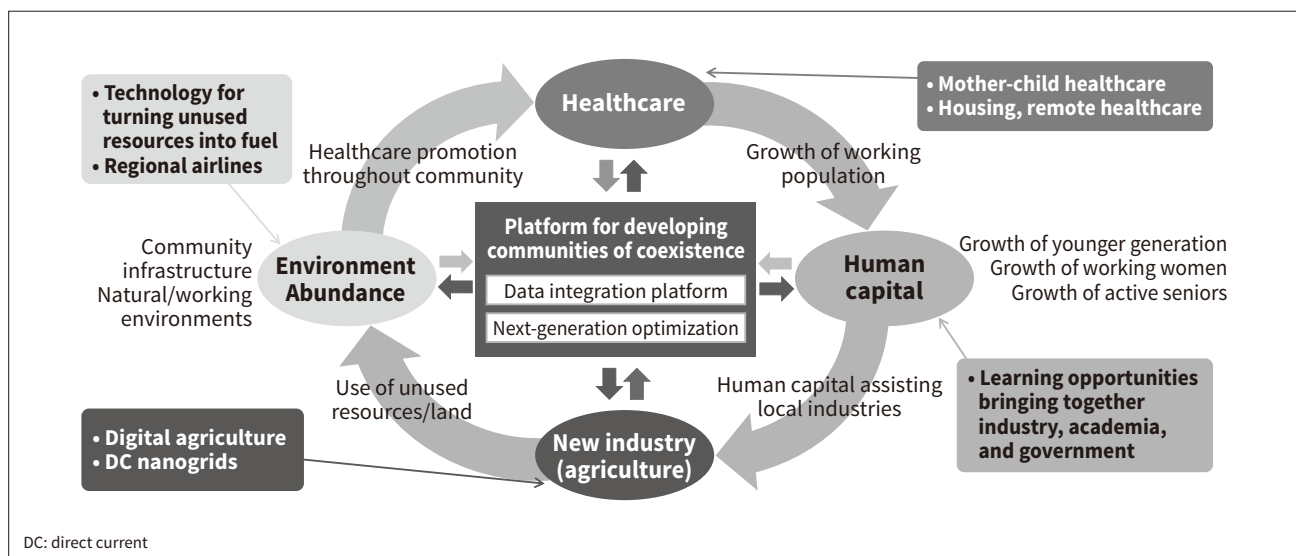
This article looks at the work being done to provide mother-child healthcare tailored to measures to combat falling birthrates and build a local energy system that will ensure a good balance between the environment (decarbonized society) and local economy.

2. Health Data Integration Platform Development

The percentage of low birthweight newborns (under 2,500 grams) has been rising in Japan since about 1990. The figure reached 9.4% in 2019, about 1.5 times the Organisation for Economic Co-operation and Development

Figure 1 — Hitachi Hokkaido University Laboratory’s Research Concept: Developing Communities of Coexistence

Hitachi Hokkaido University Laboratory (Hitachi Hokudai Lab) is constructing a platform for developing communities of coexistence. The platform’s core technologies are next-generation optimization technology and a platform for integrating local data such as healthcare, lifestyle, and infrastructure data. Sustainable local communities will be provided by a community-based cycle of healthcare, human capital development, industrial creation, and environmental improvement.



(OECD) average⁽¹⁾. Among the factors responsible is a growing interest in dieting that has resulted in a greater number of underweight women with a body mass index (BMI) of under 20%. Underweight and malnourished women are thought to not pass enough nutrition to the fetus during pregnancy. Developmental Origins of Health and Disease (DOHaD) is a research approach that suggests that the environment from the prenatal period to infancy influences the onset of developmental disabilities and chronic disease risks during adulthood. Therefore, assisting mother-child nutrition and development from the prenatal period to infancy is key for reducing future health risks.

Hitachi Hokudai Lab has been working on solving this issue since 2016 by partnering with the Innovative Food and Healthcare Master Center of Innovation (COI) site at Hokkaido University to conduct a mother-child health survey in the city of Iwamizawa that examines the intestinal environment. Survey respondents range from expectant mothers to schoolchildren. The survey has gathered and analyzed a wide range of healthcare data covering areas such as stool, blood, breast milk, and food. Its aim is to investigate new factors correlated to mother-child health and child development. It has improved the percentage of low birthweight newborns in Iwamizawa from 10.4% in 2014 to 6.3% in 2019.

The lab is working on identifying simple health indices (indicators), and on building a health data integration platform as a way to enable community building and provide food and healthcare services incorporating these health indices (see **Figure 2**). The platform has been connected to tools such as the Microbiota and Phenotype Correlation Analysis Platform (MANTA)⁽²⁾ to facilitate investigation of

health indicators. MANTA is a comprehensive correlation analysis tool for analyzing correlations between intestinal flora and other health parameters. Healthcare data from sources other than the mother-child health survey is also being integrated for use in conjunction with social capital analysis or health forecasting systems to uncover how actively people work together, along with local characteristics such as medical costs, numbers of hospital visits, and numbers of medical issues.

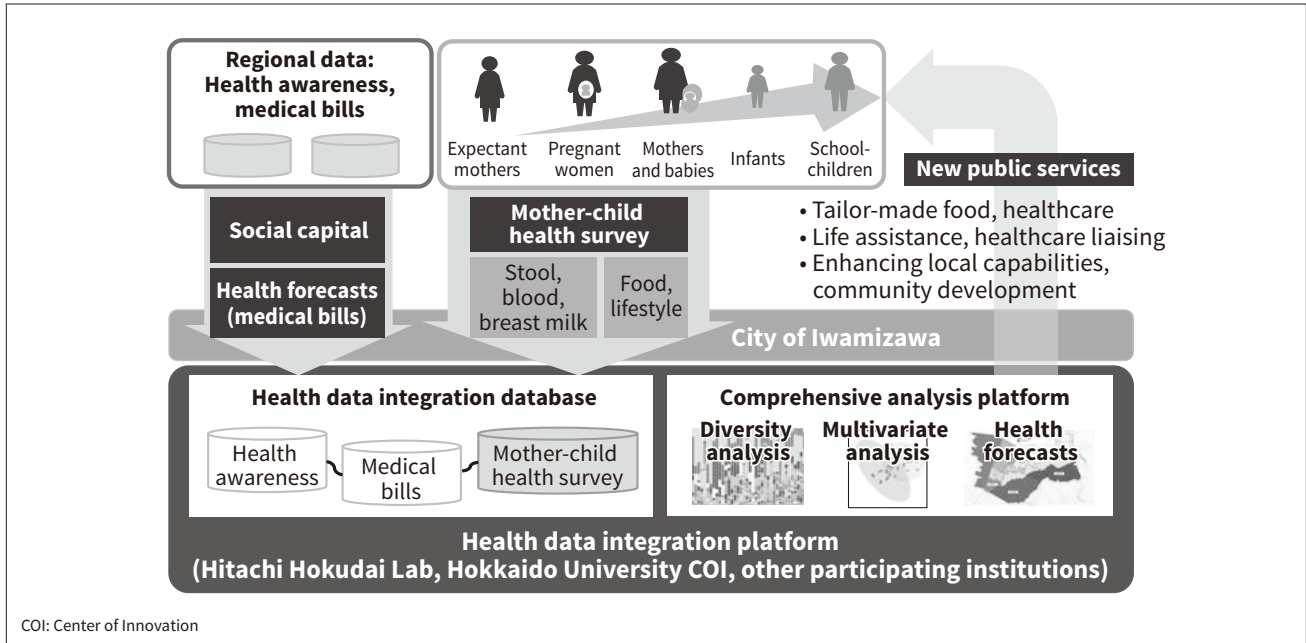
To help enable sustainable communities providing healthy lifestyles for mothers and children, the lab is working with Hokkaido University and dairy products provider Morinaga Milk Industry Co., Ltd. to create items of intellectual property that will help popularize and expand the mother-child health survey. An agreement on the release of these items has been reached.

3. Local Energy System Construction

Hokkaido is endowed with various forms of natural energy. It has been ranked No. 3 in Japan for potential to adopt solar power in the future, and No. 1 for land-based wind power⁽³⁾. However, the quantities of power supplied by solar and wind generation are highly variable. Hokkaido’s power use balances these energy sources along with thermal power generation throughout the region. So solar and wind power use has been limited in scope to ensure stable and low-cost supply quantities. Areas of demand and areas adapted to renewable energy are widely dispersed in Hokkaido, making it expensive and time-consuming to increase transmission line capacity. Grid connection of new renewable energy

Figure 2 — Healthcare Services Made Possible by Mother-child Health Survey

A health data integration platform enabling a new scientific understanding of the intestinal environment has been constructed. It will be used to create tailor-made food and healthcare services that will help enhance local capabilities and develop communities.



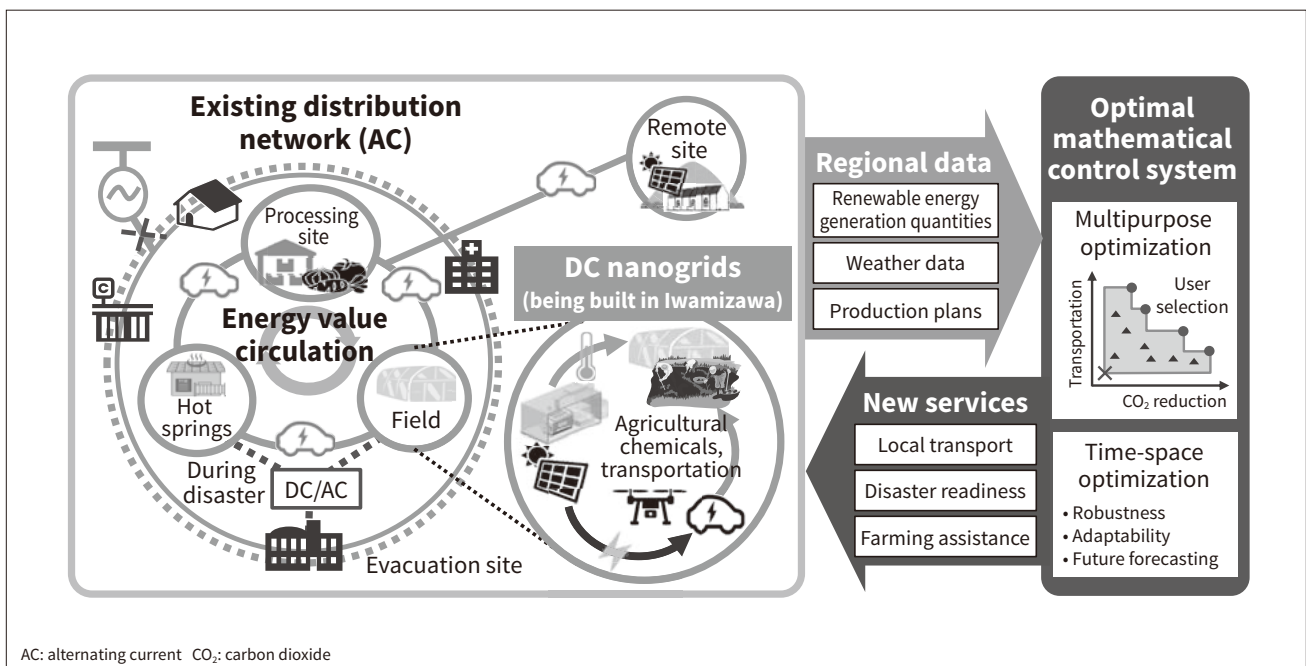
sources is difficult as a result, and making sufficient use of renewables will require construction of energy systems that do not rely on long-distance transmission and distribution networks.

To work on solving this issue, Hitachi Hokudai Lab and Hokkaido University are working with a local energy company and research organization to develop a local energy system enabling local production for local consumption

(see Figure 3). The system provides multiple local direct-current (DC) nanogrids that use solar power generation and multi-fuel engines. Mobile equipment such as electric vehicles connect the grids on a network to create a movable grid that unifies supply and demand. This configuration is designed to provide a standalone power system that can be used during major power shutdowns caused by disasters accompanied by measures to eliminate regional disparities

Figure 3 — Use of Local Energy System to Create New Environmentally Friendly Industries

Autonomous decentralized DC nanogrids have been developed that will help with agriculture, disaster-readiness, and eliminating regional disparities in electricity. An optimal mathematical control system will help create new power services such as regional transportation carrying people and things.



AC: alternating current CO₂: carbon dioxide

in electric power between regions. It is also designed to provide new services that are impossible for a single nanogrid, such as regional transport services for people or things vital to the local area. The small-scale configurations of the individual nanogrids enable construction of system technology with low installation cost and high affinity to existing power networks. These characteristics make the system promising for release in various regions. DC nanogrids that will assist local agriculture by providing energy (electricity and heat) fueled by sunlight and hot-springs gas are currently being built in Iwamizawa.

4. Conclusions

An important requirement for creating the system described in this article is to develop next-generation optimization technology (multipurpose time-space optimization technology) accommodating climate change, demand variation, and other uncertain environmental changes. This technology needs to provide the best solutions for the various types of value associated with environmental problems, economic benefits, and other issues. To enhance the development of this technology, Hitachi Hokudai Lab and Hokkaido University cohosted a marathon-type programming contest⁽⁴⁾ that attracted over 1,700 registered contestants from around the world. The lab is planning to provide analysis to help enable practical applications of the solution code. It also intends to create a model for local circular economies by connecting the energy system to users such as regional airlines and logistics service providers.

References

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Authors



Takashi Takemoto, Ph.D.

Hitachi Hokkaido University Laboratory, Center for Exploratory Research, Research & Development Group, Hitachi, Ltd. *Current work and research:* Development of health data integration platforms and self-sustaining regional energy systems for solving social problems. *Society memberships:* IEEE and the Institute of Electronics, Information and Communication Engineers (IEICE).



Takahiro Nakamura, Ph.D.

Hitachi Hokkaido University Laboratory, Center for Exploratory Research, Research & Development Group, Hitachi, Ltd. *Current work and research:* Development of health data integration platforms. *Society memberships:* IEEE and IEICE.