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Characteristics of Social Infrastructure Development and Maintenance for Industrial Creation in Northern Regions: Insights from Linguistic Date of Next-Generation Executives of Construction Companies

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Abstract

Social infrastructure in Hokkaido, a Northern region of Japan, must sustain its functions over extended time horizons under severe natural conditions amid population decline and fiscal constraints. Prior work has largely focused on structural performance evaluation, advanced maintenance methods, and municipal/urban-structure analyses, whereas research examining executives of construction companies as infrastructure-forming actors remains limited. This study clarifies how next-generation executives perceive social infrastructure development and maintenance (in normal times and during disaster recovery and reconstruction), new industry creation, and survival strategies, using linguistic data from semi-structured interviews. The analysis indicates that executives integrate inherited businesses with clear managerial philosophies, emphasize human resource development and regional contribution, and connect global concerns—especially climate change and intensifying disasters—to local site practices. They frame new industry creation as an incremental process of adding innovations to existing construction activities while protecting regional society through continuous implementation.

Key words: social infrastructure, maintenance and management, next-generation executives, construction industry, quantitative text analysis, new industry creation, survival strategies

1. Introduction: Objective and Research Questions

Social infrastructure in Hokkaido, a Northern region of Japan, must sustain its functions over long periods under severe natural conditions. For diverse forms of social infrastructure—rivers, roads, ports, and agricultural facilities—the Hokkaido Development Bureau presents, within the Hokkaido Comprehensive Development Plan, an integrated and systematic framework of "strategic maintenance and management" centered on life extension, preventive maintenance, and countermeasures against aging (Hokkaido Development Bureau, 2011, Ministry of Land, Infrastructure, Transport and Tourism, 2021). This strategic approach can be regarded as one method for sustaining social infrastructure functions with limited resources in Northern regions facing challenges such as population decline.

The report of the Committee for Examining the Future of the Regional Construction Industry in Hokkaido notes that the construction industry in Hokkaido plays multifaceted roles: not only the development and maintenance of social infrastructure but also contributions to sustaining regional society and communities as a key industry supporting the regional economy and employment. At the same time, it identifies a wide range of challenges driven by structural change—fluctuations in construction investment, workforce aging, and fewer young entrants—including labor shortages, work-style reform, productivity improvement through digital technologies, and decarbonization.

While prior studies have accumulated contributions to these issues, much of the existing literature focuses on performance evaluation of structures, advancement of maintenance methods, or analyses of municipalities and urban form (Ikeda, K., & Oshima, T, 2003). Studies that examine the perceptions of executives of construction companies as on-the-ground infrastructure-forming actors—especially next-generation executives—remain limited.

Addressing this gap, the present study visualizes the structure of perceptions held by next-generation executives of construction companies in Northern regions/Hokkaido regarding social infrastructure development and maintenance (including both normal times and disasters, i.e., disaster recovery and reconstruction) and new industry creation, drawing on modes of thinking manifested in their words and actions. The primary empirical basis is linguistic data obtained through semi-structured interviews with five executives and two related stakeholders, selected from 21 pioneering next-generation executives identified with the cooperation of the Hokkaido Construction Association and related organizations. This study addresses three research questions:1) How do next-generation executives manage their firms while grasping and responding to global and local issues? 2) How do they perceive the roles and functions of social infrastructure development and maintenance in Northern regions, in normal times and during disaster recovery and reconstruction? 3) Building on existing construction business activities, what kinds of new industry creation

and survival strategies do they envision?

Findings based on linguistic data will provide foundational materials for identifying seeds of New Industry Creation embedded in the construction industry in Northern regions/Hokkaido and for examining combined development potentials with adjacent industries, thereby offering insights for regional revitalization. In addition, with a view to hypothesis-generating international comparative research on Northern regions, this study aims to propose research questions and testable hypotheses for examination in other Northern regions based on the perception structures observed in Hokkaido.

2. Study Design and Methods

This study positions next-generation executives of construction companies in Northern regions/Hokkaido as infrastructure-forming actors. It applies quantitative text analysis to linguistic data obtained through semi-structured interviews in order to clarify the structure of their perceptions regarding social infrastructure development and maintenance (including both normal times and disaster recovery and reconstruction), new industry creation, and survival strategies.

2.1 Conceptual Definitions and Study Area

Key concepts are defined as follows. First, **Northern regions** refer to high-latitude areas in Japan exposed to severe cold and snowy conditions; this study focuses on Hokkaido as a representative case. Hokkaido is characterized by the wide spatial distribution of social infrastructure—rivers, roads, ports, and agricultural facilities—and by the need for long-term maintenance under population decline and fiscal constraints. Second, **executives of construction companies** refer to top management such as presidents, CEOs, and other executives. **Next-generation executives** in this study are current executives who are expected to influence corporate management and regional society for a considerable period. Third, **social infrastructure development and maintenance** denotes the life cycle of infrastructure, including construction/renewal and subsequent maintenance/renewal. Disaster-time responses are treated as **disaster recovery and reconstruction**, and both normal-time and disaster-time contexts are included in the analysis. Fourth, **new industry creation** broadly covers initiatives that generate new value for regional economies by developing new business domains and collaborations with related industries, based on existing construction business activities. Fifth, **survival strategies** refer to practical sets of approaches through which firms and regional society in Northern regions adapt to severe natural conditions, population decline, and fiscal constraints while sustaining social infrastructure development and maintenance.

The study area consists of construction companies headquartered in multiple regions of Hokkaido that have been continuously engaged in public works related to social infrastructure development and maintenance, mainly in roads, rivers, ports, and agricultural facilities.

2.2 Data Collection

As the core dataset, semi-structured interviews were conducted focusing on the "words" and "actions" of next-generation executives of construction companies. With the cooperation of the Hokkaido Construction Association and related organizations, pioneering next-generation executives in Hokkaido (n = 21 were identified, and five focal cases (n = 5) were selected for the main analysis. Interviews were conducted from 2021 onward, audio-recorded, and transcribed verbatim. The interview guide centered on: (1) managerial philosophy and methods; (2) perceptions of and responses to global and local issues; (3) social infrastructure development and maintenance in normal times and during disaster recovery and reconstruction; and (4) new industry creation and survival strategies.

In addition, for a rural case, to check the validity of the structured contexts derived from the analysis, two supplementary interviews (n = 2) were conducted with related stakeholders (a predecessor executive and a municipal engineering officer) using similar questions, and these were used as supplementary data.

2.3 Methodology

This study applies quantitative text analysis to linguistic data of next-generation executives to extract perception structures. The procedures are as follows. First, interview transcripts are tokenized via morphological analysis, and nouns, verbs, and adjectives are extracted as target terms. Function words and low-content terms are removed as stop words. Second, based on content analysis, statements are coded and utterances with similar meanings are grouped under the same codes. Clustering is then performed using co-occurrence relations and distribution patterns among codes, and highly related code groups are organized as modules. Third, salient words characterizing each module are examined through keyword-in-context (KWIC) analysis to scrutinize preceding and following contexts. Four keyword groups are set for comparison: (1) social infrastructure development and maintenance, (2) disaster recovery and reconstruction, (3) new industry creation, and (4) regional contribution.

Through these procedures, the study conceptualizes the images of regional society envisioned by next-generation executives in Northern regions/Hokkaido and clarifies the linkages among social infrastructure development and maintenance, new industry creation, and survival strategies. It thereby provides foundational insights that connect research domains and offers a foothold for

generating researchable questions and hypotheses to be examined in other Northern regions.

3. Results

3.1 Perceptions of Next-Generation Executives as Indicated by Coding

The resulting codes were organized into four categories: (1) managerial philosophy and methods; (2) perceptions of and responses to global and local issues; (3) social infrastructure development and maintenance (normal times and disaster recovery and reconstruction); and (4) new industry creation and survival strategies.

3.2 Perception Structure Indicated by Module Results

Clustering based on code co-occurrence and distribution patterns yielded four verb-centered clusters—"create employment," "create new industries," "protect regional society," and "implement"—and one governing noun cluster, "building the foundations of daily life and the economy" (Figure 1). In this study, the figure text uses **restoration** as a shorthand term referring to **disaster recovery and reconstruction** (Figure 1).

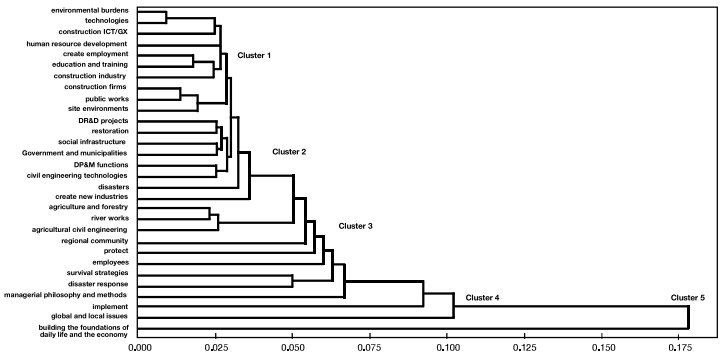

Figure 1. Perception structure indicated by module (cluster) analysis: hierarchical clustering of codes derived from interviews (author's own). Y-axis: codes (terms). X-axis: linkage distance (dissimilarity) in hierarchical clustering. Note: "restoration" is used in the figure as a shorthand for disaster recovery and reconstruction.

The contextual structure indicated by these clusters can be summarized as follows. First, firms pursue capability upgrading and environmental load reduction through construction ICT and GX, while developing human resources and creating employment. Second, through social infrastructure development and maintenance and the on-the-ground implementation of restoration during disasters, firms support functional recovery of the region. Third, these implementations connect, in urban settings, to recovery of roads and rivers, and in rural settings, additionally to foundation building for core regional industries such as agriculture and forestry—collectively narrated as practices that "protect regional society." Fourth, these practices are integrated as a logic of "implementation" embedded in everyday managerial philosophy and made most visible during disasters. Ultimately, these practices converge on the noun cluster "building the foundations of daily life and the economy," supporting executives' self-understandings that they continuously build such foundations across time and space.

3.3 Survival Strategies Indicated by KWIC Analysis

KWIC analysis was conducted for salient terms characterizing each module. Four keyword groups were used—"social infrastructure development and maintenance," "disaster recovery and reconstruction," "new industry creation," and "regional contribution"—and their contexts were compared. In addition, for a rural focal case, two supplementary interviews (n = 2) (a predecessor executive and a municipal engineering officer) were referenced to check the validity and consistency of the structured contexts.

The analysis identified three types of survival strategies. Type A, "shared survival strategies," consists of: (1) deriving optimal on-site operations under constraints; (2) maximizing human capital; (3) improving the efficiency of winter nighttime snow removal as an invisible but indispensable infrastructure service; and (4) rapid mobilization and front-line restoration during disasters (e.g., road clearance and debris removal). Type B, "firm-level survival strategies," includes recruitment, training, and promotion; strengthening construction ICT/DX; product development and utilization; and overseas expansion and market development. Type C, "region-specific survival strategies," includes investment in regional energy development; development and utilization of regional assets and disaster-base functions, as well as securing road networks; and backing regional industrial promotion.

4. Conclusions: Answers to the Research Questions

Answer to RQ1: How do next-generation executives manage their firms while grasping and responding to global and local issues? They integrate inherited businesses with clear managerial philosophies and methods and implement social infrastructure projects, placing particular emphasis on human resource development and regional contribution. In implementation, they strongly recognize climate change and intensifying disasters as global issues that directly affect local sites, and they respond by combining core business practices with technology upgrading, workforce development, and community-oriented actions.

Answer to RQ2: How do they perceive the roles and functions of social infrastructure development and maintenance in Northern regions, in normal times and during disasters? In normal times, they describe functions encompassing road development and maintenance, bridge construction and maintenance, agricultural civil engineering, development of farm and

forest roads, port facilities, and water and sewerage systems. Urban-area firms place greater emphasis on roads, whereas firms outside urban areas engage in a broader set of infrastructures. Regardless of location, "regional contribution" is positioned as a core element of managerial philosophy. During disasters, their functions become more salient through rapid mobilization, road clearance, debris removal, and coordination with multiple actors to secure lifelines and restore regional functions.

Answer to RQ3: Building on existing construction business activities, what kinds of new industry creation and survival strategies do they envision? They frame new industry creation not as replacement of existing business, but as an incremental process of "adding" innovations—such as GX, construction ICT/DX, automation, renewable and hydrogen energy, and potential linkages with autonomous driving—to existing construction activities. In parallel, they articulate survival strategies that combine shared approaches (optimal on-site operations under constraints, maximizing human capital, winter nighttime snow removal, and front-line restoration during disasters) with firm-level and region-specific strategies. Together, these narratives portray executives as infrastructure-forming actors who protect regional society while accumulating a stock of innovation.

5. Discussion: Implications for International Comparative Analysis of Northern Regions

This study analyzed linguistic data from next-generation executives of construction companies in a Northern region (Hokkaido) and clarified how they perceive social infrastructure development and maintenance, new industry creation, and survival strategies. By coding statements and structuring them into interpretable categories, the analysis provides an empirical basis for discussing executives' role perceptions and strategic orientations.

First, next-generation executives perceive themselves not merely as contractors of public works but as infrastructure-forming actors who develop and maintain social infrastructure and support regional society. Their narratives connect global concerns—especially climate change and intensifying disasters—to local practices, emphasizing that global challenges directly shape on-site conditions in Northern regions.

Second, the module analysis indicates a coherent perception structure in which employment creation, incremental new industry creation, protection of regional society, and the logic of implementation converge on "building the foundations of daily life and the economy." In this structure, disaster-time restoration is not an exceptional activity but a practice embedded in everyday managerial philosophy and made most visible during disasters.

Third, the KWIC-based contextual comparison suggests that survival strategies are articulated as combinations of shared, firm-level, and region-specific approaches. These strategies appear to provide the operational and organizational conditions under which "adding innovations" to existing construction activities becomes feasible, thereby linking routine infrastructure work, disaster-time restoration, and incremental new industry creation into a continuous strategic narrative.

Positioned as hypothesis-generating international comparative research, the findings suggest testable expectations for other Northern regions (e.g., the Arctic and Nordic contexts). It is plausible that next-generation executives in construction and infrastructure-related industries in other Northern regions similarly integrate (i) a global problem awareness of climate change and extreme events, (ii) local community-oriented infrastructure practices, and (iii) an incremental approach to new industry creation grounded in existing infrastructure functions. These propositions can be examined by applying comparable semi-structured interviews and quantitative text analysis across Northern regions and comparing the resulting perception structures and strategy typologies.

This study has limitations. The empirical scope is restricted to Hokkaido, and the number of focal cases is limited; thus, generalization should be cautious. Nevertheless, by clarifying executives' perceptions and strategies through linguistic data and by articulating structured propositions suitable for comparative testing, the study provides a hypothesis-generating foundation for further research on Northern regions.

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