Investigation of Knowledge Transfer in International R&D and Procurement for Japan's National Security Cooperation

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Abstract

Japan's defense aims to maintain a free and open international order while addressing diverse security challenges. Accordingly, international cooperation is essential in research and development (R&D) and procurement projects related to national security to strengthen strategic partnerships. The successful execution of these projects requires sophisticated information management concerning international negotiations and defense equipment, and specialized know-how and expertise. However, much of this critical knowledge remains tacit, embedded in the experiences of seasoned professionals, hindering its transfer. To address this issue, methodologies such as the SECI process and knowledge structuring have been proposed to facilitate the conversion of tacit knowledge into explicit knowledge. Additionally, research on knowledge transfer in corporate R&D project management highlights the importance of sharing "*ba*" (which roughly means "place"), as the shared context for knowledge creation. Despite these advancements, frequent personnel rotations and temporal-spatial gaps between projects hinder direct knowledge sharing through on-the-job training (OJT). While the U.S. utilizes personnel exchanges for knowledge transfer, Japan faces significant difficulties due to differences in organizational culture and structures, leaving temporal and spatial gaps unresolved. This study examines the sociological dimensions of knowledge transfer in Japan's international security cooperation. By analyzing organizational structures and institutional cultures, it identifies key factors influencing expertise retention. Through case studies and stakeholder interviews, critical knowledge is systematically organized into a dynamic transferable framework using knowledge engineering methodologies. These insights contribute to practical methods for sustaining knowledge in these national security projects. They also offer methodologies applicable to situations where direct knowledge transfer is difficult.

Keywords: national security cooperation, international R&D procurement, knowledge transfer, knowledge structuring, hybrid knowledge graph

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Introduction

Background and Problem Statement

The global security environment has undergone a substantial transformation, particularly following the outbreak of the Russia–Ukraine conflict. In response, Japan issued a new National Security Strategy, National Defense Strategy, and Defense Buildup Program in December 2022 (Ministry of Defense, 2024). One of the critical challenges emerging in this new era is the escalation of costs and delays in defense-related research and development (R&D) and procurement. These difficulties have made it increasingly difficult for Japan to independently execute major defense projects, thereby accelerating the need for international cooperation.

In light of this strategic shift, Japan is actively promoting international R&D and procurement to strengthen strategic partnerships and ensure interoperability with allied nations. This effort involves the introduction of cutting-edge technologies while mitigating risks and containing costs. Effective implementation demands advanced information management and deep domain expertise. Japan's approach encompasses four main models: International Joint R&D, Sample Purchase R&D, Direct Commercial Sales (DCS), and Foreign Military Sales (Defense Security Cooperation Agency, 2025). Among these, this study focuses on the Foreign Military Sales (FMS) model, which revealed extensive tacit knowledge (Polanyi, 1967) and know-how embedded in past procurement cases. Despite the growing importance of international cooperation, Japan continues to face persistent barriers in knowledge transfer. These include the protection of sensitive information, procedural complexity, and lack of documentation, all of which hinder effective knowledge retention and transfer.

Purpose of the Study

The primary objective of this study is to overcome challenges in knowledge transfer related to international R&D and procurement for Japan's national security cooperation. These challenges include disruptions caused by frequent personnel rotations and temporal-spatial gaps between projects.

To address these issues, the study first analyzes key problem statements and identifies the sociological factors that hinder effective knowledge transfer. These include tacit and fragmented forms of expert knowledge, the lack of structured knowledge transfer systems, and cultural or institutional barriers that arise within multinational cooperative frameworks. Building on these insights, the study then applies a structured knowledge engineering approach to capture and organize expert knowledge in a reusable and transferable format. This approach supports the conversion of tacit, experience-based knowledge into explicit, shareable forms, enabling effective transfer even during personnel changes. This approach contributes to both practical implementation and theoretical advancement in international defense cooperation.

Literature Review

Previous studies have highlighted the inherent complexity of transferring tacit knowledge within organizations (Szulanski, 2000). To address this challenge, the SECI model conceptualizes knowledge creation and transfer as a dynamic interaction between tacit and explicit knowledge (Nonaka & Takeuchi, 1995). Furthermore, the concept of "*ba*"—a shared

context for knowledge creation—facilitates this process by providing a relational space that supports knowledge generation and transfer (Nonaka et al., 2000). In recent years, knowledge structuring engineering has been applied to formalize expert insights and promote cross-domain reuse. This methodology has demonstrated effectiveness in fields such as education and eldercare, where it supports the articulation of critical know-how and its conversion into machine-readable formats for integration with artificial intelligence tools (Iino et al., 2019; Ijuin et al., 2022; Nishimura et al., 2018). These examples offer practical foundations for applying the method to defense-related domains, including international R&D and procurement.

Research Methods

In this study, we implemented a two-part methodology based on initial semi-structured interviews with 20 current and former practitioners from relevant agencies and domains. The first part involved an analysis of the current status assessment, while the second part applied the knowledge structuring method in detail.

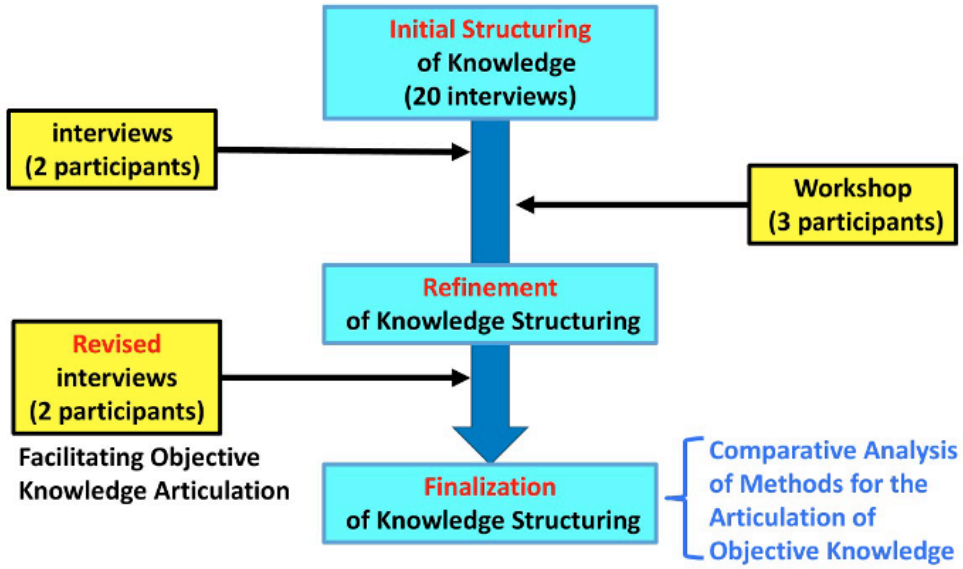
Current Status Assessment

First, we conducted a Current Status Assessment through interviews to identify key sociological factors hindering effective knowledge transfer. These included tacit and fragmented expert knowledge, lack of structured transfer mechanisms, and institutional or cultural barriers within cooperative frameworks.

Knowledge Structuring Process

Building on these insights, we applied a method called Knowledge Structuring. This process was developed based on previous methodologies (Nishimura et al., 2013, 2018). The objective was to externalize both work procedure and objective knowledge held by experts and to integrate them into a transferable framework—the Hybrid Knowledge Graph (Ijuin et al., 2022). The detailed procedure is illustrated in Figure 1.

Figure 1
Detailed Procedure for Knowledge Structuring



We began with the initial structuring of knowledge, based on 20 interviews, to extract both work procedure and objective knowledge. The resulting outputs were then validated through a second round of interviews with two expert participants. In addition, a workshop involving three participants was conducted to further refine the knowledge structuring process. Despite these efforts, the articulation of objective knowledge remained challenging due to its deeply embedded nature. To address this issue, revised interviews were conducted with two experts, specifically aimed at facilitating the articulation of objective knowledge. This process was followed by a comparative analysis of methods for facilitating the articulation of objective knowledge.

Research Results

Current Status Assessment

First, the absence of formal manuals and the limited accumulation of explicit research knowledge present significant barriers to systematic knowledge sharing.

Second, much of the relevant knowledge remains tacit, owing to the domestic-centric nature of projects and constraints arising from regulatory and security considerations.

Third, frequent personnel rotations—typically every two to three years—and long intervals between projects—often spanning five to six years—create spatial and temporal discontinuities. These gaps make it difficult to ensure continuity through on-the-job training (OJT), often resulting in repeated procedural errors.

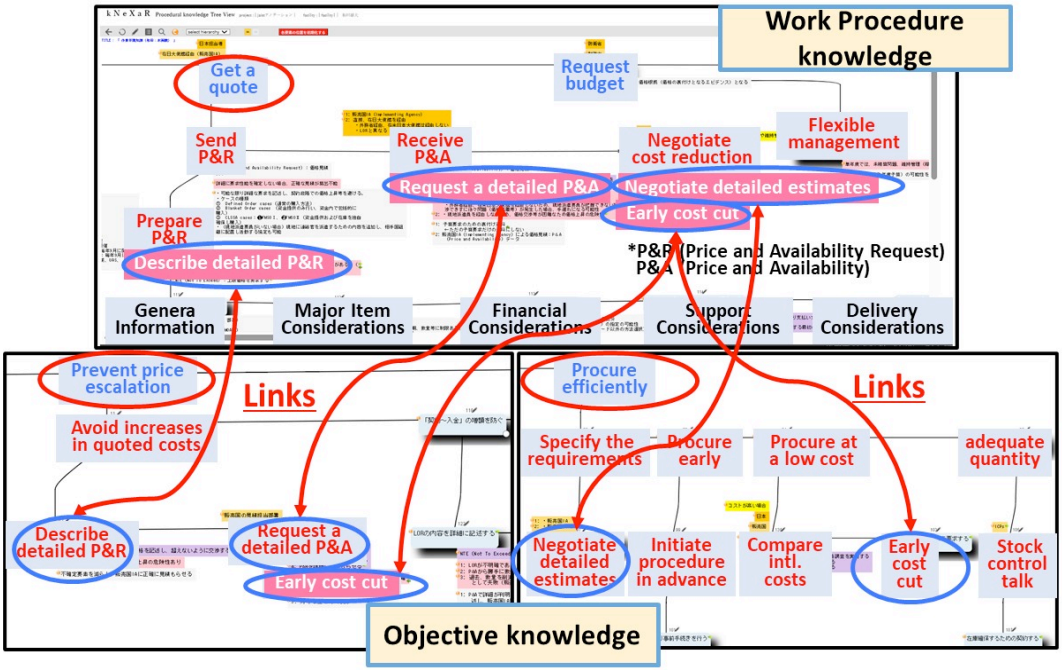
Lastly, Japan's knowledge transfer systems lack the structural integration seen in countries such as the United States. In the U.S., institutionalized personnel exchanges are routinely conducted across the military, the defense industry, think tanks, and Congress. In contrast, Japan continues to face cultural and organizational barriers that inhibit such cross-sectoral knowledge flow.

Knowledge Structuring Process

This study applied a structured methodology to the FMS procurement process to organize and externalize expert knowledge. An example of the resulting output is presented in Figure 2. Based on interview data, we employed a purpose-driven procedural modeling approach (Nishimura et al., 2013), in which each procedure was hierarchically decomposed to ensure both clarity and reusability. All nodes in the graph are represented in a consistent "verb + noun" format, with detailed metadata describing the actor, operational context, implementation method, and relevant precautionary notes.

The model integrates two types of knowledge: work procedure knowledge, which captures concrete tasks and processes, and objective knowledge, which represents the intentions and rationale underlying those actions. By linking these two layers, we constructed a Hybrid Knowledge Graph that supports both transferability and reusability. Some tasks are associated with a single objective, while others correspond to multiple objectives. This complementary structure enables the representation of not only what is done, but also why it is done, facilitating a more comprehensive and omission-free capture of expert knowledge. The results demonstrate that this structuring method is effective in visualizing, transferring, and reusing tacit knowledge, even in complex domains such as international procurement.

Figure 2
An Example of Hybrid Knowledge Graph



Conclusion

This study investigated the challenges of knowledge transfer in international R&D and procurement related to Japan's national security cooperation. Through interviews and workshops with experts, we identified key sociological and organizational barriers—such as tacit and fragmented expert knowledge, lack of structured transfer systems, and spatial-temporal discontinuities caused by personnel rotations and project intervals. To address these challenges, we applied a structured knowledge engineering approach, integrating work procedure knowledge and objective knowledge into a reusable and transferable Hybrid Knowledge Graph. This study contributes to bridging the knowledge gap in multinational defense cooperation through a novel and applicable methodology.

Academic Contributions

This research makes several academic contributions. First, it proposes a structured framework for knowledge transfer in international defense R&D and procurement. Second, it demonstrates the practical application and validation of the Hybrid Knowledge Graph in a national-level defense project. Third, it addresses the challenge of articulating objective knowledge and presents effective methods to facilitate its externalization based on comparative analysis.

Practical Contributions

From a practical standpoint, the study identified implicit bottlenecks in Japan's FMS processes and visualized undocumented procedures and rationales. This enabled the development of a reusable knowledge structuring method, which holds potential for application across other government agencies and international cooperation frameworks.

Future Work

Future research will first focus on developing and evaluating new methods to facilitate the articulation of objective knowledge, building upon the comparative analysis conducted in this study. In parallel, we will explore the integration of generative AI to accelerate and optimize the knowledge structuring process. We also plan to further apply the SECI model and the concept of *ba* (Nonaka et al., 2000) to mitigate knowledge discontinuities arising from personnel rotations and project intervals. Finally, we aim to enhance sustainability by embedding structured knowledge into daily operational practices, thereby ensuring its continued use and refinement in real-world settings.

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