Investigating Tacit Knowledge Transfer in Public Sector Workplaces

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Abstract

This poster paper presents the design and development process of TacitFlow, a voice-controlled assistant intended to support the transfer of tacit knowledge in high-stress public sector environments. Built using a Design-Based Research (DBR) approach, the system integrates voice input, knowledge graphs (KGs), Graph-Based Retrieval-Augmented Generation (GraphRAG), and graph-of-thought (GoT) Artificial Intelligence (AI) reasoning for contextual support. The system enables knowledge capture, question-answering, and peer learning through a mobile-first interface. This paper outlines the core functionality, architecture, and future evaluation plan. The design is grounded in findings from a scoping review and interviews, which are described in a separate Work-in-Progress (WiP) paper titled: "Designing for the Unspoken: A Work-in-Progress on Tacit Knowledge Transfer in High-Stress Public Institutions" in ECCE 2025 proceedings.

CCS Concepts

• **Human-centered computing → HCI design and evaluation methods**; • **Applied computing → Collaborative learning**; • **Social and professional topics → Computing and business**.

Keywords

Tacit knowledge, Workplace learning, Onboarding and Offboarding, Voice-controlled systems, GraphRAG architecture, Graph-of-thought reasoning, Design-based research

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1 Introduction

Tacit knowledge plays a key role in public sector institutions where daily work depends on lived experience, judgment, and informal practices [Leonard and Sensiper(1998), Polanyi(2009)]. When experienced personnel leave, critical knowledge is often lost [Donald(2021)]. In this paper, TacitFlow (working name), a mobile-first, voice-controlled assistant designed to support the capture and sharing of tacit knowledge during onboarding and offboarding is introduced. TacitFlow enables employees to record short audio reflections, ask voice-based questions, and receive contextual guidance. The assistant is currently in the prototyping stage and will be piloted in collaboration with the Estonian Academy of Security Sciences (EASS). Despite recent advances in conversational AI and knowledge reasoning, few tools are explicitly designed to support tacit, context-rich learning in high-stress public service roles. TacitFlow fills this gap with an auditory, explainable, and secure assistant designed for frontline workflows. It combines knowledge graphs, multimodal reasoning, and adaptive interfaces to enable easy, high-impact knowledge exchange. This paper presents the design goals, key features, architecture, and evaluation plans.

The paper focuses on the design and current features of TacitFlow, including its technical architecture and planned evaluation steps. It complements the related WiP paper mentioned in the abstract, which details the scoping review and interviews that informed the system's development.

2 Related Work and Theoretical Basis of TacitFlow

Tacit knowledge is personal, experience-based, and hard to formalize [Leonard and Sensiper(1998), Polanyi(2009)]. In high-pressure fields like corrections, onboarding relies on informal methods such as mentoring and shadowing, which digital systems rarely support [Cho et al.(2020), Correa et al.(2022)]. Enabling tacit knowledge transfer through technology with digital tools requires systems that reflect its unstructured, social nature. Such knowledge exchange often happens through informal learning — observations, social interaction, and hands-on tasks, not formal training [Eraut(2004)].

Informal learning often happens through unstructured, social experiences [Eraut(2004)], yet few tools support this in public institutions [Song et al.(2023)]. While voice interfaces are common in assistive and educational tech, they are still rarely used in public sector onboarding. As AI use in workplace learning expands, voice-controlled tools for high-stress settings must emphasize simplicity, trust, and explainability [Porcheron et al.(2018), El-Azazy et al.(2025)]. Key challenges include handling noise, building user trust, and addressing privacy concerns in speech recognition [Wang et al.(2020)].

To operationalize these concepts into a working system, TacitFlow integrates recent advances in AI to facilitate low-barrier, explainable knowledge exchange. Specifically, it builds on two techniques: GraphRAG, a framework that connects large language models (LLM) to KGs for contextualized, traceable responses [Edge et al.(2025)],

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and graph-of-thought (GoT) reasoning, which structures reasoning paths to enhance transparency and trust [Besta et al.(2024)].

Extending that idea, recent studies, such as [Kanij et al.(2025)], show that LLMs and structured graphs can preserve orally shared knowledge. Structured interviews and key information extraction help transform this into digital formats like KG. TacitFlow builds on these ideas by capturing practical experience-based knowledge via voice input with minimal disruption to daily work. It introduces a hybrid system that combines voice interaction with a dynamic digital twin, integrating both structured and unstructured inputs: conversations, documents, and observations - to stay aligned with evolving workplace practices [Peng et al.(2025)].

TacitFlow also explores passive collection methods such as background voice logging (with permission) and quick note capture linked to interface actions. These features allow the KB to grow gradually without interrupting users. By combining automation with expert review, the system balances scalability and accuracy to ensure that key insights are captured and preserved [Yu et al.(2022)].

3 System Design

3.1 Key Features of The TacitFlow Prototype

Building on the principles described in the previous chapter, the TacitFlow prototype was developed to support the continuous capture, retrieval, and sharing of experiential knowledge in dynamic work environments.

TacitFlow supports informal learning through three main features that form its core functionality:

Knowledge Capture Users can record short, informal "Knowledge Moments" to capture experiential know-how often lost during staff turnover. These can be captured and replayed via text, audio, or video on a mobile device running TacitFlow.

Context-Aware Q&A TacitFlow uses a Graph-based Retrieval Augmented Generation (GraphRAG) pipeline to connect LLMs to KGs and documents for retrieval [Edge et al.(2025)] and graph-of-thought reasoning (GoT) to retrieve knowledge from a structured graph built from internal content and indexed materials [Besta et al.(2024)]. Employees can ask natural language questions and receive voice-based answers grounded in trusted documents and peer-generated tips (e.g., "What's the standard procedure for handling a non-compliant inmate during a cell check?").

Social Scaffolding To turn individual insights into shared knowledge, the system supports peer learning by suggesting mentors with similar skills and enabling community interaction through themed discussion channels.

Gamification Features like badges and leaderboards encourage active knowledge sharing by recognizing contributions.

Experimentation The system will support controlled experiments, including A/B testing, where users are exposed to different feature versions to compare outcome, using opt-in monitoring to improve tacit knowledge transfer, user engagement, Q&A quality, and social interaction.

TacitFlow's design also meets the security and compliance needs of high-stakes public institutions. Prioritizing local, on-premise deployment ensures privacy, data localization, and legal compliance [Song et al.(2023)].

The system is being developed in collaboration with the Estonian Academy of Security Sciences (EASS), which provided role-specific training materials and will also serve as the pilot site to explore real-world use, learning practices, and knowledge retention.

Full details on the design rationale and how features were derived from scoping review and interview findings can be found in the accompanying ECCE 2025 WiP paper, mentioned in the Abstract.

TacitFlow's "Knowledge Moment" feature supports spontaneous voice-based capture of practical insights during real tasks. This addresses a key challenge from interviews: the difficulty of sharing undocumented, situation-specific knowledge. The following fictional example, based on common patterns in the research, illustrates how a typical user might interact with the system.

Example During a security check, a junior officer notices a door at checkpoint D3 jams unless the handle is pulled up before swiping. Instead of filing a report, they open TacitFlow, tap "New Knowledge Moment," and record: *"On checkpoint D3, the backdoor tends to jam unless you pull the handle upward before swiping the card. Works every time."* The app tags the entry with time, location, and task metadata. The officer sets visibility and shares it with the team. TacitFlow then links this input to similar past entries, helping surface patterns and local solutions.

This lightweight feature helps preserve unspoken know-how in time-pressured environments with limited documentation. The full interaction flow is shown below.

Initiation User taps "Capture Moment" to start recording.

Contextualization Adds an optional title and short text to describe the situation.

Recording & Transcription Records an audio message; the system transcribes it live.

AI Enrichment System suggests keywords and related links from the knowledge graph, which the user can refine.

Sharing User selects visibility (e.g., Private, Team, Newcomers) using sharing controls.

Integration The entry is saved and added to the knowledge graph for future use.

The interaction is designed to be fluid and intuitive. The user taps "Capture Moment," adds an optional title and short description, then records an audio insight with live transcription. The system suggests related keywords and links from the knowledge graph, which the user can refine. Finally, the user sets visibility and submits the entry, which is saved as a discoverable node in the knowledge graph.

4 System Architecture and Technical Design

To address confidentiality and complexity, TacitFlow uses a modular, on-premise architecture that keeps all data within organizational control and avoids cloud-related risks. As depicted in Figure 1, the architecture is containerized using Docker for consistent and secure deployment.

The on-premise setup reflects the strict security requirements of partner institutions. While cloud solutions offer scalability, local processing ensures data sovereignty and low-latency, critical in high-stress environments, see Figure 2. Future versions may explore hybrid models for non-sensitive tasks.

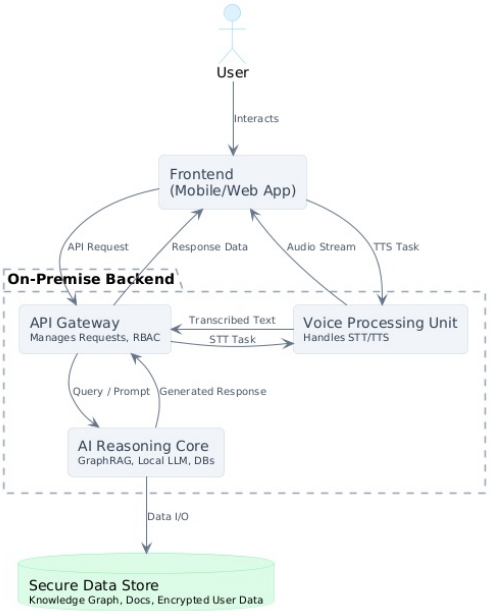

Figure 1: Conceptual System Architecture of TacitFlow

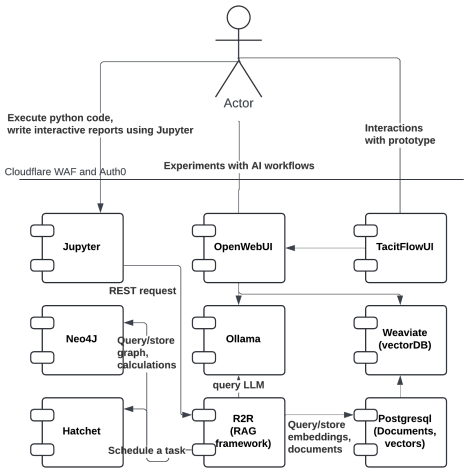

Figure 2: Deployment Diagram of TacitFlow Prototype

Frontend: A responsive, mobile-first web application built with HTML, Tailwind CSS, and JavaScript provides an accessible interface, integrating native browser APIs for speech-to-text (STT) and text-to-speech (TTS).

Backend: To ensure on-site data handling, the backend runs locally. User queries trigger a GraphRAG process [Edge et al.(2025)], combining semantic search in Weaviate with targeted retrieval from a Neo4j graph linking user tips, protocols, and personnel. The AI backend then sends this context to a locally hosted LLM via Ollama, which applies GoT reasoning [Besta et al.(2024)] to generate accurate, explainable responses.

5 Linking Findings to Design and Evaluation

To ensure the design is grounded in real-world insights, a systematic mapping connects findings from prior research to TacitFlow's features and planned evaluation activities. These aim to validate both the practical value of the features and the theoretical basis for managing tacit knowledge. Table 1 presents the results.

6 Ethics and Data Governance

Using a voice-based tool in secure, high-pressure settings demands a clear data management plan. This approach is based on user control, transparency, and data minimization.

Data Encryption All voice data and transcripts are encrypted in transit and at rest.

User Consent Each "Knowledge Moment" requires explicit, revocable consent with clear information on data use.

Role-Based Access Control Sensitive data is only accessible to authorized users, such as mentors or team members.

Anonymization Where possible, data used for analysis is anonymized to protect user identities.

7 Discussion

In the TacitFlow poster, a voice-based assistant for capturing and retrieving experiential workplace knowledge is presented. While designed for Estonian public institutions, challenges like knowledge loss during onboarding are shared across high-pressure fields such as healthcare, aviation, and other. TacitFlow's low-effort voice capture and context-aware retrieval offer a model that can support informal learning in similarly demanding environments.

At this stage, TacitFlow remains under active development. Usability testing and field evaluations are planned in collaboration with the EASS. These will include

(1) pilot usability tests to assess the interface and voice capture experience,
(2) task-based trials to evaluate information retrieval, and
(3) participatory workshops to refine the tool based on user feedback.

Challenges remain. Tacit knowledge is difficult to externalize, especially under time pressure. Technical risks include managing hallucinations and ensuring reliable responses from the AI system. Privacy, trust, and user control are critical in secure work environments, and success will also depend on cultural readiness to share and reflect on personal experience.

8 Next Steps

The next phase of the project will focus on piloting TacitFlow in collaboration with the EASS and other institutional partners. Planned activities include participatory testing workshops and field evaluations to assess system usability and integration into everyday work settings [Nonaka(1998), Cabrera and Cabrera(2005)]. Additional functionality, such as personalized learning prompts and enhanced voice interaction, will also be developed based on early user feedback.

Theme from Interviews	TacitFlow Design Response	Planned Evaluation Method
Psychologically safe culture	Voluntary voice capture with consent and role-based access control	Usability tests with think-aloud protocols to assess user comfort and trust
Formalized mentorship	Mentor-matching, buddy system, and peer feedback features	Pilot deployment analysis of usage patterns and social network mapping.
Informal interaction spaces	Community groups and social features inside the assistant	Pilot deployment analysis of usage patterns and social network mapping.
Flexible documentation systems	Voice-based "Knowledge Moment" capture linked to KG	Task-based trials ask users to capture specific experiential knowledge.
Structured one-on-one meetings	Template-based mentoring check-ins and guided prompts (planned)	Field evaluations assessing integration into daily workflows.
Standardized offboarding	Tip capture and Q&A used to document experiences before departure	Interviews with departing employees using the prototype.

Table 1: Mapping of interview themes to TacitFlow's design features and evaluation plan.

Insights from these tests will inform both the further development of TacitFlow and the proposal of a supporting framework for transferring tacit knowledge. Feedback from the ECCE community on the ethical, technical, and practical aspects of the tool is warmly welcome. It will play a valuable role in refining the direction of this research.

Planned activities include usability testing, task-based interaction trials, and participatory workshops. These will assess the system's usability, user engagement, and effectiveness in supporting tacit knowledge sharing, particularly in onboarding and offboarding contexts [Nonaka(1998), Cabrera and Cabrera(2005)]:

Evaluating the Low-Barrier Voice Capture To test the hypothesis that a voice-first interface lowers the barrier to sharing informal knowledge, we will conduct task-based usability tests where participants will be asked to capture "Knowledge Tips" using think-aloud protocols.

Assessing the Context-Aware Q&A Interface The effectiveness of the GraphRAG-powered retrieval system will be evaluated through task-based interaction trials where new employees will be asked to find answers to specific, context-dependent questions.

Investigating the Impact of Scaffolding Social Networks The features designed to support social learning will be assessed in a pilot deployment where we will analyze usage patterns and conduct interviews with participants.

Measuring the Influence of Gamification The impact of the recognition and rewards system will be evaluated by analyzing user engagement data and collecting qualitative feedback from surveys and interviews.

9 Acknowledgment of AI Use

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