

A Decision-centric Knowledge Architecture for Knowledge Retention

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Abstract: Organizations depend on expert judgement to interpret complex operational situations and maintain consistent decision-making under conditions of uncertainty, regulatory complexity and contextual variation. In SMEs as well as multinational enterprises, the reasoning structures underlying such decisions remain only partially documented and are embedded in the experience of individuals. When experienced employees leave an organization, operational decision capability may be lost. Traditional knowledge management approaches primarily focus on documenting explicit knowledge and procedural information and therefore struggle to preserve organization-specific interpretive decision structures. This paper develops and evaluates a Decision-Centric Knowledge Architecture (DCKA) designed to reconstruct and operationalize expert decision logic. The paper follows a Design Science orientation and addresses the question of how organization-specific decision structures can be modelled in a way that supports traceable interpretive reconstruction. DCKA integrates structured knowledge extraction, graph-based representation of interconnected decision structures and AI-supported interaction grounded in explicit decision structures. DCKA was originally implemented in the payroll department of an international organization facing the retirement of a highly experienced domain expert. Expert knowledge was reconstructed through structured interviews and transformed into an interconnected knowledge graph capturing contextual dependencies, decision signals, evaluation logic, governance constraints and exception patterns. The knowledge graph was connected to a large language model through a controlled retrieval process enabling conversational access to organization-specific decision structures. Evaluation showed that DCKA reconstructed operational decision structures with sufficient plausibility to support expert transition, onboarding and organizational review. In addition, exploratory applications in research, consulting and educational contexts indicated transferability beyond the original payroll domain. The findings suggest that DCKA can support continuity of operational decision-making through traceable reconstruction of implicit interpretive structures. The paper positions decision-making capability as a central object of knowledge retention and extends knowledge management research beyond document-centric approaches.

Keywords: Knowledge retention, Decision continuity, Tacit knowledge, Expert decision knowledge, Knowledge graphs, AI-supported knowledge systems

1. Introduction

Organizations depend on experienced employees to maintain continuity of operational decision-making under conditions of regulatory complexity, contextual variation and organizational change. Enterprise systems preserve documents, process descriptions and transactional data, yet operational continuity frequently declines when experienced employees leave or change roles. Organizations benefit from preserving the capability to interpret information consistently, recognize exceptional situations and apply organization-specific judgement under changing conditions. DeLong (2004) identified this challenge as a central knowledge continuity risk in organizations facing demographic transition and the loss of experienced personnel.

This paper addresses this challenge through the development of a Decision-Centric Knowledge Architecture (DCKA). DCKA reconstructs organization-specific decision structures and represents them as an interconnected knowledge graph that captures contextual dependencies, governance structures, decision signals, evaluation logic, boundary conditions and exception patterns. The reconstruction process elicits decision-relevant organizational knowledge from experts and organizational material using a structured extraction approach. An AI-supported interaction layer provides conversational access to the reconstructed decision structures while maintaining traceability to the underlying organizational knowledge model. Together, these components support continuity of operational decision-making during onboarding, expert transition and other situations in which contextual organizational knowledge becomes critical.

Operational decision-making frequently depends on contextual understanding, exception handling and organization-specific evaluation structures that remain only partially documented. Employees interpret ambiguous situations, balance competing priorities and anticipate consequences under conditions of uncertainty. These interpretive structures evolve through organizational practice and are shaped by governance requirements, strategic priorities, historical experience and professional judgement. Conventional knowledge management (KM) approaches primarily document explicit knowledge and procedural information. They therefore provide only limited support for reconstructing the decision structures that experienced employees apply during complex operational situations.

The architecture was developed and evaluated in the payroll department of an international organization facing the planned retirement of a highly experienced domain expert. Payroll operations combined strict regulatory requirements with numerous organization-specific interpretations, exception patterns and governance constraints. Operational reliability therefore depended strongly on expert judgement rather than procedural documentation alone. Additional exploratory applications in scientific research, consulting and higher education provided opportunities to examine the applicability of the reconstruction principles beyond the original organizational context.

This paper addresses the following research question: How can organization-specific decision structures be reconstructed and represented in a knowledge architecture that supports continuity of operational decision-making?

This study contributes to KM research at three complementary levels. First, it conceptualizes organization-specific decision structures as a central object of knowledge continuity and extends established knowledge retention approaches towards continuity of operational decision-making. Second, it develops DCKA as a Design Science artifact integrating structured knowledge reconstruction, graph-based representation and AI-supported interaction within a coherent architectural framework. Third, the implementation and evaluation demonstrate how reconstructed decision structures support onboarding, expert transition and organizational continuity while providing a transparent foundation for AI-supported access to organization-specific knowledge.

The remainder of the paper is structured as follows. Section 2 establishes the theoretical foundation. Section 3 describes the research methodology and artifact development. Section 4 presents the Decision-Centric Knowledge Architecture. Section 5 reports the evaluation results. Section 6 discusses the findings and concludes the paper.

2. Theoretical Foundation

DCKA builds on theoretical perspectives explaining how organizations develop, apply and preserve decision capability under conditions of contextual complexity. The architecture integrates complementary concepts from KM, organizational learning, decision-making and knowledge representation. Together these perspectives explain why experienced employees interpret comparable operational situations differently, why procedural documentation alone provides limited guidance and how organization-specific decision structures can be reconstructed and represented explicitly.

Tacit knowledge provides an important theoretical foundation. Polanyi (1966) described practical knowing as knowledge embedded in action and experience. Nonaka and Takeuchi (1995) subsequently explained how tacit and explicit knowledge interact during organizational knowledge creation, while Hansen, Nohria and Tierney (1999) distinguished between codification and personalization strategies for managing organizational knowledge. These perspectives explain why many operational decisions continue to depend on experienced individuals despite comprehensive procedural documentation.

Organizational interpretation also develops through experience. Weick (1995) described sensemaking as the process through which organizational actors construct meaning under ambiguous conditions. Argyris and Schön (1978) further distinguished between espoused theories and theories-in-use, demonstrating that operational behavior frequently reflects learned organizational practice alongside formally documented procedures. DCKA reconstructs these practical decision structures as explicit organizational knowledge that can be represented, examined and reused.

2.1 Decision-making Under Complexity

Operational decision-making frequently requires interpretation under conditions of uncertainty, incomplete information and competing organizational priorities. Decision research provides several complementary perspectives explaining how experienced professionals develop such capabilities. Simon (1957) challenged this perspective through the concept of bounded rationality and argued that organizational actors decide under conditions of limited information, limited attention and constrained cognitive capacity. March and Simon (1958) subsequently demonstrated that decisions are embedded in routines, authority systems and institutional expectations.

Naturalistic Decision-Making research provides additional insight into how experienced professionals operate under contextual complexity. Klein (1998) demonstrated that experts often rely on recognition of meaningful situational patterns rather than exhaustive comparison of alternatives. Crandall, Klein and Hoffman (2006)

further showed that expert reasoning frequently depends on contextual cues, dynamic assessment and learned expectations regarding consequences. Operational expertise therefore includes recognition of weak signals, interpretation of atypical situations and anticipation of implications that are difficult to capture through conventional documentation structures alone.

These dynamics become visible where formal governance structures and operational practice diverge. Organizations may formally communicate one set of priorities while operational decisions are shaped strongly by risk avoidance, political sensitivity or informal escalation practices. Decision-making capability thus depends heavily on implicit interpretation and historically developed evaluation structures.

2.2 Knowledge Representation and Interconnected Decision Structures

Traditional KM systems organize explicit knowledge through repositories, taxonomies and procedural documentation (Alavi & Leidner, 2001). Such approaches support standardization and retrieval, yet they provide limited backing for representing interconnected interpretive structures underlying decisions.

Knowledge graphs provide a suitable representation of complex dependencies because they support modelling of heterogeneous relationships across complex domains (Hogan et al., 2021). Their relevance lies in representational flexibility, as graph structures allow reconstruction of overlapping dependencies between:

- contexts,
- governance structures,
- organizational roles,
- process requirements,
- external triggers,
- organizational memory,
- decision signals,
- evaluation logic,
- and boundary conditions.

DCKA represents decision-making as an interconnected interpretive network in contrast to a sequential workflow. The graph therefore constitutes the representational core of DCKA. It models relationships among decision signals, contextual conditions, governance structures and evaluation logic while preserving their semantic interdependencies. The reconstruction process described later in the paper generates this graph from organization-specific knowledge sources, whereas the AI-supported interaction layer provides access to the resulting representation.

2.3 AI-Supported Reconstruction and Organizational Grounding

The rapid diffusion of large language models has intensified interest in AI- assisted knowledge systems. Conversational interfaces support interaction with enterprise knowledge repositories and internal documentation structures. At the same time, organizational applicability depends on contextual grounding because generic language models do not contain organization-specific governance structures, historical experience or operational evaluation logic.

Lewis et al. (2020) introduced Retrieval-Augmented Generation as an approach to link generative models with external knowledge repositories. Decision-making depends on contextual interpretation anchored in explicit organizational structures rather than statistical plausibility alone.

The relevance of AI therefore concerns reconstruction support and interaction with structured knowledge. Within DCKA, AI functions as the interaction layer of the architecture. Organizational decision knowledge remains explicitly represented within the reconstructed graph structure, providing traceable access to organization-specific reasoning while preserving transparency of the underlying knowledge model.

3. Research Context and Methodological Approach

3.1 Research Design

This study follows a Design Science Research (DSR) approach because the objective was the development and evaluation of an artifact addressing a practical organizational problem. The artifact is the DCKA, developed to reconstruct and represent organization-specific decision structures in support of continuity of operational decision-making.

Artifact development combined theoretical grounding, iterative design and implementation within a real organizational environment. Evaluation was conducted through a case study in the payroll department of an international organization. The case provided access to operational decision situations, expert knowledge and organizational validation. It served as the environment in which DCKA was developed, implemented and evaluated.

3.2 Artifact Development

Development started with a PRISMA-oriented literature review (Page et al., 2021). The review established the theoretical foundation for tacit knowledge, organizational decision-making, knowledge representation and AI-supported knowledge systems. These concepts guided the design of DCKA and informed the selection of decision elements reconstructed later during implementation.

The first design focused on identifying the information experienced employees use while interpreting operational situations. Successive design iterations refined the architecture after expert feedback, reconstruction workshops and practical implementation. Each iteration improved the representation of contextual dependencies, governance structures, decision signals, evaluation logic and exception patterns until the resulting architecture reflected operational practice with sufficient consistency for evaluation.

3.3 Knowledge Reconstruction

Knowledge reconstruction focused on operational decision-making rather than procedural documentation. Structured expert interviews formed the primary source of information in the payroll case. Existing organizational material complemented the interviews whenever additional context or validation was required.

A structured extraction handbook guided reconstruction. The handbook defined categories for contextual framing, governance structures, decision signals, evaluation logic, boundary conditions and exception patterns. Each interview was analyzed against these categories. Candidate decision elements were consolidated, reviewed with the domain expert and transformed into a graph-based representation.

AI-assisted extraction accelerated the identification of candidate decision structures within larger collections of organizational material. Expert review remained the authoritative validation step throughout reconstruction.

Figure 1 illustrates the reconstruction process. The figure describes the engineering workflow used to transform heterogeneous organizational knowledge into DCKA.

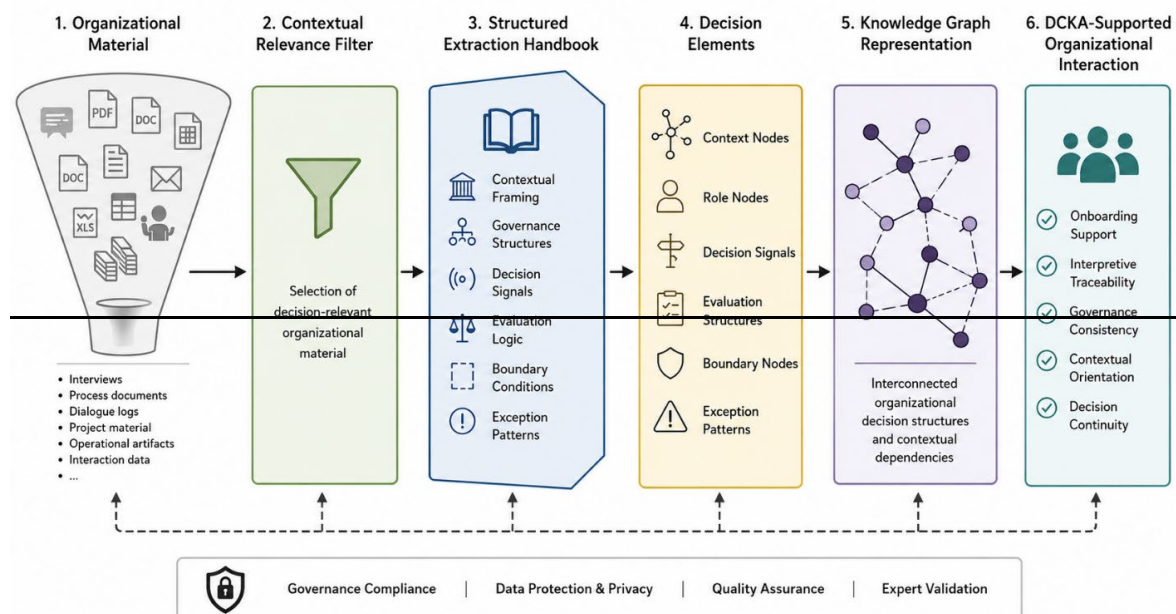


Figure 1: Knowledge reconstruction workflow leading to DCKA

3.4 Evaluation

Evaluation examined whether DCKA reconstructed organization-specific decision structures with sufficient accuracy and practical usefulness to support continuity of operational decision-making.

The payroll expert reviewed the reconstructed architecture with emphasis on decision logic, governance consistency, contextual completeness and exception handling. Revisions followed each review cycle until the reconstructed decision structures reflected operational practice.

Junior employees subsequently applied the prototype during onboarding-oriented scenarios using prepared and self-defined operational questions. The sessions explored contextual orientation, interpretation of unfamiliar situations and navigation through the reconstructed decision structures.

Additional review involved organizational stakeholders responsible for governance, operational continuity and HR-related information systems. Their feedback examined organizational applicability, governance compatibility and opportunities for broader implementation. Table 1 summarizes the evaluation criteria.

Table 1: Criteria for validation and their focus

Criterion	Validation Focus
Reconstruction of Decision Logic	Correct representation of decision criteria, responsibilities and evaluative structures
Recognition of Exceptions	Identification of exception patterns, stop conditions and escalation signals
Governance Adherence	Respect for organizational boundaries, approval structures and escalation authority
Support for Junior Staff	Improvement of interpretability, orientation and procedural confidence
Transferability and Scalability	Applicability across organizational domains and compatibility with governance structures

4. Decision-centric Knowledge Architecture

DCKA represents organization-specific decision structures as an interconnected knowledge architecture supporting continuity of operational decision-making. Section 3 described the reconstruction process through which the architecture is developed. This section presents the resulting artifact and explains its structural organization.

DCKA represents decision-relevant knowledge through interconnected elements describing organizational context, governance structures, evaluation logic and operational dependencies. Together these elements create an explicit representation of organization-specific reasoning that supports navigation, explanation and validation.

4.1 Structural Dimensions of Organizational Decision Contexts

Operational decisions emerge within organizational contexts shaped by multiple influences. DCKA reconstructs these influences as structural dimensions (see table 2) that provide the context in which individual decisions are interpreted. Each reconstructed decision element is associated with one or more of these dimensions, allowing contextual dependencies to remain visible throughout the knowledge structure.

Table 2: Structural dimensions in decision reconstruction

Dimension	Function in Decision Reconstruction
Context	Situational framing such as case type, project, process or emergency condition
Governance	Legal requirements, procedures, escalation rights and approval structures
Organizational structure	Hierarchy, role expectations, informal authority and political sensitivity

Dimension	Function in Decision Reconstruction
Professional domain	Domain-specific expertise and disciplinary interpretation patterns
Process requirements	Technical constraints, workflows and operational dependencies
External triggers	Signals from customers, regulators, owners or other stakeholders
Organizational memory	Historical precedents, lessons learned and established practices

The structural dimensions provide the organizational context for interpreting operational situations. They connect decision signals with organizational responsibilities, governance structures, historical experience and operational dependencies. Comparable situations may produce different decisions because organizations differ in their priorities, governance models and accumulated experience. DCKA preserves these contextual relationships explicitly and makes them available during later retrieval and interpretation.

4.2 Decision Structures and Interpretive Logic

Operational situations generate decision signals that initiate interpretation. During reconstruction, each signal is linked to the contextual conditions in which it occurs, the governance structures influencing the decision, the evaluation logic applied by experienced employees and the possible consequences of alternative actions. The resulting graph preserves these relationships as explicit organizational knowledge.

Evaluation logic represents organization-specific prioritization patterns that guide operational decisions. Compliance requirements, customer orientation, operational efficiency, risk tolerance or strategic priorities may receive different emphasis across organizations. Reconstruction documents the reasoning applied by domain experts across comparable situations. The resulting model makes organization-specific priorities visible.

Boundary conditions define the operational space within which decisions remain acceptable. Governance rules, approval structures, legal requirements and organizational responsibilities establish these boundaries. Exception patterns identify situations requiring additional interpretation, escalation or expert judgement because established decision paths no longer provide sufficient guidance.

Figure 2 presents the resulting architecture. Decision signals, contextual dependencies, governance structures, evaluation logic and operational constraints form an interconnected knowledge network supporting transparent reconstruction of organizational reasoning.

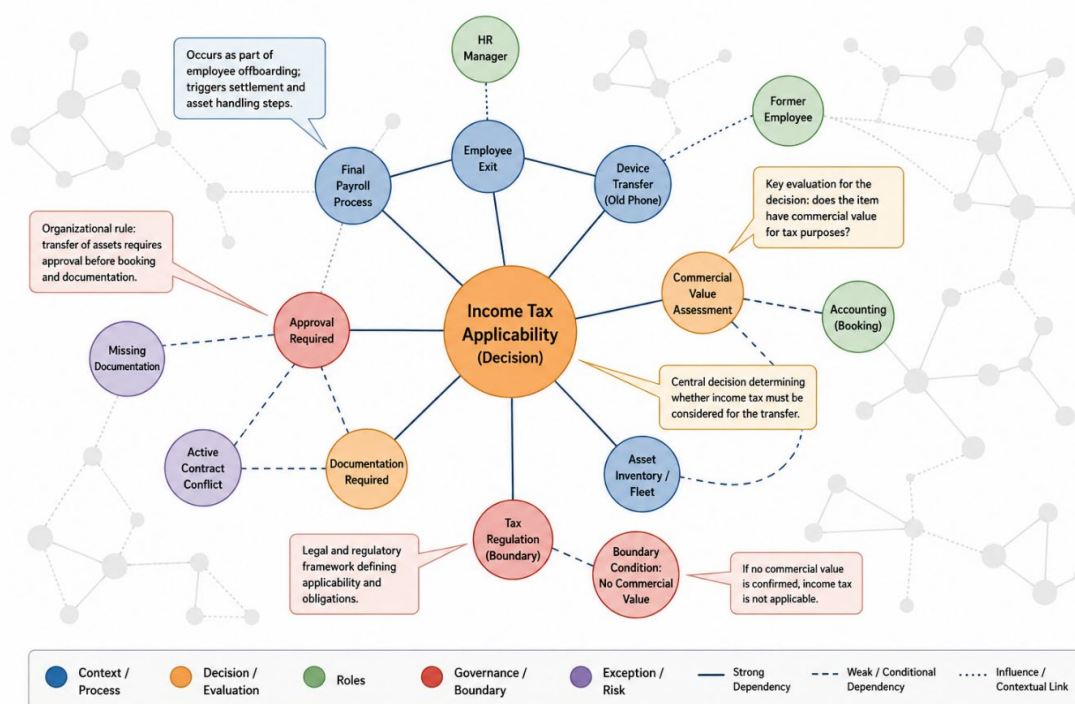


Figure 2: Network representation of decision elements, signals and contextual dependencies

The graph structure allows one decision signal to influence multiple decision situations while individual governance constraints or contextual conditions may affect several decision paths simultaneously. These semantic relationships remain explicitly represented within the architecture and can be examined, extended and validated during subsequent organizational use.

4.3 Graph-based Representation and AI-Supported Interaction

The graph represents contextual conditions, governance structures, decision signals, evaluation logic and operational dependencies through semantic relationships among decision-relevant elements.

The AI-supported interaction layer provides conversational access to this reconstructed knowledge structure. User questions are interpreted against the graph and resolved through the explicit relationships reconstructed during knowledge elicitation. Responses remain anchored in organization-specific decision structures instead of isolated documents or individual process descriptions.

Employees can explore contextual dependencies, reconstruct reasoning paths, identify applicable governance constraints and understand organization-specific evaluation logic through conversational interaction. The architecture supports onboarding, expert transition and continuity of operational decision-making while preserving transparency of the underlying organizational knowledge model.

5. Results

The evaluation produced four main results. First, the payroll expert confirmed that DCKA represented the central decision logic of the payroll domain with sufficient operational plausibility for use in expert transition. The reconstructed graph captured decision signals, contextual dependencies, governance constraints, escalation points and exception patterns that were previously distributed across procedures, individual experience and informal organizational practice.

Second, the validation revealed where operational decision-making depended on information available at the time of decision-making. Relevant information included the type of payroll case, contractual status, tax relevance, applicable approval rights, documentation requirements, prior organizational precedents and potential escalation triggers. These elements were represented as connected decision nodes rather than isolated checklist items. The resulting structure allowed users to examine for example, why a case required routine processing, additional documentation, expert review or escalation.

Third, onboarding-oriented use indicated practical value for junior staff. Participants used prepared and self-defined operational questions to navigate unfamiliar situations. DCKA supported orientation because it connected the immediate question with related governance rules, contextual conditions and evaluation criteria. Junior staff could identify relevant constraints, trace escalation requirements and recognize exception patterns more systematically than when relying on procedural documentation alone.

Fourth, organizational stakeholders assessed DCKA as compatible with broader continuity, governance and HR-related information system concerns. Their feedback emphasized three observed benefits: improved transparency of expert reasoning, more explicit representation of decision boundaries and clearer access to organization-specific interpretation during personnel transition. The evaluation also showed that expert review remains necessary because reconstructed decision structures require domain validation before organizational use.

5.1 Transferability Beyond the Payroll Case

Exploratory applications indicated that the reconstruction principles can be applied beyond payroll. In research settings, DCKA supported reconstruction of dependencies related to method selection, data quality assessment and interpretation of conflicting findings. In educational contexts, it helped structure recurring judgement situations in supervision, feedback and evaluation. In consulting contexts, comparable structures appeared in technology implementation, change management and expert advisory work, where decisions depended on stakeholder constellations, escalation logic, strategic priorities and governance sensitivities.

These transfer observations do not constitute full validation across domains. However, they indicate that DCKA addresses a recurring structural problem in decision-intensive environments: experienced actors interpret situations through connected signals, constraints, priorities and exceptions. The payroll case provides the main empirical grounding. The additional contexts suggest potential applicability where organizations need to preserve interpretive decision capability beyond a single expert or local practice.

6. Discussion and Conclusion

6.1 Knowledge Retention Through Decision Reconstruction

The results indicate that operational decision-making represents an important dimension of organizational knowledge retention. Established KM approaches provide effective mechanisms for storing documents, standardizing procedures and supporting access to explicit knowledge (Alavi & Leidner, 2001). The evaluation suggests that continuity of operational decision-making also depends on preserving the interpretive structures through which experienced employees assess contextual information, recognize exceptions and apply organization-specific evaluation logic.

DCKA extends established codification-oriented approaches through explicit reconstruction of these decision structures. Hansen, Nohria and Tierney (1999) distinguished between codification and personalization strategies because important forms of organizational knowledge remain embedded in expert judgement. DCKA contributes to this discussion through a structured reconstruction process that transforms organization-specific reasoning into an explicit and traceable knowledge architecture. The resulting graph represents relationships among contextual conditions, governance structures, decision signals, evaluation logic and operational dependencies as interconnected organizational knowledge.

The evaluation further demonstrates that graph-based representation provides an appropriate structure for preserving these relationships. Decision situations rarely depend on isolated rules or individual documents. They emerge from multiple interacting organizational factors whose relevance varies across contexts. Representing these relationships explicitly allows organizational reasoning to be examined, validated and reused while maintaining traceability to the reconstructed knowledge structure.

6.2 Organizational Implications

The case study illustrates that organizational continuity depends on preserving the capability to interpret operational situations consistently during personnel transitions. Experienced employees contribute organizational stability through their ability to recognize contextual signals, balance competing requirements and identify appropriate escalation paths. These capabilities often remain only partially documented in procedural descriptions.

The reconstructed decision structures supported contextual orientation during onboarding-oriented scenarios. Junior employees could follow reasoning paths, identify relevant governance constraints and understand evaluation criteria associated with unfamiliar operational situations. DCKA supported continuity of operational decision-making through explicit representation of organization-specific decision structures.

The reconstruction process also increased the visibility of implicit organizational priorities. Formal governance defines responsibilities, procedures and approval structures, while operational decisions frequently reflect additional considerations developed through organizational practice. Reconstruction made these prioritization patterns visible through explicit representation of escalation logic, tolerated exceptions, boundary conditions and evaluation criteria. The resulting knowledge structure provides organizations with a transparent basis for examining how operational decisions are interpreted across comparable situations.

The exploratory applications suggest that these reconstruction principles are relevant beyond the payroll domain. Comparable decision structures were identified in research, consulting and educational settings, where experienced practitioners likewise combine contextual interpretation, governance requirements and professional judgement. Although these observations require further validation, they indicate that decision reconstruction may provide a useful perspective for organizational knowledge retention across a broader range of decision-intensive environments.

The paper positions decision-making capability as a central object of knowledge retention. DCKA demonstrates how organization-specific decision structures can be reconstructed, represented and accessed through a graph-based architecture with AI-supported interaction. The artifact contributes a transparent approach for preserving interpretive organizational knowledge and supports continuity of operational decision-making during expert transition and organizational change.

AI Use Statement: We used AI-supported tools for language refinement and for the draft of visuals. AI was not used to generate research data, formulate hypotheses, simulate results or replace expert validation. All findings, evaluations and reconstructed decision structures were grounded in real organizational data and validated through human review.

Ethics and Data Protection Statement: The research was conducted in cooperation with an international for-profit organization under applicable confidentiality, privacy and data protection requirements. All permissions required for use of the underlying material were available. The paper does not disclose personal data, trade secrets or identifiable sensitive information.

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