Quantifying the Intangible: A Design Science Approach Measuring Tacit Knowledge Loss in IT Outsourcing

Master Thesis

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Abstract

Tacit knowledge is knowledge that stems from experiential and judgement-based know-how, which is difficult to articulate or codify. This knowledge plays a critical role in the continuity, quality, and governance of IT operations. During IT outsourcing or Managed Service Provider (MSP) transitions, this tacit knowledge is particularly vulnerable to loss and/or erosion which increases the operational risk, knowledge asymmetry and vendor lock-in. Despite its strategic importance, organizations currently lack the structure to assess or manage tacit knowledge loss, relying on indirect or subjective indicators such as service disruptions or cost metrics.

This thesis addresses the gap by adopting the Design Science Research (DSR) methodology, developing and evaluating the artifact which approximates the tacit knowledge loss during IT outsourcing and/or MSP transitions. This research draws on knowledge management literature, IT outsourcing governance, and empirical insights from Technology Risk, IT Auditors, Consultants, Clients-side Management and Vendor context. Triangulation was used to address both quantitative and qualitative data collection including an exploratory survey, semi-structured interviews, secondary data analysis, and a 2-round Delphi Study with human experts identifying, validating, and refining measurable indicators within the Tacit Knowledge Loss Quantification Model (TKLQM) assessment/dashboard.

The result of this research is an artifact "TKLQM" which approximates using observable indicator insights such as undocumented routines, expert dependency, incomplete knowledge transfer, and knowledge ownership weakness and its importance in weights per scenario/story/engagement. These indicators are aggregated into a composite score that provides an early-warning signal of tacit knowledge exposure and vendor dependency risk. This artifact was evaluated through expert-based Delphi validation and scenario-based demonstration, which confirmed usability and usefulness for IT Auditors and consultants in assessing tacit knowledge loss risk, while enabling client organizations to take ownership and recommended actions.

It demonstrated that tacit knowledge still can't be measured directly, but the loss or erosion of can be approximated through a structured and transparent artifact such as the TKLQM. Practically, it supports organizations in improving transition readiness, improves outsourcing governance, and mitigating long-term vendor lock-in.

Keywords: Tacit Knowledge, Knowledge Transfer, IT Outsourcing, Managed Service Providers (MSP), Quantification Model, Knowledge Asymmetry, Vendor Lock-In, Knowledge Asymmetry.

TABLE OF CONTENTS

Acknowledgement 8

List of Abbreviation/Acronyms 9

1 Introduction 11

1.1 Background and Context 11

1.1.1 Knowledge Loss Vulnerability in IT Outsourcing 11

1.1.2 European Significance for IT Outsourcing and Managed Services. 12

1.2 Problem Statement and Research Gap 13

1.3 Scope of the thesis 14

1.4 Research Objectives and Research Question 15

1.5 Research Method and Approach 16

1.6 Thesis Structure 17

2 Literature Review 18

2.1 Foundation of Tacit Knowledge and the varieties 18

2.1.1 Approaches to Measuring Tacit Knowledge 19

2.1.2 Examples of Tacit Knowledge 20

2.1.3 Organizational Value of Tacit Knowledge 21

2.1.4 Quantifying Tacit Knowledge Loss – Operational Proxies and Effects 22

2.1.5 Summary of tacit knowledge in literature 23

2.2 The Knowledge Sharing Models: SECI and Organizational Learning. 23

2.3 The Knowledge-Based View: A Strategic Approach. 25

2.4 Knowledge retention in IT Outsourcing. 26

2.4.1 Knowledge Risk and Vulnerabilities 26

2.4.2 Governance and Vendor Lock-in in IT Outsourcing 27

2.4.3 Knowledge Transfer During Outsourcing Transitions 28

2.4.4 Knowledge-Intensive Outsourcing Models: KPO and OPD 28

2.4.5 Managed Service Provider's Operational Structure and Knowledge Risks 29

2.5 The Tacit Knowledge Inventory for Managers (TKIM) 30

2.6 Knowledge Management Artifacts and Design Science Foundation. 31

2.7 AI usage for capturing tacit knowledge and enabling organizational innovation 31

2.8 Key Takeaways 32

3 Research Methodology 34

3.1 Research Design overview and rationale 34

3.2 Data Collection 35

3.2.1 Three-cycle combined with the DSRM steps 35

3.2.2 Perspective of the Auditor and Consultant 41

3.3 Artifact Development Method 42

3.3.1 Early findings 43

3.3.2 Problem identification 46

3.3.3 Requirements 49

3.4 Validity and Evaluation 51

4 Artifact Design 53

4.1 Indicators and Scoring Logic 54

4.2 Weighting and Composite Score 56

4.3 Indicator Contribution & Composite score 57

5 Evaluation & Findings 59

5.1 Delphi Study – Surveys + Panel with Scenario-based design 59

5.1.1 Round 1 - Survey 59

5.1.2 Round 2 – Panel + Scenario-based design? 61

5.1.3 Evaluation and result 62

5.1.4 TKLQM – Dashboard 62

5.2 Interpretation of Findings 64

5.3 Answering the Research Question 64

5.4 Contributions 65

6 Limitations 67

6.1 Scope and boundaries 67

6.2 Sampling and perspective limitations 67

6.3 Future Research 68

7 Conclusion 69

References 70

Appendices 75

Appendix 1: Data Management Plan **75**

Appendix 2: Survey email request **82**

Appendix 3: LinkedIn Post **83**

Appendix 4: Survey Content **84**

Appendix 5: Consent Form **91**

Appendix 6: Requirement(s) Table **93**

Appendix 7: Semi-Structured Interview Draft for evaluating Knowledge Transfer/Retention/ Loss **95**

Appendix 8: Interview Summaries **97**

Appendix 9: Delphi Study Round(s) **110**

Appendix 10: Dashboard Screenshots **122**

Appendix 11: Use of Generative AI Tools **125**

11.1 Technology Statement 125

11.2 Logbook for the Usage of AI Tools 125

FIGURES

Figure 1: Mechanism of tacit knowledge erosion during the transition phase. 11

Figure 2: Conceptual framework of tacit knowledge in IT outsourcing and Managed Services context 14

Figure 3: Modes of Knowledge Creation 24

Figure 4: Three-cycle diagram with the DSRM steps. 35

Figure 5: Hevner's three cycle for DSR 36

Figure 6: Activity phasing 41

Figure 7: Internal vs External validity 51

Figure 8: Example of TKLQM Position 54

Figure 9: TKLQM – PoC Dashboard 63

TABLES

Table 1: Foundational Terms with definitions. 12

Table 2: DSR Mixed-method Table 17

Table 3: Varieties of Tacit Knowledge and Relevance for IT outsourcing/ MSP 21

Table 4: List of interviewers 38

Table 5: Tacit Knowledge Challenges 48
Table 6: Requirement – Design Artifact: TKLQM 49
Table 7: Indicator and baseline normalization parameters 55
Table 8: Initial weighting scores 56
Table 9: Initial TKL Assessment 57
Table 10: Evaluated TKL Assessment 60

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List of Abbreviation/Acronyms

Abbreviation(s) / Acronym(s)	Definition
AFM	Autoriteit Financiële Markten
AI	Artificial Intelligence
DNB	De Nederlandse Bank
DSRM	Design Science Research Methodology
DSR	Design Science Research
ITAC	IT Application Controls
ITGC	IT General Controls
KBV	Knowledge Based View
KPO	Knowledge Process Outsourcing
MSP	Managed Service Provider
MTTR	Mean Time to Repair
PoC	Proof of Concept
SLA	Service Level Agreement
SNA	Social Network Analysis
TCO	Total Cost of Ownership
TKIM	Tacit Knowledge Inventory for Managers
TKLQM	Tacit Knowledge Loss Quantifiable Model

1 Introduction

1.1 Background and Context

1.1.1 Knowledge Loss Vulnerability in IT Outsourcing

"We know more than we can tell", the one who attributed the concept of tacit knowledge also known as Polanyi's paradox (Autor, 2014). Tacit knowledge refers to experiential and judgement-based know-how that is difficult to articulate or codify. In today's digital landscape, organizations increasingly rely on IT outsourcing and Managed Service Providers (MSPs) to access scalability, cost efficiency, and expertise. An MSP is a third-party organization responsible for a customer's ongoing, day-to-day responsibilities, monitoring, and maintenance of a tasks or functions, and usually bounded by a contract with a service level agreement (SLA) defining expectations and quality of the delivered services (SAP, sd). While these arrangements support transformations and operational flexibility, they also shift knowledge outside the client organization. In practice, vendors can gradually become the operational knowledge base of the environment because they accumulate undocumented knowledge, workarounds and dependencies on single expert. This creates a tacit knowledge gap that depreciates incident recovery, change management and the client's ability to challenge vendor decisions.

As organizations transfer their IT functions to vendors, the risk of losing internal organizational memory increases. One of the most significant risks is the erosion of organizational memory and slowly losing tacit knowledge within internal teams across the organization as depicted in figure 1. It includes the nuanced understanding of legacy system interdependencies, undocumented configurations and complex tacit problem-solving heuristics that only experienced personnel acquire over time. During outsourcing transitions, only parts of tacit knowledge is transferred, which increased the gap between explicit documented and practical know-how, which raises the likelihood of risk within the business continuity and any critical service(s) disruption (Alsondos, Pangil, & Othman, 2015).

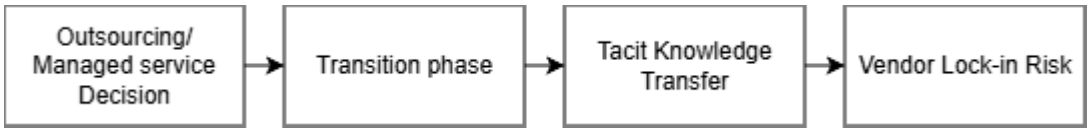

Figure 1: Mechanism of tacit knowledge erosion during the transition phase.

(Source: Created by this thesis)

This thesis focus on practice-based insights from technology risk, IT Audit, Assurance, Consulting, Client-side management, and outsourcing environments because these actors are directly involved in transitions, outsourcing assessments, and governance evaluations.

1.1.2 European Significance for IT Outsourcing and Managed Services.

The European market for IT outsourcing and managed service continues to grow because demand for digital capabilities are on a rise, but talent remains scarce. Digitalisation across the regio is accelerating e.g. European's share of SMEs basic level of digital intensity increased from 70% of basic digital intensity in 2022 to 74% in 2024 (CBI, 2026). This makes outsourcing strategically relevant but also increases the importance of keeping control over knowledge that remains critical for continuity and governance.

For any organizations, outsourcing offers flexibility, expertise access, and cost efficiency. However, more operational responsibilities are delegated which results in more vulnerable firms where hidden knowledge gaps are deepened, especially during transition periods when responsibilities, systems, and routines are redistributed across the organization. This is particularly visible in MSP where providers are integrated in day-to-day monitoring, maintenance and support. Over time, this operational involvement enables providers to accumulate knowledge from systems and practical know-how in which slowly leaves the from the client.

Because this study combines concept from outsourcing, managed services, and knowledge management, Table 1 defines the core terms used throughout the thesis.

Table 1: Foundational Terms with definitions.

Term	Definitions
Client	The organization outsourcing part of its IT operations to an external provider.
Vendor/ Service Provider	The external party delivering IT services under contractual and operational agreements (SLA)
Managed Service Provider (MSP)	A provider is responsible for ongoing, day-to-day operational management. They often are deeply embedded in daily processes and decision flows.
IT Outsourcing	The transfer of IT functions, systems, or responsibilities to an external vendor.
Tacit Knowledge	Experienced-based know-how that is difficult to articulate, document, or codify. This included heuristics, undocumented practices, workarounds, and professional judgement.
Explicit Knowledge	Formalized knowledge that can be documented, stored, and easily transferred.
Knowledge transfer	The process of transferring operational, contextual, or experiential knowledge between individuals or teams.

Vendor Lock-In	A condition in which the client becomes dependent on a vendor due to the loss of internal capability or knowledge asymmetry.

(Source: Created by this thesis)

These developments highlights outsourcing growth is accompanied by growing tacit knowledge risk. At the same time, supervisory authorities such as the De Nederlandse Bank (DNB) and Autoriteit Financiële Markten (AFM) expects boards to demonstrate control over outsourced and MSP-delivered activities, including continuity of critical processes (DNB, 2023; AFM, 2024).

1.2 Problem Statement and Research Gap

Despite the strategic importance of knowledge retention during the IT outsourcing transition, currently organizations lack robust and quantitative methods to measure and approximate or assess any loss in tacit knowledge, or even procedural knowledge. In practice, decision-makers often rely on indirect outcomes, such as downtime, cost, or service issues, while the underlying erosion of undocumented know-how remains insufficiently governed (Watson, 2025). The responsible key stakeholders are usually the Chief Information officer (CIO) and IT Director(s) for any successful implementation of IT outsourcing projects. These stakeholders must decide on whether one IT-function or BU needs to be replaced by third-parties or to retain its team improving and building its internal skills. Depending on the decision, the organization might contain its strategic autonomy by solving this problem. Lead auditors and IT Auditors from big consulting firms are secondary problem owners, as they need reliable metrics to advise clients on any transition risk while validating their knowledge preservation objectives. While IT Auditors and consultants play a critical role, accountability for knowledge retention, governance, and risk mitigation remains at the client. These stakeholders are being forced to rely solely on objective measurements or assessments such as system downtime or the total cost of ownership (TCO) as there are no clear measurement frameworks aligning with the “tacit” knowledge of the employees, which issues the opportunity of proactive knowledge management (Dastaki, Afrazeh, & Mahootchi, 2022). Consequently, there is a need for a structured approach which does not measure tacit knowledge but approximates the loss through observable indicators for governance and risk assessment. Figure 2 depicts the macro context, organizational tacit-knowledge risk, the research gap and the tacit knowledge inventory model solution in a simple manner

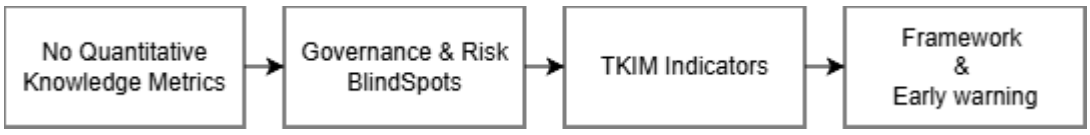

Figure 2: Conceptual framework of tacit knowledge in IT outsourcing and Managed Services context
(Source: Created by this thesis)

From a business perspective, the stakes are high because weak knowledge transfer can increase transition costs, slow recovery, and reduce the client's ability to retain control. (Watson, 2025). From an academic perspective, literature acknowledges the importance of tacit knowledge, knowledge transfer, and outsourcing governance, but offers limited validated artifacts for approximating tacit knowledge loss during transitions. Therefore, a clear research gap exists that currently no structured, validated framework for quantifying tacit knowledge loss during IT outsourcing transition. This research looks at the prescriptive guideline for practitioners or stakeholders measuring standard governance practices of any intangible knowledge such as "tacit" knowledge for effortless transition. By aligning all relevant research papers, this thesis provides a solution and/or framework that is theoretically ground and practically solid for retaining the most amount of knowledge during the IT outsourcing transition.

1.3 Scope of the thesis

Tacit knowledge loss remains difficult and a missing puzzle in IT outsourcing and MSP managed service transitions because experiential knowledge, professional judgement, and undocumented routines are critical for the business continuity, but rarely governed in a structured way. The problem becomes most prominent during transitions, when organizations depends on workarounds, heuristics, and coordination routines that are not fully documented. Currently governance decisions about handovers, evaluation, or assessing vendor dependencies are based on the subjective experience rather than driven by data. Technology risk teams, IT auditors and stakeholders lack the structured ways identifying these risks early on as no framework exist for measuring how much tacit knowledge is lost during the transition phase.

The thesis shows by deriving indicators from literature, surveys, interviews, and Delphi Study evaluations, and combining them into a structured assessment and dashboard. The aim is not to measure tacit knowledge loss directly, but to approximate its erosion in a way that supports governance, discussion, and decision-making. Essentially, the scope of this thesis is to design and evaluate a risk-oriented artifact that helps organizations identify, monitor, and discuss tacit

knowledge loss during outsourcing and managed service transitions, with a specific focus on outsourcing documentation and transition-related knowledge risk.

1.4 Research Objectives and Research Question

The objective of this research is to design and evaluate an artifact that is risk-oriented with a methodology that supports the assessment of tacit knowledge loss during IT outsourcing and Managed Service transitions. More specifically, the Tacit knowledge Loss Quantification Model (TKLQM) dashboard is developed as a structured governance tool for managing related tacit knowledge loss risks. It examines how erosion can be approximated through indicators, weights, and a dashboard-based assessment that supports a more informed discussion and decision-making. This dashboard consists of (1) theoretically and empirically grounded indicators, (2) expert-validated weights for the scoring model, obtained via a Delphi Study, and (3) an algorithm with decision thresholds to get the index of the Tacit Knowledge Loss. Together, these components provide a practical methodology for evaluating tacit knowledge loss

- Identifying measurable indications of tacit knowledge within IT functions or BU.
- Identifying the requirements for creating a PoC dashboard.
- Evaluating the utility, accuracy, and relevance of the artifact for practitioners such as CIOs and client-side IT decision-makers, supported by IT Auditors and Consultants.

These objectives, but not limited to, will fundamentally address the problem of unmeasured knowledge erosion in large-scale IT transitions and lead to the following research question:

To what extent can an artifact approximate tacit knowledge loss and support the management of documentation in IT outsourcing and Managed Service transitions?

Additionally, sub questions are needed to break down the research question and to align with the specific chapters:

RQ1: What forms of tacit knowledge are most vulnerable during IT outsourcing and MSP transitions?

Reason RQ1: Tacit knowledge can be divided into 3 categories, which are relational, somatic and collective tacit knowledge. Somatic tacit knowledge pertains to the body, meaning that skills that are embodied in physical capabilities are not relevant for this research. Somatic Tacit knowledge won't be researched upon as this falls outside the scope. In terms of relational tacit knowledge, which comes

from relationships, communication patterns, trust and collaboration between people. This is important due to the intercommunication between vendors and internal expert, which can cause vendor lock-in due to the loss in relational knowledge (Collins, Tacit Knowledge, Trust and the Q of Sapphire, 2001). Furthermore, collective tacit knowledge comes from the knowledge embedded in group routines, shared norms, team workflows and organizational culture. IT teams/functions or BU have their shared practices which are undocumented. Usually, they bypass the collective routines and "get things done how it's done" (Collins, Tacit and Explicit Knowledge, 2010).

RQ2: Which indications or metrics can approximate tacit knowledge loss levels in practice?

Reason RQ2: Having clear, well-thought indicators and metrics are important to capture as close as possible the current tacit knowledge loss levels within a transition period. Well-constructed indicators can translate qualitative insights into actionable measurements, informing transitional planning and readiness decisions.

RQ3: How can these indicators be integrated into practical, actionable and useful artifacts to support identification and mitigation of tacit knowledge loss?

Reason RQ3: Capturing the remaining tacit knowledge is a difficult task, so having these indicators would be of great help already. Converting these indicators or metrics into actionable artifacts will reveal knowledge where knowledge loss is occurring, but it doesn't particularly translate into usable tools.

1.5 Research Method and Approach

The approach for this study is the design science research (DSR) methodology, which is well-suited for developing innovative and practical solutions for complex organizational problems. The DSR is a flexible research methodology that consist of both quantitative and qualitative, utilizing a mixed-method approach to develop and evaluate artifacts.

Having semi-structured interviews will help identify requirements regarding the pain points, current practices, experience with vendor lock-in and what should be measured in an artifact. Additionally collecting both business and technical requirements, contextual understanding of why this is important, and prioritizing features for the PoC dashboard. After having the artifact ready to show, focus groups, expert judgement, feedback and heuristic evaluation is held to qualify the shown artifact. Alternatively, the quantitative elements in DSR consist of scoring levels, Likert-scale indicators, metrics. In summary, qualitative data elements are to discover the problem and design

requirements, whereas quantitative data elements are to measure the construct and evaluate performance of the artifact, see table 2.

Table 2: DSR Mixed-method Table

DSR	Qualitative	Quantitative
Problem identification	Interviews, Observations, secondary data analysis, Document analysis	Survey
Requirements	Interviews, feedback, secondary data analysis	-
Artifact Design	Shaping Constructs (building a framework)	Numerical operationalization of constructs
Artifact Development	-	Metrics, Scoring models, Likert-scale
Artifact Evaluation	Expert opinions, Delphi study	Surveys, rating scales

(Source: Adopted from (Hevner A. , March, Park, & Ram, 2004)).

This thesis chooses for a dashboard-oriented artifact because tacit knowledge loss is part of a risk profile, and not a singular outcome. Practitioners such as IT auditors, technology-risk Consultants, and CIOs typically work with comparable tools. By having a dashboard, the aggregated indicators transforms into a readiness and risk index, that is aligned with decision-making practices in assurance and governance. Thus, this artifact functions as a risk assessment tool supporting scoping, planning, and monitoring of the transitions, instead of being a conceptual model.

1.6 Thesis Structure

This thesis is structured around seven chapters, including the introduction and is as follows:

The remainder of this thesis is structured as follows. Chapter 2 reviews literature on tacit knowledge, outsourcing, knowledge management, and artifact design. Chapter 3 explains the Design Science Research (DSR) methodology and the data collection method used. Chapter 4 presents the design of the TKLQM, including indicators, normalization, weighting, and scoring logic. Chapter 5 evaluates the artifact through the Delphi Study and scenario-based demonstration. Chapter 6 discusses the findings and contributions. Chapter 7 outlines the limitations and future research directions, and Chapter 8 concludes the thesis.

2 Literature Review

The literature review sections in this thesis uses the academic databases that are part of the Information System Research, including Scopus, Google Scholar, and the AIS eLibrary. Furthermore, peer-reviewed articles/publications from information system journals such as MIS Quarterly, Journal of Knowledge Management, Information System Journal, Journal of Strategic Information Systems, and Information & Management. Besides using these journals, the perspective of practitioners was also used such as outsourcing reports, consultancy whitepapers, and industry analysis report (CBI, MarketsandMarkets, Mordor Intelligence).

2.1 Foundation of Tacit Knowledge and the varieties

Tacit knowledge is commonly defined as knowledge that is difficult to articulate, codify, and transfer if compared to explicit knowledge, which can be formalized and communicated through documents, rules and/or data stores (Nonaka, 1994). Michael Polanyi captures the phrase "we know more than we can tell", emphasizing that tacit knowledge is experimental and cannot be fully articulated in propositional form (Polanyi, 2001). Polanyi further suggest that tacit knowing is inherently personal and context-dependent, generated through action rather than description

Tacit knowing and tacit knowledge are an often-ignored distinction that Collins tries to clarify the confusion about Polanyi's though and modern debates (Collins, Tacit and Explicit Knowledge, 2010). Tacit knowledge can be divided into three distinct categories, 1) Relational tacit knowledge, which compromises the tacit knowledge only to interpersonal interaction or attention. 2) Somatic tacit knowledge comes the human body's physical properties or limitations. 3) collective tacit knowledge is the knowledge that depends on social and cultural judgment, depending on context and therefore, this cannot be generalized in explicit form (Stephen G., 2011). From an organizational standpoint, tacit knowledge diffusion is closely related with societal networks and long-standing relationships. Even when knowledge could be made explicit, the interpersonal dynamics might be the reason for constraining the articulation. A firms partial learning stems from socially embedded relationship, which is the reason employees remain at the company, but the loss of organization-level tacit knowledge through employee turnover is detrimental to the performance of a firm (Scott B & Jenny M, 2003).

The social nature of spreading tacit knowledge means that organizations need to craft intentional environments, focused on interaction, apprenticeship, and collaboration. The concept of communities of practices by Lave and Wenger shows that situated learning is where an amateur

becomes an expert by gradually participating in tasks helps to cultivate knowledge (Jean & Wenger, 1991). Knowledge transfer in this case becomes less documented, but more immersed through mentorship and shared experiences. However, organizations nowadays face increasing challenges that consist of distributed work, increased mobility and digital mediation. Remote work environment hinders subtle and spontaneous interactions where one can exchange tacit knowledge (Keppler & Leonardi, 2023), rather, it supports the explicit knowledge sharing, while tacit knowledge relies on casual embodied presence and observation (London School of Economics, n.d.).

Additionally, the role of Artificial Intelligence (AI) and automation in organisations that mediate knowledge excels at handling all explicit knowledge and rule-based tasks but struggles when it comes to tacit knowledge that require interpretation, ethical judgement and/or intuitive decision-making (Zuin, Mastelini, Loures, & Veloso, 2025). This highlights the importance and value of human tacit knowledge, which calls for the focus on experiential contributions from employees. Technological tools can enhance tacit knowledge by enabling contextual cues, supporting reflection and learning. Tacit knowledge accounts for the capability of an organization, which is characterized by the relational and collective forms. The resistance to documented or codifying makes this resource strategic and vulnerable if not being meticulous. Organizations tend to seek resilience and innovation, therefore cultivating social structures, cultural environments and various networks will continue to cultivate sharing and retaining tacit knowledge.

2.1.1 Approaches to Measuring Tacit Knowledge

Although tacit knowledge is hard to articulate, multiple research domains have tried to identify the approximate indicators allowing some measurements. Studies found that knowledge management emphasizes that tacit knowledge cannot be quantified directly due to the difficultness of interpretation and experience (Nonaka, 1994; Choo, 1996),. This statement led to the development of various indirect assessment mechanisms.

An adopted approach is the expertise mapping, which is to visualize the distribution of skills, tasks, and domain-specific proficiency within teams. These maps contribute and identify key stakeholders and experts where leaving the company causes substantial knowledge gaps (Dalkir, 2013). Similarly, (Durst, Hinteregger, & Zieba, 2019) researched upon the knowledge risk assessment to evaluate any potential knowledge loss by examining criticality, rarity and substitutability of expertise. These assessments are used for organizations that are undergoing transitions such as mergers & acquisitions, restructuring or outsourcing. Additionally, social networks analysis (SNA) is also a widely applied method that assumes tacit knowledge to flow primarily through information

communication channels. Mapping these social ties, SNA reveals individuals, bottlenecks and how closely the collaboration network is (Cross, Borgatti, & Parker, 2002). Reducing or elimination of the network or cohesion between teams may indicate the loss of tacit knowledge, especially when the outsourcing transition phase starts. Finally, problem-solving speed, error rates, execution of tasks, reliance on workarounds are all examples of behavioural proxies proposed researchers. These proxies are measuring the effect of tacit knowledge rather than the general knowledge itself (Nissen, 2006). Although these methods provide useful indicators, it is non-standardized and context dependent.

2.1.2 Examples of Tacit Knowledge

Tacit knowledge becomes most visible in work practices that doesn't document "all" of its processes. In IT Outsourcing and Managed services, it is often mentioned that undocumented rationales and heuristics enables service continuity under time pressure (Goyette, Cassivi, Courchesne, & Elia, 2014). In ERP support for SAP FI/CO, such tacit knowledge appears four ways, 1) the period-end closing sequences effective only if executed in a locally known environment and/or order, 2) runbook deviations during payments were senior analyst brittle variants on prior incidents, 3) reconciliation heuristics between FI and CO when dealing with clearing or when custom SAP Business Application Programming interface (BAPI) are missing, and 4) situational escalation in which specific functional owners to contact first during any outages, which all results based on trust (Ao, Gelman, & Hukins, 2016). These undocumented routines and workarounds are what make these successful implementations and operations difficult to outsource or transfer. In the MSP environment, tacit knowledge is consisting of 3 manifestations such as 1) incident heuristics, 2) cross-team hand-offs which are optimized by local supporting teams and 3) vendor-specific knowledge that are embedded and escalated to third-party vendors. Studies show that managed incident response show improved transfer of tacit patterns in terms of proximity, shadowing, and simulation environments (Cho, Happa, & Creese, 2020).

Professional judgement represents the application of training, knowledge, and experience to make informed decisions about the appropriate actions during the process of audit (Lam & Tuan, 2023). Polanyi's work argues that performing professionally depends on "the unwritten set of rules" (Polanyi, 2001). This highlights the importance of tacit knowledge awareness over explicit knowledge. On a relational level, professional judgement depends on the social context, which often becomes collective that is embedded in group routines and shared norms, unable to convey into explicit information (Collins, Tacit and Explicit Knowledge, 2010). Professional judgement develops over time through project immersions. In knowledge-intense environment such as IT Audit,

Technology Risk, or outsourcing transitions, practitioners rely on (professional) judgement invisible to Jr. staff. As a result, judgement-based tacit knowledge such as professional judgement becomes especially vulnerable. Relational patterns, experiential reasoning, and undocumented heuristics often vanishes when individuals or teams are shuffled due to new projects.

These examples fit with Polanyi's idea of "we know more than we can tell" with relational and collective forms of tacit knowledge considered as high-risk in enterprise IT, especially when outsourcing or MSP comes to play (Henderson, 2023).

2.1.3 Organizational Value of Tacit Knowledge

Tacit Knowledge highlights the operational resilience, innovation capacity and strategic autonomy. In ERP operations, IT compresses decision time and enables improvisation when explicit documentation is incomplete. On the other hand, from a knowledge-based view, tacit knowledge is difficult-to-imitate resource and even harder to keep a competitive advantage (Farnese, Barbieri, Chirumbolo, & Patriotta, 2019). Especially when it comes to migrating into outsourcers/MSP, the client is risking dependency and higher switching cost due the vendor lock-in. Empirical study shows that converting tacit into explicit by using the SECI model, it will contribute to performance and innovativeness, while literature mentions in governance that relational mechanisms must complement client-vendor contracts to gain the added through the lifecycle (Lin & Vaia, 2015).

Table 3: Varieties of Tacit Knowledge and Relevance for IT outsourcing/ MSP

Type(s) of Tacit Knowledge	Definition	Key characteristics	Relevance in IT Outsourcing/ MSP
Relational	Knowledge that could technically made to be explicit but is not, often due to social constraints, secrecy, or communication patterns	Contextual, inter-personal, negotiated in practice, trust-dependent, emergers through interactions and recurring collaboration.	- Loss results in escalation pathways and cross-team coordination; accelerates client dependency on outsourcing/MSP when only the provider is responsible for this (Lin & Vaia, 2015). - In MSP Settings, relational tacit knowledge accumulates on vendor's side. Governance must combine contractual and relational mechanism to counterbalance vendor knowledge and advantages (Lin & Vaia, 2015).
Collective	Knowledge that is impossible to make explicit because it	Emergent from shared practices, hard to externalize, information rituals, local routines,	- Loss destabilises documentation and "the way we get things done", which increases the

	exists in group norms, routines and culture	ingrained team behaviours, slow transfer	transition risk and failure in change (Farnese, Barbieri, Chirumbolo, & Patriotta, 2019). - MSP teams form collective routines like habits that forms the de facto way of operating (Strand, 2024; Farnese, Barbieri, Chirumbolo, & Patriotta, 2019; Cho, Happa, & Creese, 2020). - Knowledge concentrates in MSP, reducing client's internal knowledge and strategic autonomy (Argote & Miron-Skeptor, 2011; Windrum, Reinstaller, & Bull, 2009)
Somatic	Knowledge embedded that is rooted in physical body and skills, making it difficult to codify.	Sequences, perceptual cues, bodily skills, physical actions or sequences.	- Not relevant for this research. IT outsourcing and MSP tasks are cognitive, judgement-based, and system-oriented, rather than physical

(Source: Adopted from (Collins, Tacit Knowledge, Trust and the Q of Sapphire, 2001; Collins, Tacit and Explicit Knowledge, 2010)).

2.1.4 Quantifying Tacit Knowledge Loss – Operational Proxies and Effects

While tacit knowledge is not measurable, erosion of tacit knowledge used as evidence through leading and lagging indicators referenced from knowledge-risk, social network analysis (SNA), and ERP performance literature. The leading indicators during a transition or an MSP onboarding are as follows:

- **Network cohesion drops** which is the degree of connectedness and solidarity among the organization (Cross, Borgatti, & Parker, 2002).
- **Externalisation Shortfall**, the gaps between the validated documentation and the identified critical routines (Ao, Gelman, & Hukins, 2016).
- **Shadowing/ co-presence hours** vs target for vendor/MSP engineers (Krancher & Dibbern, 2020)
- **Provider bottlenecks,** the rising proportion of SAP tickets that is can only be resolved by a vendor/MSP team → knowledge asymmetry.

Lagging indicators on the other hand, which are post transition effects, are:

- **Increased Mean Time to Repair (MTTR), incident recurrence, and escalation** in ERP operations. The deficit in tacit slows down the root cause analysis, resulting in more third-party escalation (Cho, Happa, & Creese, 2020).
- **Increased in failure rate of change and the rate of reopening** (tickets that are being re-opened after being resolved) (Farnese, Barbieri, Chirumbolo, & Patriotta, 2019).
- **Increased cost and decreased negotiation leverage**, which is the classic form of vendor lock-in when knowledge is only available from the provider's side.

2.1.5 Summary of tacit knowledge in literature

Across literature, tacit knowledge is the unarticulated, experienced-based, and socially embedded information from one's knowledge. The SECI model from Nonaka provides a roadmap for converting tacit knowledge into explicit knowledge and has been operationalized by linking it with the performance and innovativeness of the organization. Relational and collective tacit knowledge are becoming valuable yet vulnerable during the transitions phase in outsourcing and MSP.

2.2 The Knowledge Sharing Models: SECI and Organizational Learning.

The foundation of Nonaka's SECI model of knowledge dimension stems from hands-on research and practical experience of Japanese firms (Nonaka, 1994). It conceptualizes knowledge conversion as a dynamic spiral through four 'modes': Socialization (tacit-to-tacit), Externalization (tacit-to-explicit), Combination (explicit-to-explicit), and Internalization (explicit-to-tacit) (Nonaka, 1994). The mere transfer of knowledge often makes little sense unless experience, observation, imitation and practices has been shared between employees. According to Nonaka and Takeuchi, the dynamic interaction between tacit and explicit knowledge in a cyclical process is considered true innovation. "Socialization" is the process of creating tacit knowledge through shared experience. The use of social processes exchange and combination of different tools such as meetings and telephone conversations require both parties to reconfigure existing information through sorting, adding, recategorizing, and recontextualizing of explicit knowledge, leading to new knowledge (Nonaka, 1994). This continuous cycle of conversion is depicted in figure 3, which is theoretical a "gold standard" direction to understand how specific knowledges are transformed into the core of an organization

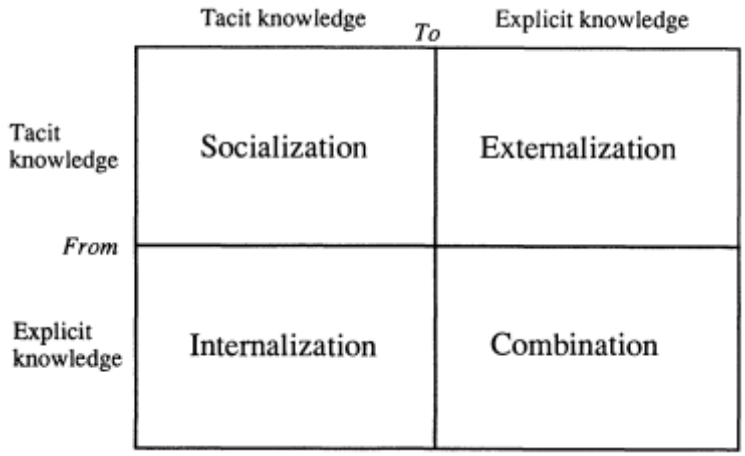

Figure 3: Modes of Knowledge Creation

(Source: (Nonaka, 1994))

Internalization and externalization are all about relating patterns of both tacit and explicit knowledge. It captures the idea that both these knowledges are complementary and can expand over time. Figure 1 illustrates the four modes of knowledge conversion. The SECI model emphasizes on effective knowledge creating that is required to have smooth transition between tacit and explicit domains. Failure to do so can causes problems such as a lack of commitment and neglect of personal meaning of knowledge, limited crystallization or embodiment knowledge in a form that is concrete enough to further create knowledge in a wider social context (Nonaka, 1994). Therefore, organizations must cultivate environments where these transitions can occur continuously. Refinements of the model highlights that cultural and contextual dependencies challenges in externalizing are deeply embedded in tacit knowledge, which often poses a difficult conversion.

Empirical studies shows that the SECI processes can be measured and linked to performance outcomes. (Farnese, Barbieri, Chirumbolo, & Patriotta, 2019) A researcher in Italy, Farnese et al. successfully operationalized the SECI model in a multidimensional questionnaire and validated the influence where organizational performance, innovativeness, and collective efficacy in knowledge-intensive context. The SECI's model relevance has been emphasized through this research for designing measurable constructs, which is an important foundation for developing any kind of tacit-knowledge artifact.

Multi-organisational projects can be seen as a contingent response to absence of certain capabilities, competencies or resources within the company. Knowledge sharing is the key driver of alliance formation. The SECI Model's holistic approach provides a robust framework for understanding creation of knowledge, applicable for various organizational context.

2.3 The Knowledge-Based View: A Strategic Approach.

The knowledge-based view (KBV) for outsourcing demonstrates that knowledge sharing is key to emphasize competitive advantage through activities and experiences within the firms (Scuotto, Giudice, Bresciani, & Meissner, 2017). KBV can be both acquired and created through interaction of explicit and tacit knowledge from social interaction from the firm as well as interaction with other organizations through networking. Therefore, it is the most strategically significant resource of the organization, by even surpassing the physical assets in contribution towards sustainability (Nguyen & Be, 2025). (Grant, 1996) emphasizes that tacit knowledge is particularly valuable due to its immutability and difficultness for competitors to replicate, which makes this the core driver for long-term relationships and competitive advantage. Based on scholarly work regarding outsourcing from the KBV's perspective, it shows that the nature of knowledge being outsourced determines the success of outsourcing arrangement. (Bustinza, Molina, & Gutierrez-Gutierrez, 2010) found out that outsourced activities involve high levels of tacit knowledge, which the outsourcing team heavily depends on to retain this knowledge internally. It concluded that collaborative know-how and a firm's willingness to learn strongly influences the outcome of outsourcing projects, reinforcing KBV's knowledge management. Tacit knowledge is particularly prone to leakage, resulting in damaging the firm's reputation and performance (Venturini, Ceccagnoli, & Zeebroeck, 2019) if knowledge has been leaked without proper governance mechanisms. If tacit knowledge is becoming tight to vendor(s), clients will lose critical competitive advantage by becoming more dependent on the outsourcing provider.

The "productivity paradox" refers to an empirical observation where large investment in IT often fails to materialize in productivity gains (Brynjolfsson, 1994). (Windrum, Reinstaller, & Bull, 2009) argues that large-scale organizations can reduce long-term productivity by reducing capacity for innovation. This lies heavily on internal knowledge. When too many activities are outsourced, the firm tends to lose its internal knowledge that is required to (re)configure processes effectively. Recent studies also demonstrate that productivity outcomes depend on knowledge factors, not just IT investment. Product paradox persists throughout the lifecycle, unless there is simultaneous development in human capital and knowledge to technology adoption (Nguyen & Be, 2025), which should be a combination of IT and tacit knowledge embedded in employees. Similarly, (Chang & Gurbaxani, 2012) shows evidence about firms achieving productivity gains from IT investment, only when IT-related knowledge held by vendors and internal capabilities stores it knowledge and applying it, can a firm achieve productivity gains. Without these internal capabilities, outsourcing can be

dangerous and results in the productivity paradox by widening the gap between the potential technology and organizational performance.

While the SECI model provides a roadmap for knowledge creation and retention, not able to effectively manage these conversions results in added explanation regarding the "productivity paradox" mentioned in chapter 1. Failing to capture the tacit knowledge required to operate efficiently and expecting increased productivity will be detrimental to IT infrastructure as it will remain the same or even deteriorate. Therefore, the productivity paradox doesn't explain the failure of the technology itself, but rather the failure of quantifying and retaining the tacit knowledge during it outsourcing transition.

Beyond the traditional outsourcing solutions, the KBV also offers important explanations for the growing risks that is associated with the MSP models. In MSP environments, vendors are not only doing their tasks but are also deeply embedded in the operational lifecycle such as handling incidents, performing system maintenance, and daily decision-making (Walsh & O'Brien, 2017). (Irec, Rebernik, & Hojnik, 2012) researched on strategic outsourcing and argues that external vendors tend to take complex, knowledge-intensive activities to acquire experiential understanding which inevitably is difficult to replicate from the client side. MSPs continuously operate rather than project-based, which results in a compounding effect of knowledge that strengthens the operational familiarity of internal systems. The KBV predicts that these asymmetries in tacit knowledge and experience-based knowledge creates structural knowledge dependency, which limits the decision-making of clients and increases the risk of vendor lock-in (Smuts, Kotzé , van der Merwe, & Loock, 2015). Thus, positioning the MSP escalates the KBV concerns by the increased vendor's tacit knowledge in terms of transfer, accumulation, and embedding, thus making quantifying tacit knowledge loss especially critical.

2.4 Knowledge retention in IT Outsourcing.

2.4.1 Knowledge Risk and Vulnerabilities

Outsourcing introduced multiple forms of knowledge risk that originates from redistribution of knowledge between vendors and clients. The primary risk is the knowledge leakage, meaning that sensitive or proprietary information unintentionally is transferred to third parties. When vendors serve several clients, this becomes common within the same domain. Another critical concern is knowledge symmetry, which a vendor acquired operational knowledge where the vendor gain a disproportionate amount of control over the system.

Organizational forgetting is a related vulnerability compared to knowledge leakage and knowledge asymmetry. During the transition phase of outsourcing, clients often reduce internal staff or eliminate legacy teams. While these experts are slowly leaving, the organization also slowly loses its historical knowledge, workarounds, and contextual understanding (Argote & Miron-Skeptor, 2011). The absorption capacity decreases, defined by (Gerard & Shaker, 2002) as the ability to recognize, internalize, and apply any new knowledge. The low absorption capacity of employees creates an increased dependency on outsourcing vendors, results in weak long-term autonomy. Generally, these risks tend to create structural vulnerabilities manifesting to disrupt services of clients, increased switching cost and limited innovative capabilities.

2.4.2 Governance and Vendor Lock-in in IT Outsourcing

The effectiveness of IT outsourcing governance has become critical for managers, given that IT outsourcing often underperform. Securing the effectiveness of IT outsourcing becomes more important due to its low success rate of 56% (Koh, Ang, & Straub, 2004) emphasizing the need for stronger governance. IT outsourcing performance, including cost efficiency, performance improvement, and overall satisfaction has been greatly affected due to the effectiveness of Governance (Kim, Lee, Koo, & Nam, 2013). Two governance pillars shape outsourcing success across the lifecycle of IT outsourcing has been identified through systematic reviews, which are governance structures such as formal contracts and decision rights, and governance mechanisms such as coordination, relational mechanisms and trust (Lin & Vaia, 2015). Both contractual and relational mechanisms are needed to mitigate risks, maintain vendor performance, and align expectations from both parties.

Literature on outsourcing governance further highlights that both contractual and relational governance must be implemented. Contractual governance are mechanisms that provide safeguards against any opportunities through a form of specification, while relational governance are mechanisms that are rooted in trust, shared norms, mutual problem solving which supports flexibility and adaptive collaboration in dynamic environments[(Oshri, 2022; Kotlarsky, Rivard, & Oshri, 2023). Reflecting on broader outsourcing governance research highlights the effectiveness of governance frameworks, which enhances performance, reduce conflicts and support innovation outsourcing arrangements (Kotlarsky, Rivard, & Oshri, 2023).

Vendor lock-in becomes apparent when a customer depends solely on a single vendor for products or services ,which makes it difficult or costly to switch[(Vadeedbasha & Natarajan, 2024; CloudFlare, n.d.) and remains a critical concern within the governance frameworks. Specialized

knowledge through client-vendor collaboration can significantly increase the cost and dependability of the vendor. Research shows that clients should consider keeping key knowledge assets within the organization or request vendors to use popular technologies that other vendors offer and strict adherence to standards (Shawosh & Berente, 2019). As knowledge becomes embedded within the vendor's environment, the client loses the required internal knowledge to control operations or switch providers. This illustrates why tacit knowledge erosion during outsourcing transition results in strategic vulnerability.

2.4.3 Knowledge Transfer During Outsourcing Transitions

Knowledge transfer is considered the most difficult component during the outsourcing transition phase. Research shows through 35 studies of knowledge transfer in transition phase that engineers require months or even years of structured practice(s) before achieving performance comparably to the critical teams, unlike managers (Krancher O. , 2020). Being able to transfer all the required knowledge can be completed within weeks is a common assumption. Transitions involve not only explicit assets like documents, codes and manuals, but also tacit knowledge from experienced employees (Krancher O. , 2020; Oshri, 2022). Many organizations don't realize that outsourcing affects everyone by the IT Outsourcing arrangement. The emotional impact is unmeasurable which can progress into the biggest problems faced by the outsourcing projects if not managed well (Oshri, 2022).

Social processes such as pairing, shadowing, co-presence needs to be implemented. There is no other way to transfer these mechanisms, particularly managerial expertise, routines and problem-solving heuristics (Hassan, Noor, & Hussin, 2017). Research also show tools like e-mail, cloud storage system, short messaging system, phone and network infrastructure can be seen as support systems that are key for transition management where formal documentation with flexible interaction can be captured effectively.

2.4.4 Knowledge-Intensive Outsourcing Models: KPO and OPD

Knowledge Process Outsourcing (KPO) refers to the outsourcing of core information-related business activities that are knowledge-intensive, complex and domain-specialized. It involves high-end processes like valuation research, investment research, patent filling and legal and insurance claims processing. There tends to be more risks involved that benefits in having KPO. The value that is brings is the customized and efficient way of competing effectively with upcoming technologies, but the catch is to recruit domain specific knowledge which requires higher quality standards,

confidentiality and enhanced risk management (Sen & Shiel, 2006). The risk of tacit knowledge loss and vendor dependency are significant, especially when tied to another critical business process.

Outsourced Product Development (OPD) involves outsourcing specific activities or (in some cases) all activities related to development and maintenance of a product. It enables product owners to tap into experts and global talent. The deep integration of product architecture, design, quality standards and long-term product stewardship is what makes OPD different from the traditional and conventional software outsourcing vendors (aspiresystems). These areas are rich in tacit knowledge such as architectural trade-off, non-functional requirements and operational heuristics, but are also susceptible to knowledge loss if OPD is not govern and documented.

2.4.5 Managed Service Provider's Operational Structure and Knowledge Risks

The arrangement of MSP's differs per project's outsourcer because they are embedded in the provider distinctively in day-to-day processes, which changes how knowledge gets to be created, accumulated, and governed (Oshri, 2022; Irec, Rebernik, & Hojnik, 2012). Because MSP's are not time-bounded projects, the maintain continuous operational exposure to the clients such as monitoring, incident responses, patching, and maintenance, which increases the acquired tacit knowledge from the MSP's side (Oshri, 2022; Cho, Happa, & Creese, 2020). Therefore, from the perspective of a consultant, MSP's can be divided in three layers:

1. The Service Operational Layer

   The MSPs consistently performs tasks such as monitoring, handling incidents, execute changes and maintenance frequently, which leads to the creation of situated heuristics like workarounds, escalation paths, and troubleshooting patterns that are often not being documented but improves the quality and efficiency of the service (Cho, Happa, & Creese, 2020; Goyette, Cassivi, Courchesne, & Elia, 2014). The result is through learning-by-doing as mentioned by (Nonaka, 1994). The higher the volume and variety of operations, the faster a provider accumulates tacit knowledge compared to the organisation from which it uses the service (Krancher & Dibbern, 2020; Oshri, 2022).

2. The Knowledge Accumulation Layer

   Across the lifecycle, MSP teams transform the exposure to familiarity with legacy dependencies, undocumented configurations, and the "de facto" ways of working to maintain continuity throughout daily operations (Strand, 2024).The knowledge that is converted to familiarity is considered relational and collective because it stems from routines, shared norms,

and coordination which makes it hard to document and transfer back to the organisation (Collins, Tacit and Explicit Knowledge, 2010; Farnese, Barbieri, Chirumbolo, & Patriotta, 2019). (Argote & Miron-Skeptor, 2011) and (Gerard & Shaker, 2002) argues when client teams reduce their involvement during these transitions, organizational forgetting occurs and as a result the absorptive capacity and workarounds tends to decline.

3. Governance & Dependency Layer

(Grant, 1996) argues that a KBV is a strategic and difficult-to-imitate resource because it is the primary driver of performance and innovation. It accumulates asymmetrically from the provider's side due to the continuous embedded operations, which creates this knowledge asymmetry and increases the service cost, resulting in (possibly) vendor lock-in conditions (Smuts, Kotzé , van der Merwe, & Loock, 2015; Shawosh & Berente, 2019). Additionally, SLAs alone are not enough to control such tacit asymmetries. The effectiveness is a combination of contractual and relational mechanisms that retains the capability over time from the vendor's side (Lin & Vaia, 2015; Kim, Lee, Koo, & Nam, 2013). If there is no balance, clients are risking the productivity paradox of outsourcing as it weakens the internal capability and innovation because the most important knowledge resides within the MSP (Windrum, Reinstaller, & Bull, 2009; Chang & Gurbaxani, 2012)

2.5 The Tacit Knowledge Inventory for Managers (TKIM)

One of the practitioner's focused approaches is the Tacit Knowledge Inventory for Managers (TKIM) which attempts to structure tacit knowledge towards a usable format (Wagner & Sternberg, 1985; Wagner & Sternberg, 1987). Originally, the TKIM was developed to help managers to identify tacit, experienced-based knowledge that are embedded in teams, specifically in environments where judgement, routines, and situational expertise play an important role (Wagner & Sternberg, 1985). Mapping the knowledge dependencies that are not documented but was critical for operational continuity was its main purpose. The TKIM offers a semi-structured way for revealing tacit knowledge before it poses danger and vulnerable, which aligns with prior work on knowledge risk (Durst, Hinteregger, & Zieba, 2019) and the focus on mapping knowledge expertise (Dalkir, 2013). Essentially, it motivates to reflects on four core questions which are 1) who holds critical expertise, 2) where undocumented knowledge resides in processes or routines, 3) which task depend heavily on judgement or contextual insights, and 4) how easily this can be transferred or replaced. Empirical studies show that tacit knowledge loss frequently hovers around role-specific routines, workarounds,

troubleshooting heuristics, and cross-team coordination norms, especially when it comes down to IT transitions (Ao, Gelman, & Hukins, 2016; Krancher O. , 2020).

TKIM is structured around literature relatable concepts such as expert dependencies (Scott B & Jenny M, 2003), local routines that are embedded in daily tasks (Goyette, Cassivi, Courchesne, & Elia, 2014) and the difficulties of transferring tacit knowledge routines without co-presence nor guidance (Krancher & Dibbern, 2020). These concepts are closely related to tacit knowledge loss observed from IT Outsourcing and MSP environments because knowledge usually tends to stay at the vendor (Oshri, 2022). Although these all seem useful, limitations such as quantification of tacit knowledge loss or its risk (Nissen, 2006), multiple stakeholder transitions (Smuts, Kotzé , van der Merwe, & Loock, 2015), and lack of integration with governance controls from outsourcer (Lin & Vaia, 2015). Note that TKIM doesn't account for the distinction of pre-transition, during and post-transition phases, but the loss of tacit knowledge occurs throughout all the stages (Krancher O. , 2020). Furthermore, TKIM is not designed to account for auditability nor documentation within the Dutch Environment (AFM, 2024; DNB, 2023). The conceptual framework clarifies what type of tacit knowledge needs to be considered and highlights the need for mapping knowledge across stakeholders with its proprietary task(s) that will support tacit signals into indicators.

2.6 Knowledge Management Artifacts and Design Science Foundation.

The key to a Design Science Research (DSR) lies in the creation of artifacts, which are models, frameworks, dashboards, or methods addressing real-world organizational problems (Hevner A. , March, Park, & Ram, 2004). In the knowledge management realm, artifacts are usually developed to aid capturing knowledge, codifications, retention or retrieval. However, shortage of artifacts regarding the design of quantifying tacit knowledge, especially in dynamic environments in IT outsourcing becomes prominent. Most of the knowledge management systems focuses on the storage of explicit knowledge, but tacit knowledge remains overlooked due to the intangible information (Holsapple & Joshi, 2002). These challenges are highly sensitive in IT outsourcing projects where vendors and clients operate across the globe and having cultural differences makes collecting and transferring tacit knowledge even more difficult.

2.7 AI usage for capturing tacit knowledge and enabling organizational innovation

Last year (Al-Alawi & Ahmed, 2025) provided a comprehensive literature review on how AI can support, enhance and complement tacit knowledge sharing within an organization, while emphasizing that human remain irreplaceable when capturing experiential knowledge. The researcher also

highlights the intuiting, professional judgement and experiential understanding cannot be fully documented through automation, but AI will significantly enhance the organizational learning and knowledge-sharing process. In lieu, AI will increase the human capabilities such as information structure, searchability and supporting decision-making (Al-Alawi & Ahmed, 2025). AI should be used as a supportive tool to capture tacit knowledge insights, resulting in better retained, shared knowledge management. Adding to this paper, (Seghroucheni, Lazaar, & Achhab, 2025) argues that AI and NLP technologies can support tacit-to-explicit knowledge conversion within the knowledge management system by using an analytical framework. It proposes a NLP pipeline that extracts tacit knowledge signals using the general-purpose text corpora techniques such an entity recognition (NER), sentiment analysis, and topic modelling to validate the ability to extract key phrases and analyse syntactic relationships (Seghroucheni, Lazaar, & Achhab, 2025). Identifying patterns and recurring topics becomes a reflection of insights in tacit knowledge, thus making it accessible for decision-making and organization learning.

Overall, both findings emphasise that tacit knowledge conversion won't be fully automated due to human factors, but having AI will provide structure, sentiment analysis, and pattern recognition. It results in revealing an important knowledge gap. While both studies demonstrate that AI an NLP can support retaining tacit knowledge, neither provides either quantitative or qualitative methods for assessing what kind of tacit knowledge levels currently are and what the knowledge loss will be over time. This gap will be addressed in this thesis by developing an artifact that is quantifiable, supporting knowledge continuity and informed transition governance.

2.8 Key Takeaways

To summarize, literature review shows multiple foundational insights to outline the understanding of tacit knowledge and its vulnerability within IT outsourcing and MSP environment from consultancy within a Big Four's perspective and are as follows:

- **Tacit knowledge is deeply experiential, context dependent, and difficult to articulate.**
    - Essentially, tacit knowledge is more fragile during transitions in IT outsourcing or MSP compared to explicit knowledge. The relational and collective forms of knowledge depends on interpersonal interactions, shared routines, "experience" and workarounds which can be impacted when personnel or responsibilities are shifting which would be categorized as High-Risk (Polanyi, 2001; Collins, Tacit and Explicit Knowledge, 2010).

- **Direct measurement of tacit knowledge is not possible/feasible**
    - Expertise mapping, knowledge-risk assessment, SNA, and behavioural proxies provide limited knowledge on how tacit knowledge flows and vulnerabilities during transitions. It highlights that tacit knowledge is essentially an operational practice which includes troubleshooting heuristics, undocumented workarounds, coordination norm, and professional judgement, which all these are key the continuity of IT operations.
- **Tacit knowledge is embedded in critical IT operational practices**
    - The KBV emphasizes that losing it will impact the internal capability and absorptive capacity while increasing its dependency on external vendors. This effect increases when MSP are being arranged, where the accumulated knowledge of vendors is increasing, resulting in an increased risk of vendor lock-in and thus decreasing the client's autonomy.
- **Tacit knowledge is a strategic organizational resource**
    - Governance mechanisms must address both explicit and tacit knowledge, because the contractual mechanism such as an SLA cannot prevent knowledge erosion. Additionally, relational mechanisms such as trust, collaboration, shadowing, and walkthroughs are effective for knowledge transfer. Existing knowledge management system focusses on explicit knowledge, whereas tacit knowledge is neglected.
- **AI can support, but not replace tacit knowledge**
    - While AI can support structuring and identifying patterns in shared tacit knowledge, AI cannot replace human intuition nor professional judgement. Current AI approaches capture knowledge are improved, but quantifying tacit knowledge levels, remains unexplored, revealing a methodological gap. It raises demand for a structured artifact to quantify this loss during outsourcing and MSP transition from an auditor's perspective.

3 Research Methodology

3.1 Research Design overview and rationale

This research adopts a design science research methodology (DSRM) (Hevner A. , March, Park, & Ram, 2004), because the aim is to develop and evaluate an artifact that addresses a concrete organizational problem: tacit knowledge loss during IT outsourcing and managed service transitions (Hevner A. , March, Park, & Ram, 2004). Within IS literature and the discipline, DSRM is recognized as one of the two foundational paradigms alongside behavioural science, which offers explicit guidelines for problem relevance, design as an artefact, rigorous evaluation and research contribution (Hevner & Gregor, Positioning and Presenting Design Science Research for Maximum Impact, 2013).

Building on this foundation, DSRM shows how to position the levels of abstraction, problem/solution maturity and how to communicate artifact knowledge for maximum impact while ensuring that the TKLQM is useful and citable (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). DSRM is a step-by-step process which starts with problem identification, design, demonstration, evaluation with iteration across all steps as the artifacts improves and matures. The sociotechnical nature of tacit knowledge in the context of outsourcing or MS projects aligns well with a DSR approach.

The methodology follows the Hevner three-cycle view which consist of relevance, rigor, and design and is represented by the DSRM steps (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007) within the three-cycle view as depicted in figure 4[1]. The relevance cycle begins with the organisational context of tacit knowledge loss in IT outsourcing and MS projects. The goal in this phase is to understand the problem, gather stakeholder information and identify evaluation scenarios for the final artifact. The rigor cycle uses the existing knowledge base such as tacit knowledge theory, governance, transition phase in outsourcing or MS and evaluation methods to ensure that the TKLQM is validated. This consist of both the structural as well as the operational indicators of the dashboard. After completing these two cycles, the design cycle iterates through all DSRM steps to build, test and refine the artifact. Integration semi-structured interviews, having a focus group and using the Delphi method will help in creating an artifact for demonstration and evaluation against the predefined criteria from the interviews. Validating the requirement, refining components/indicators/metrics and

[1] The combination of Hevner's three-cycle view and Peffers DSRM steps will help in aiding this research with rigor process of capturing tacit knowledge

ensuring the final version is suitable for demonstration, the predefined requirements need to be evaluated.

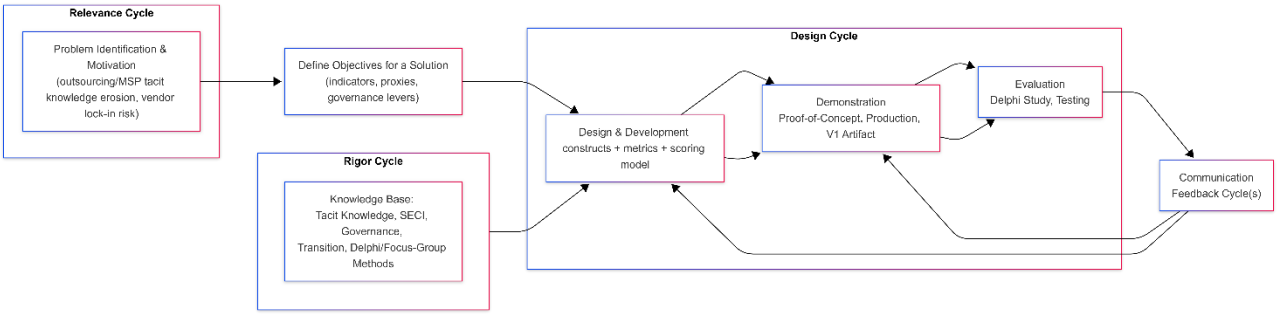

Figure 4: Three-cycle diagram with the DSRM steps.

(Source: Adopted from (Hevner A. , March, Park, & Ram, 2004; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007)

As mentioned in literature, tacit knowledge is impossible to capture or measure directly through traditional documentation or quantitative instruments. Through this research, capturing tacit knowledge was done indirectly by observable manifestations in practice, such as undocumented routines, expert dependency, clarification cycles, and operational disruptions during IT outsourcing and/or MSP transitions. These will function as proxies that indicate the current risks and erosion of tacit knowledge rather that knowledge itself. Adopting a dashboard-oriented artifact will be its design result, as these proxies are usable and auditable. The artifact is intentionally designed as a decision-supported dashboard that aggregates indicators into a structured overview of tacit knowledge exposure, transfer quality, and dependency risk. The dashboard bridges the gap between the intangible nature of tacit knowledge and governance practice by translating these into interpretable indicators, normalized scores, and visual risk representations. It enables practitioners to reason about tacit knowledge loss through a systematic and comparable way, while explicitly acknowledging the limitations of direct measurements.

3.2 Data Collection[2]

3.2.1 Three-cycle combined with the DSRM steps

Figure 5 depicts a strategy of collecting data that should be done using Hevner's three cycle view (Hevner A. , March, Park, & Ram, 2004), which ensures that developing the artifact is grounded in the context of problem, the existing knowledge base and iterative evaluation cycles.

[2] All empirical inputs are anonymized and managed according to the Data Management Plan (Appendix 1)

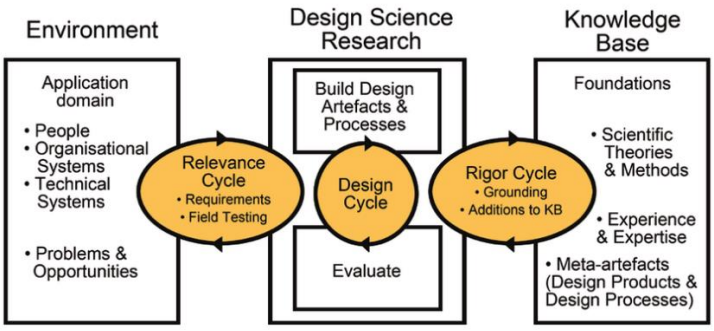

Figure 5: Hevner's three cycle for DSR

(Source: (Hevner A. , March, Park, & Ram, 2004))

These cycles are being operationalized through the DSRM steps of Peffer, which will help guide the current tacit knowledge loss problem to be identified, gathering the requirements, designing the artifact, demonstrating and evaluating, which are as follows:

Relevance Cycle – Understanding the problem

The relevance cycle focusses on understanding the problem by collecting empirical insights from employees within a consultancy firm who are actively engaged in IT outsourcing and managed service transitions. The purpose is to gather information and to characterise how tacit knowledge loss manifest in real-world settings by identifying user requirements and defining evaluation scenarios for TKLQM. To do this, the three activities below show the structure of this first cycle out of the three, 1) exploratory survey, 2) semi-structure interview, and 3) secondary data analysis.

This study applies a purposive expert sampling strategy where participants are selected based on their direct involvement in IT outsourcing/ MSP, Audits, and transition governance. The objective of the sampling is not for statistical generalization, but to acquire relevant and knowledgeable perspectives that is required to identify the problem, requirements, and artifact design and evaluation. To support this purposive approach, an exploratory survey is first used to screen stakeholder groups experiencing the various levels of tacit knowledge loss during these transition periods.

The data collection process starts with an exploratory survey (n=80) in which this is served as an initial scope (screening) to identify which stakeholder groups experience the most difficulty with tacit knowledge loss during outsourcing and MS project transitions. The exploratory survey (Appendix 4) targets employees across stakeholder groups within the consultancy setting (internally and externally). The internal sample size should be between 15-20 participants and externally should be approximately the same. This gives preliminary insights about the experience from people working in the fields of IT Audit/ Assurance, Technology Risk or Consultancy with client(s) transitions,

technology projects, knowledge transfer, or outsourcing governance. Internally, an email through a Partner role is sent out (Appendix 2) across the department of Technology Risk to gather information and externally, a LinkedIn post is posted (Appendix 3). Because the survey is aimed for an exploratory purpose, a response count of approximately 10-20 participants with a minimum of 2-3 per role is sufficient for the scope. The topic fits across multiple roles[3] within the organisation. The result from the survey is used to get broad, quantitative insights into where tacit knowledge challenges are the highest and which group should be prioritized for deeper qualitative inquiry. The purpose is to ground this research into the problem context which should be well-defined before continuing with the DSR process. The preliminary segmentation of the various stakeholders highlights the reoccurring issues such as undocumented routines, inconsistent handover practices, and dependency on key individuals from client-vendor.

Based on the survey insights, approximately 1 – 4 participants from different roles in the firm are selected purposively to maximize role diversity and relevance based on the survey to conduct a semi-structured interview between 45-60 min. These interviews allow for further exploration on the topic within the identified group(s) that experience experiential knowledge, transition pain points and tacit routines that are unable to be captured solely on surveys. The interviews are conducted based on generic interview questions with added personalized questions based on the answers from the preliminary surveys. A consent form is asked to be filled prior to the interview. The interview starts with broad introductory information and continues to deepen the conversation of knowledge loss. Interviews (n=13) are recorded and transcribed for analysis such as codifying similar themes to capture the most common issues and challenges across multiple layers of roles. A combination of surveys and interviews helps to ensure the requirements is created as a baseline of the artifact is both representative (survey answers) and rich (interview answers). A summary of the interviewers is represented in table 4.

The interviewees, categorized as IT Auditors have chosen for this research stems from the preliminary survey where the content of the given open questions is interesting and closely aligned with what the researcher pursued to dive deeper into and thus were purposively sampled. While IT Auditors assess how compliant an outsourced process within an organization is such as the service desk or finance department, it does not reach how the internal organization struggle when the outsourcer or MSPs staff rotates or leaves. This gap, in which the IT audit does not really experience

[3] The roles within a firm are limited in this research to a Jr. Consultant, Consultant, Sr. Consultant, Manager, Senior manager, Director/ Principle and a Partner/ Executive

limits the perspective on how this research direction needs to go. Due to this limitation, other categories were found from the researcher's own network on the other two perspectives, in which are clients and IT outsourcers/MSPs, resulting in an interconnected perspective that highlights the concurrent issues.

Table 4: List of interviewers

Person	Position/ Role	Experience in years	Department	Category	Date of Meeting	Duration (HH:MM:SS)
1.	Staff - Working Student	1	Technology Risk	IT Audit	23-02-2026	43:40
2.	Staff – IT Auditor	3	Technology Risk	IT Audit	03-03-2026	58:43
3.	Senior Staff – IT Auditor	4	Technology Risk	IT Audit	04-03-2026	52:18
4.	Staff – IT Auditor	2	Technology Risk	IT Audit	09-03-2026	59:50
5.	Staff – IT Auditor	4	Technology Risk	IT Audit	10-03-2026	01:02:15
6.	IT Risk Consultant / Security Specialist	3	Advisory	IT Audit	11-03-2026	01:10:12
7.	Senior Staff – IT Auditor & AI project team member	6	Technology Risk	IT Audit	11-03-2026	41:57
8.	Partner	12	Technology Risk	IT Audit	12-03-2026	25:09
9.	Financial Administrator – Outsourced/MSP	1.5	Finance	Outsourcing	16-03-2026	25:43
10.	Technical Support – Outsourced/MSP	1.5	ServiceDesk	IT Outsourcing/ MSP	17-03-2026	59:50
11.	Senior Staff – IT Auditor	5	Technology Risk	IT Audit	17-03-2026	33:43
12.	Project Manager Cloud Solutions – Outsourcer/MSP	0.5	Broadband Solutions (BBS)	IT Outsourcing/ MSP	20-03-2026	45:29
13.	IT Manager – Client Side	1	IT Department	Client	26-03-2026	49:52

(Source: Created by this thesis)

The interview data as seen in appendix 8 were reconciled through a process of thematic fusion and triangulation. Interview recordings were transcribed, summarized and reviewed to identify recurring themes related to tacit knowledge loss, knowledge transfer practices, and dependency risks

across roles. Insights were compared across participants to identify the various patterns and indicators. These themes were then triangulated with the findings from the exploratory survey and literature review, ensuring that only cross-validated and relevant observations are taken into account.

Additionally, secondary data analysis was conducted to cover the context of knowledge loss/retention and transfer, which considers transition documentation, process descriptions, incident histories, documentations, and internal knowledge materials. Also aligning all the answers from the interviews towards the literature is going to confirm what challenges are still there prevalent. These are examined to identify where explicit documentation is missing, where tacit knowledge overpowers the operational work and how these professional judgements dependencies are influenced in the service delivery. It provides concrete examples of tacit knowledge risks that occurs in practice combined with surveys and the interviews. Together, these three activities fulfil the required knowledge for the relevance cycle by understanding how this problem fits into the artifact.

Rigor Cycle – Structuring the knowledge base

The next step[4] is to integrate theory and prior findings towards the artifact which is to ensure that the dashboard reflects the validated knowledge on tacit knowledge, knowledge transfer, IT governance, metrics, and evaluation techniques. According to Hevner et al. (2004) the rigor cycle introduces the theoretical foundations, empirical evidence, and methodological principles tailored towards the knowledge base rather than intuition. The Delphi study is employed across 6-8 experts for 2 rounds to validate the definitions of indicators, importance, weights, and threshold interpretation. This is to get a basic understanding of the metrics and weighting vector. Secondary data analysis is used to map out theoretical constructs such as relational tacit knowledge, absorption capacity/rate, knowledge-risk categories and governance mechanisms from real organisational structures and practices to observe these into the consultancy context. The usage of the secondary data in both the relevance cycle as well as the rigor cycle helps align DSR principles whereby artifacts such as documents or behaviour to be integrated into both practitioner relevance and theoretical grounding (Krancher O. , 2020).

Hevner's guidelines highlights that design choices should be traceable to the knowledge base which emphasizes the explicit positioning of the artifact's contribution and Peffers et al. (2007)

[4] The Rigor Cycle does not occur before the Design cycle but operates in parallel to ensure each iteration in the design cycle is validated with knowledge and proof.

mentions to link the solution objectives to validated theory and principles to ensure that the artifact is conceptually correct.

Design Cycle – Iterate and evaluate the artifact

Finally, the design cycle is executed through an iterative cycle that consists of building and evaluating to shape the TKLQM into a robust, and usable artifact. Although it seems that the design cycle is the last out of the three cycles, it is not. The design cycle is central, with continual interactions with both the relevance and rigor cycles (Hevner A. , March, Park, & Ram, 2004). Three evaluation activities are implemented such as a Delphi study which is the study to use a structured method for gathering, analysing and achieving consensus on expert opinions through multiple rounds of questionnaires (Linstone, , & Turoff, 1979).

Initially, a focus group was considered as a potential formative evaluation method. However, given the artifact which is a conceptual dashboard representing an assessment and How dashboard, having expert evaluations methods was the better choice. A Delphi study offers a more rigorous and repeatable approach for achieving structure. The Delphi study will consist for 2 rounds where the interviewees get a chance to establish consensus on the importance of certain indicators, category weights, and threshold values for e.g. traffic lights. The reliability of controlled feedback from experts and predefined criteria's helps with finetuning a state-of-the-art artifact consensus regarding indicators and weight schemes (Okoli & Pawlowski, 2004).

Additionally, a scenario-based demonstration is held to adjust the artifact in a real-world setting and is evaluated by 4-6 interviewee's identify usability issues and assess the design of the artifact. By applying this TKLQM dashboard, the tacit knowledge loss index can be calculated and documented to govern the actions of scores.

Figure 6 depicts how the DSR methodology is operationalized during this research. Each phase of the DSR cycle is explicitly linked to empirical methods and design activities that are being done by the researcher. This informed figure showcases how each of the individual activity led to the development evaluation of the TKLQM.

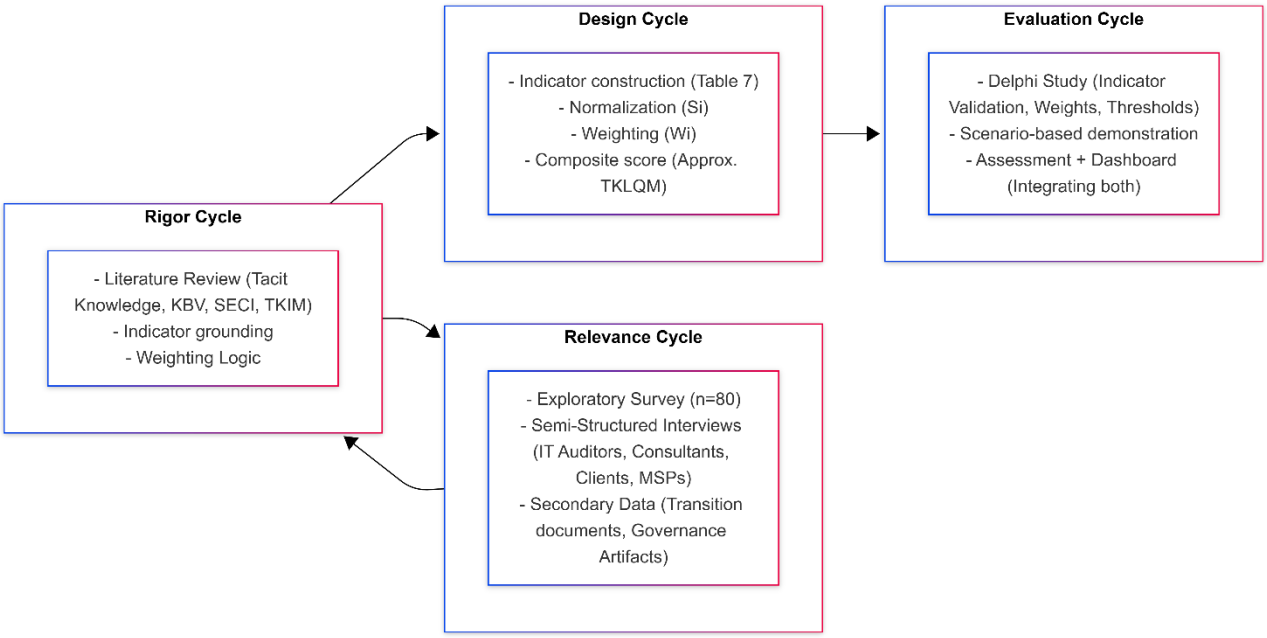

Figure 6: Activity phasing

(Source: Adopted from (Hevner A. , March, Park, & Ram, 2004; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007))

3.2.2 Perspective of the Auditor and Consultant

From the perspective of an auditor, specifically in IT Audit, Technology Risk, and Assurance the representation of tacit knowledge poses challenges because it is fundamentally undocumented, person-dependent, and non-standard. It relies on traceability and repeatability per assessment per evidence, but these "tacit" routines and professional judgements are often shared among others through informal communication, social ties, or team-specific practices rather than documenting it (Collins, Tacit and Explicit Knowledge, 2010; Cross, Borgatti, & Parker, 2002). This makes it difficult to verify or test, which is a risk in knowledge-transfer research (van Waveren, Oerlemans, & Pretorius, 2025). In Dutch outsourcing and MSP environments, auditors frequently encounter knowledge asymmetry and inadequate documentation, especially when it comes to transitions with employees having critical operational knowledge. The Dutch Central Bank (DNB) and the Authority for Financial Markets (AFM) require auditors in the Dutch sector to have auditable insights into any outsourced and/or MSP-delivered activities (AFM, 2024; DNB, 2023). Additionally, financial institutions may outsource its processes, but full responsibility for risk management must remain at the organization as it ensures outsourcing does not prevent supervision. These expectations make it even more interesting from an auditor's perspective to evaluate the current tacit knowledge risk in organizations where environments are being outsourced or having an MSP in place.

Auditors are directly involved in documentation gaps, vendor dependencies, lack of knowledge transfer, and weakness in governance. Therefore, auditors make the perfect candidate because they are in direct involvement in which they can also validate the TKLQM artifact. Having these experts evaluate and give feedback on the artifact will give insights into the effectiveness of tacit knowledge exposure affecting operational resilience and risk.

While auditors are mainly focused on assurance, evidence and regulatory compliance, consultants experience tacit knowledge loss through a different lens that are focused on execution, organizational change, operational governance, and client-vendor alignment. Consultants frequently act as the intermediaries (middleman) between business stakeholders, technical teams, and external vendors. This makes consultants position themself uniquely as they observe the risk of tacit knowledge loss during implementations. At the same time, auditors only see evidence/compliance but not always the operational root cause, which means that biases towards regulated context and auditability is prominent and may not represent deep tacit routines.

From a consultant perspective, the concern of practical delivery risk affecting project timelines, service stability, vendor dependency, and an organization's autonomy is part of the tacit knowledge erosion (Oshri, 2022; Lin & Vaia, 2015). But consultants frequently participate in knowledge-transfer workshops, shadowing sessions, transitions planning, process redesign, and stakeholder coordination in which it enables consultants to observe the tacit knowledge loss in real time. The insights complement auditor's perspective by providing practical, experiential data about how to flows or fails throughout the organization during the outsourcing and/or MSP lifecycle (Oshri, 2022; Krancher & Dibbern, 2020). Directly witnessing undocumented routines and workarounds, experiencing relational and collective tacit knowledge gaps during transitions, assessing readiness and knowledge transfer completeness, and witnessing vendor-client knowledge asymmetry are all linked to a day-to-day work of a consultant. By including consultants into the data collection will provide a broader view of tacit knowledge loss as the contribution to support identification of indicators helps in building the requirements for the artifact.

3.3 Artifact Development Method

The development of the artifact to quantify and approximate tacit knowledge follows an interactive conceptual strategy within the Design cycle of the DSR. Instead of building the finalized version at once, its better do to in step-by-step to progress slowly and get some quick wins to see the value of the artifact. After each iteration, the artifact gets better because of validated feedback during the Delphi study from stakeholders and the requirements from the interviews and surveys. It allows

the artifact and the researcher to learn from small mistakes, misinterpretations or problems that occur. This method keeps all stakeholders in check, and it gives them a sense of responsibility for the final product. The combination of DSR, which is to learn through building and Agile, which is the iteration cycle focused on user-centric speed, is the hybrid method that enables tackling complex, real-world problems by building functional artifacts (Kayanda, Busagala, Oyelere, & Tedre, 2022).

3.3.1 Early findings

To get a general understanding of how the organization experiences tacit knowledge loss during IT outsourcing and/or MS projects transitions, a preliminary survey was conducted internally and externally. The purpose of this preliminary survey was to identify which stakeholder groups encounters the most challenges related to undocumented knowledge, handover gaps and dependencies across teams. It also identifies which level of role does knowledge loss tends to start, which should be most important to address first. After reviewing the survey results, a set of semi-structured interviews was conducted with the respondents from the most affected groups of stakeholders where deeper questions can be asked to explore these issues further. The findings below summarise the survey insights and interview themes, which contributes to the root cause of why tacit knowledge is kept at bay.

- **Preliminary Survey (internal/External)**

In Appendix 4 the preliminary survey was distributed across different stakeholder roles in consultancy firms such as Technology Risk, IT Audit, IT Assurance, and client transition projects from the Netherlands (n = 80). The preliminary survey was used as a screening instrument to gather initial insights where tacit knowledge challenges occur most frequently across various roles, and which forms of undocumented or experiential knowledge tend to be at risk across the project. The roles include Staff, Senior Staff, Manager, and Senior Manager with most participants having between 3-5 years of experience. The findings across respondents shows key patterns and themes of knowledge loss.

1. **Tacit Knowledge Dependency & Operational Impact**

   64/80 respondents indicated that teams “Often/Always” depend on undocumented or experiential knowledge (80%) with 16 reported “Rarely” (20%). Teams frequently rely on knowledge stored in individuals, with a result in not documenting the processes, especially under time pressure. Tacit Knowledge is becoming a bottleneck due to rotation or leave

of employees. Therefore, the high dependency highlights the strategic vulnerability when organizations shift its internal resources.

Multiple forms of undocumented knowledge have been identified where routine is required to perform certain tasks. The types that most mentioned were business process details (62), role-specific knowledge (55), System workarounds (42) troubleshooting heuristics (40), routines/coordination methods (25), and legacy code insights (10). Tacit knowledge in a business process reflects team-dependent norms. A respondent mentioned that the unwritten rule is that "this is how things are done", which is rarely documented. The knowledge per role accumulates over time and with experience which is not transferred effectively during employee changes. Workarounds for problem-solving are often not documented due operational constraints and specific acquired evidence. These categories represent what kind of knowledge is most vulnerable during transitions.

The most critical operational issue lies in errors, delays, and inconsistency of tacit knowledge. One respondent mentioned that "people work based on previous year or examples" which is a copy-paste method but doesn't understand what they are doing. Another respondent mentions that while a new team member can follow the written steps, informal workarounds are still missing when experienced team members automatically apply this to their work. Depending on a single expert rated a 2.75/5 suggest vulnerability hotspots where knowledge is not distributed evenly.

2. **Knowledge Transfer Governance is structural weak.**

Responsibility assignment is a structural weakness ass 45% of the respondents selected "Neutral", and an equal spread of responses for "Not Clear" and 'Somewhat Not Clear" regarding to ambiguity and/or inconsistency. Most employees don't define a formal RACI for knowledge transfer. Respondents also recall that transition activities often start before scoping the project is complete, which leads to reactive knowledge transfer instead. It increases the likelihood of tacit knowledge loss across all phases of a project.

Across knowledge transfer methods, a lack of unified approaches is prominent in teams. Employees often write their own "newly gained" knowledge in personal folders (60), have personal step-by-step handovers (58), various workshops (40), shadowing sessions (28), pair troubleshooting (20) and recorded demonstration (15). Although recorded demonstration is often outdated. While written documentation is common, but not a "best

practice" for tacit knowledge transfer. Shadowing and pair troubleshooting (happens mostly between Staff-Managers), results in effective tacit knowledge transfer.

During the survey, "How often do you observe incomplete knowledge transfer", 8/10 respondents selected "Often" which reflects missing context, unclear handover boundaries, dependency on individuals, and not enough time for knowledge transfer due to the workload on 3-4 projects per employee[5]. The majority experience incomplete knowledge transfer, which validated the need for a proactive measurement dashboard such as the TKLQM.

3. Vendor Dependency & Lock-In Risk

Across the survey, all respondent perceived that incomplete knowledge loss increases the dependency on vendors, but the levels vary. If there are past examples of filled in documentation (Kanhai, 2024), and this vendor requires a yearly report, then the knowledge is almost kept the same. This perceived dependency correlates with vendor lock-in conditions such as legacy system complexity (48), loss of client-side technical knowledge (45), exclusive operational knowledge on the vendor side (40), missing documentation (25), and limited internal capability (22). The combination of these causes risks where tacit knowledge is not retained, resulting in switching to vendors to be costly and autonomy of the client decreases.

4. Requirements + Adoption Constraints → Knowledge Transfer Measurement Tool

In the survey a question about "Which measurements would be most valuable for such a tool?" was asked across employees at the Big four and Consultancy firms. As a result, from most to least employees want a rating of undocumented knowledge (65), vendor dependency score (52), transition readiness score (48), and post-transition stability indicator (35) with interest in an expert dependency map (20) for specific context. Features such as tracking the knowledge transfer progress (60), gap heatmaps (40), vendor-client alignment indicators (28) and suggested mitigation actions (25) are nice to haves to make knowledge transfer more easily manageable.

[5] The number of projects differs per role within an organization. E.g. staff usually has 2 projects and does most of the documentation, whereas Managers have 3-4 projects for checking on the documentation and signing it for clearance.

As the Big Four and Consultancy firms are heading towards AI Adoptions across service-lines, all these measurements and features do their fair share of concerns such as data accuracy, data availability, AI Concerns and its dashboards' complexity, Therefore, the TKLQM needs to be lightweight on the data side, while being explainable.

To summarize the points above, these themes suggest that tacit knowledge loss is a structural weakness and risk by governance ambiguity and operational "tacit" errors, delays, and inconsistencies during transitions.

3.3.2 Problem identification

Based on the evidence collected in the relevance cycle such as preliminary survey (n=80), initial interview(s), and secondary documents. These participants are working in roles involving assurance, technology-intensive, and client transition projects. The results of these findings reveal multiple recurring patterns that validate the significance of tacit-knowledge challenge.

1. **Role specific experiential knowledge**

Multiple respondents indicated that undocumented knowledge, role-specific insights is the most frequent and this critically relied on during transitions of projects. Examples of this includes system workarounds, decision heuristics, and task-specific judgement that are not documented or implemented in procedures.

2. **Undocumented Business-Process Details and routines**

The gap in capturing everyday operational routines, business-process details, and coordination practices is a problem where all this collective tacit knowledge is mainly embedded in team workflows, informal norms, and shared practices, but are not documented. Also, depending on the projects, the teams that you are working for at e.g. project A might be different from project B etc. in this case, it means that the routines are solely based on how higher-up roles have their routines set up.

3. **Troubleshooting and problem-solving heuristics**

"Used in practice, but not documented", this the response of one respondent which emphasized that this plays a critical role in project execution. Its quick and easy to just ask a question whenever you don't know what to do, but ultimately its wasted time if it has been documented. This experiential knowledge is developed over time as more employees gains

more experience, at the same time because its experiential knowledge, it is increasingly difficult to articulate explicitly.

After all, these findings demonstrates that tacit knowledge during any transitions are deeply embedded per person through experience, informal routines, and professional judgement which are captured rarely in documentation. The surveys also reveal that tacit knowledge tends to be vulnerable across all stages, but definitive differences are as follows:

- Before a transition/ new project

Respondents mention poor preparation and lack of knowledge-scoping are key indicators, which consist of the highest uncertainty and remains hidden until the project is already ongoing. Issues occur later because of poor preparation, especially when early review or scoping is absent.

- During transitions

Tacit knowledge loss tends to be at its peak during transitions of projects. 84% of the respondents selected "Often" or "Always" when asked about dependency on undocumented knowledge and 67% of the participants selected "Often" for incomplete knowledge transfer during observation of tasks within projects. Serious issues, such as delays, errors, reliance on singular experts scored on average 4.5/5 across all participants. On the other hand, a 1.5/5 has been scored on vendor misunderstanding of client systems[6].

- After the project – post transition phase

Knowledge erosion continues after the completion of a project, particularly when reviews or reflections such as Agile's final retrospective, it seems to be absent as there is little to no time to cover this part. Therefore, knowledge often dissipates as individuals rotates across teams and projects, resulting in gradual loss of specific tacit knowledge. Additionally, IT auditors are planned accordingly to the availability per week/month/project. So, there is no "resting" or "knowledge sharing" period calculated. That means that whenever a project is finished, another one starts right away. Although Big four companies implemented LEAD feedback, which usually are done three times a year which is mandatory where you can also share specific knowledge that one has gained throughout the project.

[6] Client systems refers to the systems that IT Audit/ Assurance uses daily.

To summarize, tacit knowledge loss occurs the most during the transitions of a project influenced by prior insufficient preparation and limited retention sessions afterwards. Therefore, identifying tacit knowledge is hard and often forgotten after project activities. Table 5 shows in detail the specific recurring pain points/themes and linkage towards the TKLQM. These observed patterns validate the need for a structured artifact that can identify tacit-knowledge levels, quantifying the risk levels, and support more reliable knowledge transfer processes across project by using AI.

An overview of the categories from the interviews, including the key pain points and traceability is provided in Appendix 8. This overview will strengthen the transparency of the qualitative analysis by ensuring all the themes that occurs during the interview and tacit-knowledge drivers are consistent.

Table 5: Tacit Knowledge Challenges

Type(s) of Tacit Knowledge[7]	Problem	Description	Traceability – Survey + Interview XX
Relational 1	Unclear knowledge-transfer responsibilities	Transition roles and responsibilities are often ambiguous which causes to rely on interpersonal judgement rather than predefined procedures.	Q13, A, B, C, D, H, I
Relational 2	Single-expert dependency	Teams depend majority of the time on individuals who hold undocumented heuristics, escalation knowledge and professional judgement. On average, more than 19 questions from staff to managers are being asked.	Q14, A, D, G, H, I
Relational 3	Vendor-Client knowledge asymmetry	Vendors accumulate operational insights, while clients lose opportunities for (de)escalation and problem-solving.	Q14, Q20, Q28, C, F, G, H, I
Relational 4	Ineffective interpersonal communication during knowledge transfer	Any knowledge transfer method relies on non-formal methods such as verbal explanation, ad-hoc walkthroughs and learn by example(s), which is limited to surface level knowledge transfer.	Q14, A, C, E, H, I
Collective 1	Undocumented business-process routines	Daily operational routines, process nuances, and informal practices that are not documented but needed for continuity.	Q12, A, C, E, H,I
Collective 2	Inconsistent knowledge transfer practices across teams	Knowledge Transfer methods differ per team such as workshops, handovers, recorded demos, shared digital space, walkthroughs and shadowing sessions which all lead to inconsistent processes.	Q14, Q15, A, B, C, D H, I

[7] *Relational Tacit Knowledge* refers to the knowledge of relationships, communication patterns, trust and collaboration between people. *Collective Tacit knowledge* refers to group routines, shared norms, team workflows, and organizational culture.

Collective 3	Incomplete Knowledge Transfer during transitions	8/10 respondents reported that incomplete knowledge transfer **often** reflects weakness. Reviewing engagements after projects is not standard nor mandatory (Kanhai, 2024).	Q18, A, D, E, H, I
Collective 4	Knowledge fragmentation due to poor ownership	Half of the respondents rated ownership tracking poorly (4), and staff leaving early (3). The collection of knowledge evaporates across transitions	Q21, Q23, A, C, D, H, I
Collective 5	Legacy system knowledge is known within a few individuals at the organization	Knowledge about legacy environments such as COBOL and old ERP landscape are not broadly shared, which increased the risk of transition and operational brittleness.	Survey Open Questions, C, F, G
Collective 6	Operational disruption caused by tacit gaps.	The frequency of errors, delays, and clarification disruption during transitions functions as warning for fundamental issues.	Q14, A, B, E, H, I

(Source: Created by this thesis, Surveys Content – Appendix 4, and Interview Summaries – Appendix 8)

3.3.3 Requirements

The requirements below are only from the preliminary survey (n=80), the literature review, and interviews (Appendix 7) from the practitioner's context[8]. To further continue the findings from section 3.3.1 and the underlying problem above, this section combines these two findings into requirements needed for this DSR approach. Given the goal of creating a functional prototype artifact, the requirements are formulated "SMART" (Mannion & Keepence, 1995) as shown in table 6. The requirements are split into three categories[9]; Functional Requirements (FR), Non-Functional Requirements (NFR), and Data Requirements (DR). By focusing on what is a "Must Have", the artifact can gain "quick wins" and can drive to improve it through feedback and Delphi sessions. For the full table, see Appendix 6.

Table 6: Requirement – Design Artifact: TKLQM

Category	Requirement	Reason(s)	Traceability
FR 1	The artifact must quantify exposure to undocumented business-process details, role-specific knowledge, workarounds, and troubleshooting heuristics.	Approximately 70-80% of survey respondents reported frequent reliance on undocumented knowledge or so-called professional judgement	Q2, Q10-Q15, A, B, C, D, E, H

[8] It's the context of IT Auditor/ Assurance
[9] FR – What the artifact MUST do, NFR – What the artifact MUST adhere to, DR – What minimal information is needed to operate

FR 2	The artifact must include indicators that measure whether knowledge has been full transferred before, during, and after transitions.	90% of the respondents mention incomplete knowledge transfer	Q13, Q17, Q14, Q15, A, C, D, E, H
FR 3	The artifact must measure the level of expert dependency and highlight critical person-risk	Vendors tend to rely on their own expertise, but an exit strategy is needed to reduce vendor lock-in in case.	Q14, Q23, Q24, A, D, G, H
FR 4	The artifact must compute a vendor-dependency risk score informed by the extent of undocumented knowledge and knowledge transfer gaps	Quantifying this is needed to calculate the weight/score what the risks	Q12, Q20, Q28, A, D, G, H
FR 6	The artifact must integrate key indicators into an overall readiness score to inform transition planning and risk assessment	Readiness is important to consider as this shows the organization what its vulnerability is during these transitions.	Q10-Q15, A, D, H
FR 7	The artifact must include at least one visual representation of knowledge gaps or risk levels	The request of visibility tools is needed to remove the effort of reading and just looking at what is at risk	Q29, Q31, A, B, E, F, H
FR 8	The artifact should output concise governance recommendations	Mitigation actions are requested by 30-35% of the respondents to know exactly what to do in specific situations	Q31, Q33, B, F, G
FR8-A	The artifact must support Auditors and Consultants in formulating risk-based observations, assurance implications, and advisory discussion points related to tacit knowledge loss	Mitigation actions are requested by 30-35% of the respondents to know exactly what to do in specific situations	Q31, Q33, B, F, G, Partner Demo
FR8-B	The artifact must generate client-specific governance and remediation actions addressing ownership, documentation, knowledge transfer, and vendor dependency	Mitigation actions are requested by 30-35% of the respondents to know exactly what to do in specific situations	C, F, G,I, Partner Demo
NFR 1	The artifact must operate with a limited set of inputs to reduce overstimulation of the practitioner	With too many inputs and indicators, the practitioners don’t know what to focus on anymore. It also reduces the data accuracy and availability	Q33, A, C, E, H
NFR 2	The artifact’s calculations must be transparent, with simple formulas that can be validated easily.	Indicators and metrics need to stem from reasonable formula’s that can be traced back in case it shows wrong KPI’s	Q33, B, D, H
NFR 3	The artifact must be easily understandable by	Assuming all practitioners to know everything is wrong, Therefore, making it as	Q13, Q15, A, C, E, H

	practitioners and usable in knowledge transfer sessions	simple as possible is the key to success and adoption	
DR 1	The artifact must have simple ratings like the Likert-Scale (1-5)	Like a Risk Assessment, these ratings will indicate the readiness of the tacit knowledge loss retention/transferring/loss.	Q10-Q15, All Interviews
DR 2	The artifact must have basic meta data such as project, teams, duration, outsourcing company, status	Basic meta data is standardized and easy to filter and to cover what is still left to ask. It also helps to categorize per “engagement group” or “types of reporting”. This makes it easier to find similar ratings if needed for other projects.	Q1-Q5, Q20-Q28, C, F, G
DR 3	The artifact must have an option to input Yes/No whether its present or not.	By limiting the option to only Yes/No, it can be filled in quickly without hesitation. Comments is added for additional information if needed by the practitioner	Q18, Q20, Q29, Q31, Q33, A, B, D, E, F, H

(Source: Created by this thesis, Literature review – Chapter 2, Surveys Content – Appendix 4 and Interview Summaries – Appendix 8)

To summarize the above table, these requirements are a “Must Have” to have a satisfactory artifact that is both presentable and usable across teams at Big Four, consulting firms and clients with outsourced processes.

3.4 Validity and Evaluation

The ensure that the artifact is consistent across different practitioners, context and use case scenarios, a validity and evaluation phase is conducted. Validity needs to be checked both internally and externally as depicted in figure 7.

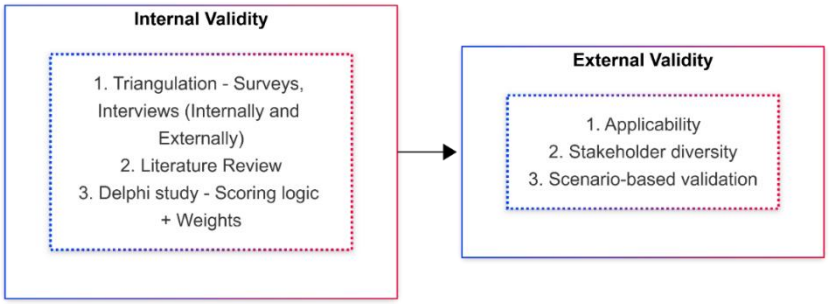

Figure 7: Internal vs External validity

(Source: Adopted from (Eckel, 2026))

Internal validity assesses whether the indicators or metrics are derived from theory and whether the logic behaves predictably across similar cases. To support internal validity, Delphi studies are held to generate expert consensus. The second validity check is externally, where you evaluate whether the practitioners interpret the indicators consistently and whether the results from the artifact

about tacit knowledge loss aligns with real-world experiences. For this research, building internal validity first is important as this ensures that all the indicators and logic of the artifact are theoretically grounded and accurate. Tacit knowledge required clear operational definitions and controlled interpretation[10]. External validity is used to strengthen through feedback loops and demonstrations to ensure the artifact generalizes diverse inputs in outsourcing and MSP context.

[10] No assumptions can be made to ensure rigor research

4 Artifact Design

Fundamentally, tacit knowledge is experiential, relational, and context-dependent which makes it difficult to measure directly from the source. The purpose of this artifact is not to "measure" but rather to determine to what extend tacit knowledge loss can be approximated through structural indicators and metrics, professional judgement, and weighting. A tacit knowledge quantification dashboard is developed as a conceptual framework, translating qualitative and implicit knowledge signals to indicators/metrics for quantification. By combining the measurable indicators[11] a formula is created to score the mechanism and readiness index, and the framework does not mention to capture tacit knowledge directly but rather approximate the erosion and evaluate how it can support client organizations in identifying, prioritizing, and governing actions to mitigate vendor lock-in during IT outsourcing or MSP transitions. A risk-oriented dashboard for the TKLQM is built to track traces in multiple structural and behavioural indicators. For stakeholders, it highlights the severity of combined exposure and how much it affects one's transition readiness and vendor lock-in risk. Having a dashboard makes it easy to interpret during discussions, audits, and meetings in which this "tool" supports decision-making.

Chapter 4 presents the structure, components, and logic of the artifact. The indicators are derived from the relevance cycle (Survey + interviews) and refined in the rigor cycle (theory). The Delphi study is crucial to evaluate the artifact through multiple rounds and validating the iterative process of improvement. This artifact aims to be a tool that helps auditors, consultants, and transition managers mitigating the vendor lock-in when tacit knowledge starting to be lost and the gap is widening. Overall, the artifact combines qualitative expertise and quantitative decision-making in a generic sense. Identifying how far tacit knowledge loss can be quantified meaningfully and where the limitations of measurements start is the key to this artifact. It provides 1) a structured method to approximate tacit knowledge loss, and 2) pictures actionable insights to reduce various factors leading to vendor lock-in and supports more resilient governance in IT outsourcing or MSP environments.

[11] Expert dependency, undocumented indicators, vendor-client knowledge asymmetry

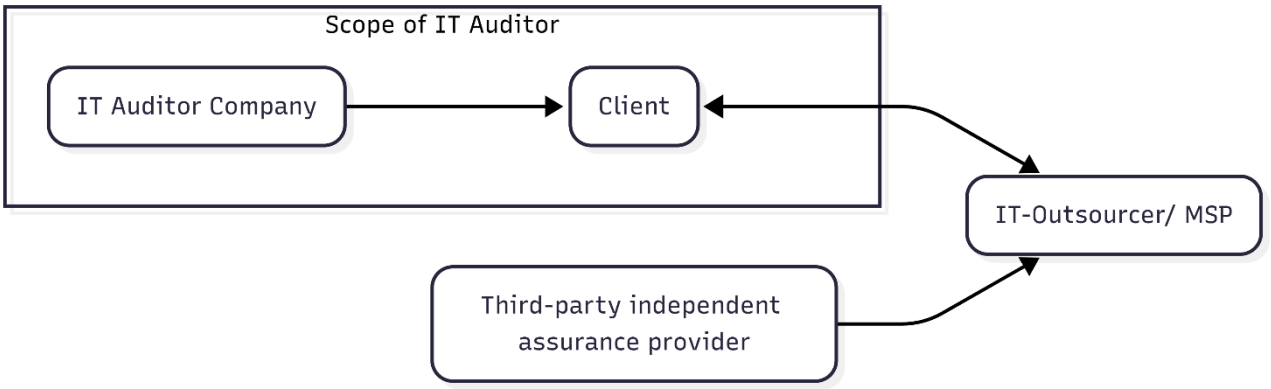

Figure 8: Example of TKLQM Position

(Source: Created by this Thesis)

Figure 8 depicts how the TKLQM is positioned in which the IT Outsourcer and MSP environments, the client-side remains accountable for operational continuity, risk management, and knowledge governance even when execution of operation is at the external provider. IT auditors and consultants act as the independent assessor and advisors that evaluate governance effectiveness, knowledge transfer quality, and dependency risks[12]. Reports such as SOC1/ISAE3402, SOC2/ ISAE3000 provide transparency to service provider controls, but do not replace client-side ownership of tacit knowledge and decision-making.

4.1 Indicators and Scoring Logic

To approximate tacit knowledge loss in IT Outsourcing or MSP transitions, core indicators are derived through the triangulation method between an empirical method (surveys/ interviews) and literature from (Polanyi, 2001) and (Collins, Tacit and Explicit Knowledge, 2010). The indicators highlight the various importance of tacit knowledge loss such as undocumented routines and workarounds, expert dependency, incomplete knowledge transfer, interpersonal communication, and knowledge asymmetry. To maintain interpretability, all indicators are normalized between 0 and 1 makes, because there are different scales. To normalize the indicators from both empirical findings and literature, the following formula is used based on the Likert scale rating:

$$S_i = \left(\frac{R_i - R_{min}}{R_{max} - R_{min}}\right)$$

[12] IT-auditors and Consultants do not own nor operate the outsourced processes.

Table 7 highlights the operationalization of the TKLQM indicators by linking each of the indicators to empirical measurements from the survey. R_i is average rating from the survey, whereas the R_{min} and R_{max} are the minimum and maximum rating per indicator. The S_i is the normalized score between 0 and 1, where 0 means no exposure and 1 means notable exposure. Normalization means that the values are adjusted from various scales towards a common scale and thus eliminate inequality. A simple formula such as the one above keeps the dashboard transparent and interpretable for practitioners who eventually will use it. For example, if undocumented routines are scored on a 4/5, the normalization becomes $S_i = (4-1)/5-1) = 0.75$. A 0.75/1 indicates a significant exposure on tacit knowledge loss, so setting the threshold as $S_i > 0.50$ marks when risk becomes slightly significant and $S_i > 0.60$ becomes significant. Individual indicators such as UKD, KTRA, KOTW, and IKTF create a significant risk(s) of losing tacit knowledge during transitions of IT Outsourcing or MSPs, this results in a slight significant risk as the average S_i across all indicators is 0.5, which hits the threshold mark.

Table 7: Indicator and baseline normalization parameters

Dimension	Indicator Code	Name	R_i	R_{min}	R_{max}	S_I	Risk
Tacit Knowledge Exposure	UKD	Undocumented Knowledge Dependence	4	1	5	0.75	Significant
Knowledge Transfer Governance (Clarity)	KTRA	Knowledge Transfer Responsibility Ambiguity	3.825	1	5	0.71	Significant
Operational Disruption	EMK	Errors due to Missing Knowledge	3.23	1	5	0.56	Slightly Significant
Expert Dependency	DSE	Dependency on Single Expert	2.75	1	5	0.44	Not Significant
Vendor Knowledge Gap	VMCS	Vendor misunderstanding Client Systems	1.5	1	5	0.13	Not Significant
Knowledge Ownership	KOTW	Knowledge Ownership Weakness	4	1	5	0.75	Significant
Transfer Completeness	IKTF	Incomplete Knowledge Transfer Frequency	3.5	1	5	0.63	Significant
Vendor Dependency	VLC	Vendor lock-in Condition	0.45	0	1	0.45	Not Significant
Operational Disruption	ICON	Inconsistent Procedures after	3	1	4	0.67	Significant
Knowledge Loss drivers	KLD	Knowledge Loss Drivers	0.38	0	1	0.38	Not Significant

Operational Disruption	CLAR	Wasted Time due to clarification	2.67	1	4	0.56	Slightly Significant

(Source: Created by this thesis)

4.2 Weighting and Composite Score

While the selected indicators contribute to the risk of tacit knowledge loss, not all indicators contribute equally towards it. For example, losing a COBOL[13] expert, is more damaging than undocumented knowledge. Interviews and the Delphi study rounds showed that some indicators have greater impact compared to others. To account for the levels of importance, weights are introduced into the dashboard that reflects each indicator, which is defined as follows:

$$W_i = \frac{E_i}{\sum_{j=1}^{n} E_j}$$

This formula takes each expert score and expresses it proportionally of the total importance (E_j) given across all indicators. To reflect these differences an expert, assign an importance score (E_i) to each indicator through the Delphi process. These scores are then normalized into weights (W_i); thus, a higher weight indicates greater importance. With this formula, finding the most important indicators will be easier and more prominent in whether the TKLQM is successful or not. Table 8 showcases the scoring weight per parameter importance and will be validated and refined through Delphi studies as described in Chapter 5.

Table 8: Initial weighting scores[14]

Dimension	Indicator Code	Name	E_i	$\sum E_i$	W_i[15]
Tacit Knowledge Exposure	UKD	Undocumented Knowledge Dependence	7	69	0.101
Knowledge Transfer Governance (Clarity)	KTRA	Knowledge Transfer Responsibility Ambiguity	7	69	0.101
Operational Disruption	EMK	Errors due to Missing Knowledge	6	69	0.087
Expert Dependency	DSE	Dependency on Single Expert	10	69	0.145
Vendor Knowledge Gap	VMCS	Vendor misunderstanding Client Systems	2	69	0.029

[13] COBOL is a procedural programming language created in 1959 and remains the backbone of the financial industry (~43% of banking systems, ~95% of ATM-transactions and $3T in daily commerce) (Piscicelli, 2024)

[14] These are the initial weights prior derived from empirical findings and will be validated and adjusted through the Delphi study before the final weighting score.

[15] Due to rounding errors, the sum of W_i should be very close to 1. In the Dashboards, these will be percentages (1-100% for ease of use and later converted to what is seen above.

Knowledge Ownership	KOTW	Knowledge Ownership Weakness	8	69	0.116
Transfer Completeness	IKTF	Incomplete Knowledge Transfer Frequency	9	69	0.130
Vendor Dependency	VLC	Vendor lock-in Condition	6	69	0.087
Operational Disruption	ICON	Inconsistent Procedures After	5	69	0.072
Knowledge Loss drivers	KLD	Knowledge Loss Drivers	5	69	0.072
Operational Disruption	CLAR	Wasted Time due to clarification	4	69	0.058

(Source: Created by this thesis)

4.3 Indicator Contribution & Composite score

The next step is to combine the normalized and weight score from 4.1 and 4.2 into a single and easy-to-understand score This composite score highlights what the effect of each indicator is to the overall tacit knowledge loss exposure during a transition period. The indicator contribution is calculated by multiplying S_i with W_i and is defined as:

$$TKL_i = S_i \times W_i$$

The TKL_i is the amount of contribution to tacit knowledge loss, and because S_i and W_i are constrained within 0 and 1, the final contribution per indicator should also be between 0 and 1 to maintain overall interpretability. This formula highlights that a high indicator is the results of being impactful when importance is also high, thus presents which issues are more severe than others. Essentially the TKL_i is comparable to a risk assessment, where you calculate the risk based on the possible risk x importance and mapped in a matrix.

Table 9: Initial TKL Assessment

Dimension	Indicator Code	Name	TKL_i
Tacit Knowledge Exposure	UKD	Undocumented Knowledge Dependence	0.076
Knowledge Transfer Governance (Clarity)	KTRA	Knowledge Transfer Responsibility Ambiguity	0.072
Operational Disruption	EMK	Errors due to Missing Knowledge	0.049
Expert Dependency	DSE	Dependency on Single Expert	0.064
Vendor Knowledge Gap	VMCS	Vendor misunderstanding Client Systems	0.004
Knowledge Ownership	KOTW	Knowledge Ownership Weakness	0.087

Transfer Completeness	IKTF	Incomplete Knowledge Transfer Frequency	0.082
Vendor Dependency	VLC	Vendor lock-in Condition	0.039
Operational Disruption	ICON	Inconsistent Procedures after	0.048
Knowledge Loss drivers	KLD	Knowledge Loss Drivers	0.027
Operational Disruption	CLAR	Wasted Time due to clarification	0.032

(Source: Created by this thesis)

Once the TKL_i is calculated for all the individual indicators as shown in table 9, the final step is to sum all contributions. Given the transition of any outsourcing arrangements, an initial overall score of this transition is representing the readiness of an organization.

$$Approx.TKLQM = \sum_{i=1}^{n} (S_i \times W_i) \approx 0.579$$

Interpreting the results whether a company's knowledge transfer is complete, dependents on key individuals or stakeholders, and the cause of documentation gaps that are likely causing continuity flow is between 0 and 1. This approx. TKLQM is a clear score, which can be part of a readiness and risk classification.

5 Evaluation & Findings

The purpose of this evaluation is not to validate any predictive accuracy, but to assess the plausibility, interpretability, and usefulness of the TKLQM as a decision-supported artifact.

5.1 Delphi Study – Surveys + Panel with Scenario-based design

The Delphi Study for this thesis is a combination of Surveys and one panel-based round. It consist of two rounds with its distinct purposes. Surveys were used in round 1 to draw out independent expert judgement per group for the risk/exposure (R_i) and importance. (E_i) that are derived from the TKLQM formulas defined in Chapter 4. The survey aims to be role-specific to reflect how different stakeholders observe tacit knowledge loss in practice. A panel with various scenario designs in round 2 was conducted to interpret, validate, and contextualize the quantitative results, rather than modifying the weights or the indicators. This method was selected because it allows experts to assess the TKLQM in a controlled and yet realistic environment. The results from the panel are being projected into a excel dashboard with the approximated tacit knowledge loss. Scenario-building is important to validate whether the TKLQM indicators are relevant to "real-world" scenario's. The scenarios are created using the internal Microsoft Co-Pilot and validated with Senior Auditor(s) from the interview to ensure rigor and imitates real-world context. Additionally, they are not used to generate empirical measurements of tacit knowledge loss, but to support, demonstrate and evaluate whether the TKLQM dashboard is useful under realistic conditions.

5.1.1 Round 1 - Survey

The first round of the Delphi Study was conducted to gather an initial expert validation across the acquired indicators from the exploratory survey and interviews with regards to the TKLQM to validate the indicators and weights. The primary objective for this round is to assess the perceived importance, clarity, and practical relevance for each indicator and evaluate if indicator importance/weight needs to be adjusted, not on evaluating the dashboard as a whole. An anonymized, survey-based evaluation was conducted to guarantee independent expert judgement and to minimize biases. The Delphi methodology (Dalkey & Helmer, 1963) focuses on reducing dominance bias by having anonymity as the central point and fostering unbiased assessments. The survey in Appendix 9.1 aims at three perspectives, which are Auditors, MSP/IT Outsourcing leads, and Clients and approximately 3-4, 2-3 and 1-2 respondents respectively. The results focuses on how professional judgement affects perceived importance regarding the indicators and whether the initial weights needs to be adjusted.

Table 10: Evaluated TKL Assessment

Indicator Code	Name	Initial W_i	Evaluated W_i	%Change of Wi + Re-evaluated TKL[16]
UKD	Undocumented Knowledge Dependence	0.101	0.107	5.94% 0.080
KTRA	Knowledge Transfer Responsibility Ambiguity	0.101	0.071	-29.70% 0.050
EMK	Errors due to Missing Knowledge	0.087	0.089	2.30% 0.050
DSE	Dependency on Single Expert	0.145	0.071	-51.03% 0.031
VMCS	Vendor misunderstanding Client Systems	0.029	0.125	331.03% 0.016
KOTW	Knowledge Ownership Weakness	0.116	0.125	7.76% 0.094
IKTF	Incomplete Knowledge Transfer Frequency	0.130	0.107	-17.69% 0.067
VLC	Vendor lock-in Condition	0.087	0.089	2.30% 0.040
ICON	Inconsistent Procedures after	0.072	0.107	48.61% 0.072
KLD	Knowledge Loss Drivers	0.072	-	-
CLAR	Wasted Time due to clarification	0.058	0.107	84.48% 0.060

(Source: Created by this thesis)

Table 10 compares the initial weights derived from the preliminarily survey and semi-structured interviews with the weights discussed in the first round. Overall, the results show that the weighting can shift once practitioners reflect on the indicators in more detail. The most noticeable increases were observed for VMCS, ICON, and CLAR which indicates stronger expert opinions on operational tacit-knowledge risks, while DSE and KTRA were weighted lower than in the initial dashboard.

[16] While the changes are big for some, these are not the final weights, because weights of importance differ per organization and it is the amount of risk one can take.

The weights in the TKLQM should not be treated as universal or static. In practice, the weights should be determined in a joint conversation between the client and the IT auditor, because both perspective are needed to assess what is most critical in that specific transition. Additionally, the weights can be adjusted throughout the project, since in real-life situations more meetings take place, clarifying questions are asked, and new information becomes available over time. The TKLQM is not meant to prescribe one final weighting, but to support an ongoing governance discussion around tacit knowledge loss risk, documentation, and transition readiness.

5.1.2 Round 2 – Panel + Scenario-based design?

The second round of the Delphi Study is focused on evaluating the TKLQM based on various scenarios where the dashboard will be demonstrated. While the first round aimed to validate and refine the importance and weighting of indicators, the purpose of Round 2 is to evaluate the interpretability, plausibility, and practical usefulness of the artifact in realistic outsourcing and MSP transition scenarios. This serves as a demonstration and evaluation by showing experts concrete, realistic situations in which the TKLQM would be applied in practice. (Hevner A. , March, Park, & Ram, 2004) emphasizes that artifacts should be evaluated on both internal consistency and its usefulness and relevance in real-world context. The weights (W_i) varies across all scenarios as the importance per story differs. Each organization take upon a different importance, focus, continuity risk, and transition depending on the scale. The full scenario descriptions per category are in appendix 9.3. The panel consisted of practitioners from three perspectives: IT Audit/ Technology Risk, IT Outsourcing and MSP operations, and client-side IT Management. The scenario-based evaluated showed that different stakeholder groups interpret tacit knowledge through distinct lenses yet consistently recognized the core risk patterns that are captured by the TKLQM. No new indicators are mentioned as additional risk.

The panel with scenario-based design was divided into two groups 1) Panel Auditors, and 2) panel IT Outsourcer/MSP and Client-Side. While both groups relied on professional judgement, the difference in perspective showed complementary assessment rather than conflicting evaluations. It highlights how TKLQM accommodates the perspective of multiple stakeholders by showing the tacit knowledge exposures, which is applicable across roles involved in IT outsourcing and MSP transitions. Group one assessed indicators through a compliance- and risk-oriented lens, sometimes assuming “foreseeable” risks related to compliance with regulations and standards. In contrast, group two tended to evaluate indicators based on operational experience, focusing more on the practical dependencies, transition friction, and operational impact.

In addition to the two primary panel groups, an additional group was invited to participate in the scenario-based evaluation as an external perspective. These participants had not been previously involved or informed about the development of the TKLQM throughout this thesis. This group was included to assess the dashboard from a fresh perspective and to evaluate its interpretability and perceived usefulness without prior contextual bias. As a result, feedback from this additional group, as well as the primary panel groups, indicated that the TKLQM was perceived as useful, easy to complete, and effective in providing a clear high-level overview of which tacit knowledge indicator were currently missing or insufficiently governed. Participants noticed that the dashboard enabled quick identification of gaps and areas that requires further investigation. At the same time, participants frequently raised questions about aspects that were not explicitly described in the scenario. This shows that professional judgement stays prominent because practitioners naturally probe beyond the available information in the scenarios to assess the risk, importance, and contextual relevance.

Participants highlights that scenario-based evaluations inherently provides less information than real-world engagements, where multiple meetings, follow-up discussions, and iterative assessments are typically required to determining what is truly missing and how important/critical each indicator is. Despite these constraints, participants consistently described the dashboard as relevant, meaningful, and applicable to IT outsourcing and MSP transition context. And one participant mentioned that the descriptions per indicator are keywords for asking specific questions

5.1.3 Evaluation and result

The results of the scenario-based evaluation showed that the TKLQM provides value for both IT auditors and client organizations. Auditors viewed it as useful for structuring assessment and surfacing risk-related drivers, while participants from the client-side recognized the value for clarifying the ownership, actions, and dependency risks early on. All participants emphasizes that the artifact should solely act as a supportive tool but not replace professional judgement.

5.1.4 TKLQM – Dashboard

The purpose of the TKLQM dashboard is to make tacit knowledge loss exposure visible, discussable, and comparable across transitions. Practitioners rate a set of indicators, after which the dashboard normalizes scores, applies weights, and present the result as a structured overview of tacit knowledge risk. The PoC assessment dashboard is intentionally designed as a risk-oriented assessment tool rather than a predictive or causal management system. It supports reflection and risk-based discussions by translating tacit knowledge

signals into interpretable exposure scores. The outputs should be read as a decision-supported signal, which is not exactly a measurement of tacit knowledge itself.

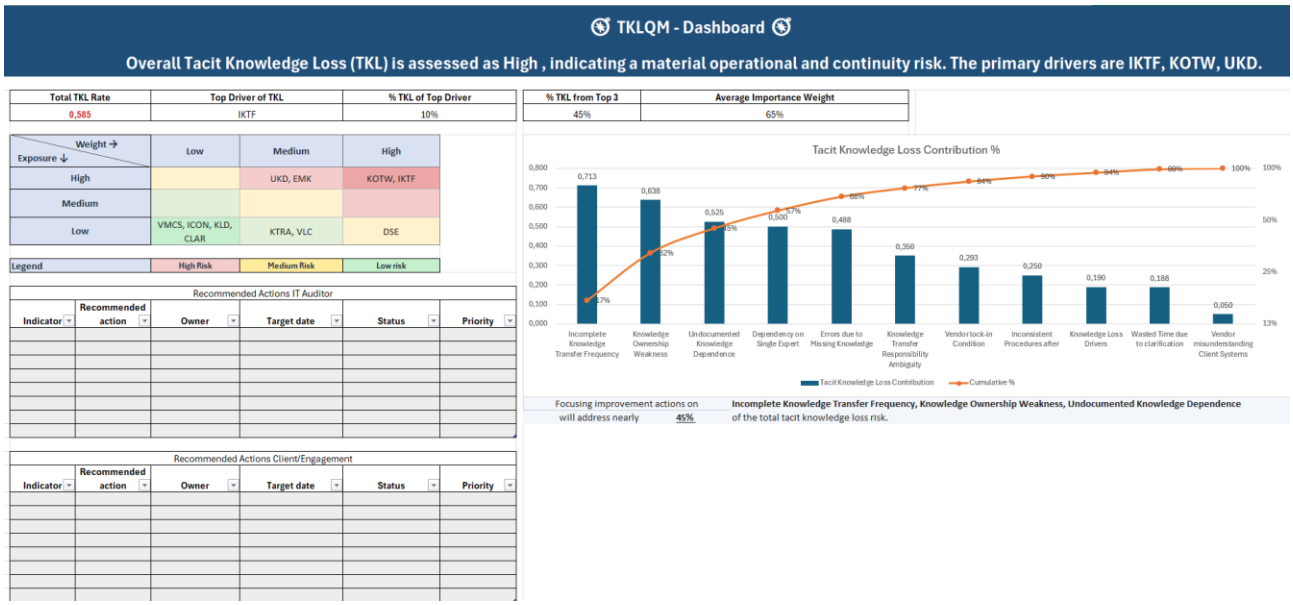

Figure 9: TKLQM – PoC Dashboard

(Source: Created by this thesis)

The design of this dashboard is created deliberately as Auditors, IT Outsourcers, and MSPs usually work with risk assessments, and by applying the logic of a risk assessment it represents a familiar governance tool that would simplify the interpretability, reduce cognitive load, and improve adaption potential. Participants of the panel mentioned that the TKLQM Assessment dashboard validated that this high overview of the current tacit knowledge risk is relevant and applicable. The TKLQM dashboard needs to be interpreted as a decision-supported signal, not a measurement instrument. The reason being is that the scores indicate relative exposure and readiness rather than objectively quantifying tacit knowledge loss. Additionally, organizations may identify new or modified indicators reflecting domain-specific form(s) of tacit knowledge loss.

The TKLQM dashboard explicitly differentiates between recommended actions for the IT Auditor and the Client organization. The IT auditor's side focus on assessment follow-up, assurance implications, and advisory discussion points. The client-side recommendations focusses on governance remediation, knowledge ownership assignment, documentation improvement, and operational mitigation actions. This split of recommended actions reflects responsibility for risk management and knowledge retention that remains with the client, while the IT auditor provides independent assessment and advisory report. The TKLQM is designed with adjustability in mind in case the underlying structure of the dashboard needs adjustments.

The purpose of this chapter was to interpret the findings and position the TKLQM within academic literature and professional practice(s). Using the DSR methodology, this chapter does not introduce new empirical data but is solely reflecting on what the evaluation results mean for this thesis's research objectives, research question, and expands the understanding of tacit knowledge loss in IT outsourcing and MSP environments.

5.2 Interpretation of Findings

Overall, the findings of this research suggest that the tacit knowledge loss is not abstract or marginal, but a structural and recurring governance risk. Across surveys, interviews, and expert evaluations, organizations consistently reveals that reliance on undocumented routines, experiential judgement, and informal coordination mechanisms are captured inefficiently with the traditional method of documentation and contractual controls. In IT Outsourcing and MSPs, the difficulty is amplified because knowledge is shifting across organizational boundaries, increasing dependency and reducing client autonomy.

A relatively small change in the composite TKLQM score after the Delphi study suggests refinement of the indicator weights rather than instability of the dashboard itself. This means that the expert feedback did not fundamentally change the structure of the TKLQM, but mainly adjusted the relative emphasis placed on specific indicators. With that in mind, the results supports the internal robustness of the dashboard. Prior research on expert-based assessment methods highlighted that refined emphasis and interpretation focus rather than producing large number of aggregated outcomes is the result of re-weighting through iteration (Dalkey & Helmer, 1963; Okoli & Pawlowski, 2004).

From an evaluation perspective, experts consistently recognized these various dynamics when using the TKLQM. The indicators used in the dashboard are fully aligned with practitioners experiences, especially expert dependency, incomplete knowledge transfer, knowledge transfer responsibility ambiguity. It suggests that tacit knowledge cannot be captured directly, but erosion of knowledge that are being observed can be systematically approximated.

5.3 Answering the Research Question

The study shows that tacit knowledge loss cannot be quantified directly in a strict sense because tacit knowledge is experiential, relational, and context dependent (Polanyi, 2001). However, tacit

knowledge can be meaningfully approximated indirectly through this TKLQM that translates organizational signals to interpretable indicators and their weights. (Nonaka, 1994; Nissen, 2006) validated that erosion of tacit knowledge can only be approximated through observable manifestations and organizational effects. In that sense, the answer to the research question is that tacit knowledge loss can be approximated to a useful extent for governance and decision-support purposes, even if it cannot be measured as an objective standalone variable.

The TLKQM addresses tacit knowledge erosion through a set of empirically grounded and evaluated indicators, such as undocumented knowledge dependence, expert dependency, knowledge ownership weakness, and incomplete knowledge transfer. When normalized exposure values (S_i) and the weights (Wi) are treated as fixed inputs derived, the evaluated scenarios in this research to demonstrate and validate the TKLQM. It supports real-world applications; however, the S_i values and W_i are context-dependent and are expected to change as organizations re-evaluate the various exposure levels and importance across different sort of transition, time periods, and operational conditions. Regarding vendor lock-in, the TKLQM can indirectly support mitigating this risk by using the exposing knowledge asymmetries and dependencies early stage. It enables organization to recognize when the operational dependency is slowly shifting toward vendors and thus provides informational and reflective foundation necessary for organisations to take governance and mitigation actions constructively.

The evaluation results indicate that the TKLQM provides useful decision-support by making tacit knowledge exposure visible, comparable, and discussable across stakeholders. While the dashboard does not reduce vendor lock-in directly, it supports mitigation by having early-warning signs of knowledge asymmetry and dependency. This enables organizations to take informed governance actions and enhances awareness, transparency, and informed professional judgement. This position is consistent with DSR principles, which emphasize actionable knowledge over representational accuracy when addressing any socio-technical problems (Hevner A. , March, Park, & Ram, 2004; Hevner & Gregor, Positioning and Presenting Design Science Research for Maximum Impact, 2013).

5.4 Contributions

This research contributes and extends current existing literature and discussion on tacit knowledge and IT outsourcing by moving beyond the descriptive amounts of knowledge loss towards an artifact that operationalized tacit knowledge erosion which can be approximated and governed. Prior studies mentioned that tacit knowledge is experiential, relational, and difficult to articulate (Polanyi, 2001; Collins, Tacit and Explicit Knowledge, 2010), yet remain descriptive when

addressing the tacit knowledge loss during transitions. The TKLQM extends this by demonstrating knowledge erosion to be treated as a governance risk, rather than a cognitive phenomenon.

Operationalizing tacit knowledge loss through various observable signals such as undocumented routines, expert dependency, and incomplete knowledge transfer, the dashboard creates manageable exposure from unmeasurable assets/indicators. It does not contradict the theory of knowledge, but aligns with prior work, suggesting that effects and consequences of tacit knowledge can be meaningfully assessed, even when not one cannot observe it directly (Nonaka, 1994; Nissen, 2006). By doing so, this research bridges tacit knowledge theory with IT governance and outsourcing literature, additionally bridges assurance assessment and client-side operational decision-making In IT Outsourcing/ MSP transition. It suggests that tacit knowledge loss represents a distinct and under-addressed dimension, which requires its own assessment logic that complements each other rather than replacing any existing governance mechanisms in place.

From a practical perspective, the main contribution of this research lies in the development of the artifact "TKLQM" that makes any tacit knowledge visible and discussable across stakeholders. Practitioners involved in IT outsourcing/ MSP transitions such as auditors, consultants and client-side managers often recognize tacit knowledge gaps, but only after they have had occurred. The TKLQM provides a structured way to highlight these risks early one by translating these experiential and relational knowledge loss into interpretable indicators. The value of the TKLQM does not depend on precise measurement accuracy, but rather how to utilize this for structured professional judgement that supports highlighting risks and support informed discussions during transition planning and reviews. The dashboard functions similarly to a risk assessment tool used in assurance and IT governance, where scores are interpreted as signals. The TKLQM lowers the barrier for adoption and integrating this into existing assurance and transition workflows. It supports proactive knowledge retention strategies and reduces the likelihood of tacit knowledge loss being not discovered until vendor lock-in or business continuity risk has already emerged.

6 Limitations

6.1 Scope and boundaries

The main limitation of this study lies within the evaluation scope of the artifact. While the TKLQM dashboard has been verified through the Delphi Study of two rounds. Its evaluation and iteration cycles during the Design Phase limited and solely tested on fictitious scenarios. These scenarios provide structured and realistic illustrations of IT outsourcing and Managed Service Provider (MSP) transitions but remains a simplified representation of practice. As a result, the study does not include real-world deployment or outcome-based validation. DSR explicitly acknowledges early- to mid-maturity artifacts to be evaluated through expert validation and "realistic" scenarios, but when it comes to real-world deployment or longitudinal measurement it is not feasible yet (Hevner A. , March, Park, & Ram, 2004; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007).

The TKLQM was not applied repeatedly within the same organizational context to track changes over time. Consequently, it remains unclear whether the artifact would be used as a continuous monitoring instrument or primarily as a periodic assessment (such as a ISAE3402 Type I). Due to the time-bounded nature of this thesis, no empirical evidence is available regarding how tacit knowledge exposure scores evolve over time or whether repeated use of the artifact leads to improvements in knowledge retention or reduced vendor dependency. From a design science perspective, the TKLQM represents an artifact at an early-to-intermediate maturity level because the conceptual validity and perceived usefulness has been established, but large-scale deployment and longitudinal valuations are yet to be confirmed.

6.2 Sampling and perspective limitations

The empirical data collection of this study reflects primarily on the perspectives from IT Audit, Technology Risk, Consulting, IT Outsourcing/MSP, and client-side IT management with a strong emphasis on the Big Four and consultancy environments. While it strengthens the relevance of the artifact for governance, assurance, and transitions oversight context, it may underrepresent perspectives from purely operational or on-regulated environments. Furthermore, the study applies purposive expert sampling over probabilistic sampling, which is consistent with DSR objectives. It does not represent population-level distribution of tacit knowledge loss, but to inform artifact design and evaluation through expert insights.

While the TKLQM is deliberately designed to be adaptable, allowing organizations to recalibrate the weights and thresholds, it limits claim of standardized benchmarking across organizations.

6.3 Future Research

The limitations above provide clear directions for future research and artifact maturation. Firstly, future studies could deploy the TKLQM in "live" IT outsourcing or MSP transitions to evaluate its longitudinal effectiveness and tracking changes in tacit knowledge exposure and governance readiness over time. These deployments would enable realistic outcome-based evaluation and operational impact. By integrating this decision-supported tool, auditors and organizations are able to measure how effective the TKLQM would be and any possible challenges that arises. Secondly, future research could explore how the TKLQM acts and adapts to sector-specific projects and therefore refine the indicators and weights for domains such as healthcare, telecommunication, or public sector outsourcing. This type of research is comparative which can validate the adaptability of the artifact. As noticed during the scenario-building, each story differs on the weights of the indicators, but this is still limited to the IT Outsourcing/MSP transition sectors, but to implement this further into other industries to keep (mostly) all tacit knowledge within a department would be valuable key insights. Finally, integrating AI-assisted support mechanism such as pattern detection, or indicator pre-population. Future research could examine how AI can enhance and support the scalability and consistency of tacit knowledge signal detection. Organizations could also experiment with Agentic AI or AI-assisted transcription and summarization tools to capture key decisions, rationales, and action points during transition meetings or Agile/Scrum retrospectives. These tools might help structure the long-lost/ degrading tacit insights into notes, checklist, or reusable replies from Agentic AI, while keeping the actual interpretation and professional judgement fully with human experts.

7 Conclusion

This thesis was aimed to explore to what extent tacit knowledge loss during IT Outsourcing and Managed Service Provider transitions can be approximated through a structured artifact. The findings showed that tacit knowledge loss cannot be measured directly, but its erosion can be approximated through observable organizational signals and converted into governance-related insights. By adopting a Design Science Research approach, this study developed and evaluated the TKLQM dashboard, which is an artifact that integrates indicators, expert judgement, and transparent weighting logic into a coherent assessment/dashboard which is a decision-support tool. The evaluation results shows that the dashboard is interpretable, plausible, and useful for practitioners that operates in complex outsourcing environments, particularly when tacit knowledge loss is starting to deteriorate.

Conversely, this research does not claim that the TKLQM captures tacit knowledge loss entirely, nor does it replace professional judgement nor existing governance mechanisms. Instead, it should be understood and used as a supporting tool enhancing awareness, supporting structured discussions, and enables early signs of knowledge-related risks during any phase of the transition. To conclude, this thesis contributes to both research and practice by showing how intangible experiences can be addressed through approximation and evaluation. It highlights the challenge of tacit knowledge loss not because knowledge is absence or starting to erode, but because no structure is found to capture it, in which using the TKLQM would be a possible solution towards it.

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Appendices

Appendix 1: Data Management Plan

This document will help you plan how to manage your research data. More detailed instructions for each section are available online in the Research Data Management Guide for Students.

1. Research data

Research data refers to all the material with which the analysis and results of the research can be verified and reproduced. It may be, for example, various measurement results, data from surveys or interviews, recordings or videos, notes, software, source codes, biological samples, text samples, or collection data.

In the table below, list all the research data you use in your research. Note that the data may consist of several different types of data, so please remember to list all the different data types. List both digital and physical research data.

Research data type	**Contains personal details/information***	**I will gather/produce the data myself**	**Someone else has gathered/produced the data**	**Other notes**
Data Type 1: Exploratory Surveys	x	x		
Data Type 2: Semi-Structured Interviews	x	x		
Data Type 3: Secondary Data Analysis	x		x	
Data Type 4: Delphi study	x	x		

* Personal details/information are all information based on which a person can be identified directly or indirectly, for example by connecting a specific piece of data to another, which makes identification possible. For more information about what data is considered personal go to the Office of the Finnish Data Protection Ombudsman's website

2. Processing personal data in research

If your data contains personal details/information, you are obliged to comply with the EU's General Data Protection Regulation (GDPR) and the Finnish Data Protection Act. For data that contains personal details, you must prepare a Data Protection Notice for your research participants and determine who is the controller for the research data.

I will prepare a Data Protection Notice** and give it to the research participants before collecting data ☑

The controller** for the personal details is the student themself ☑ the university ☐

My data does not contain any personal data ☐

** More information at the university's intranet page, Data Protection Guideline for Thesis Research

3. Permissions and rights related to the use of data

Find out what permissions and rights are involved in the use of the data. Consult your thesis supervisor, if necessary. Describe the use permissions and rights for each data type. You can add more data types to the list, if necessary.

3.1. Self-collected data

You may need separate permissions to use the data you collect or produce, both in research and in publishing the results. If you are archiving your data, remember to ask the research participants for the necessary permissions for archiving and further use of the data. Also, find out if the repository/archive you have selected requires written permissions from the participants.

Necessary permissions and how they are acquired

Data type 1: Semi-structured interviews

Data type 2: Preliminary Survey

Data type 3: Interviews

Data type 4: Delphi study

3.2 Data collected by someone else

Do you have the necessary permissions to use the data in your research and to publish the results? Are there copyright or licencing issues involved in the use of the data? Note, for example, that you may need permission to use the images or graphs you have found in publications.

Rights and licences related to the data

Data type 1: Secondary Data Analysis

4. Storing the data during the research process

Where will you store your data during the research process?

In the university's network drive ☐

In the university-provided Seafile Cloud Service ☐

Other location, please specify: ☑ On the work/internship laptop of the researcher from the company.

The university's data storage services will take care of data security and backup files automatically. If you choose to store your data somewhere other than in the services provided by the university, please specify how you will ensure data security and file backups. Remember to make sure you know every time where you are saving the edited/modified data.

If you are using a smartphone to record anything, please check in advance where the audio or video will be saved. If you are using commercial cloud services (iCloud, Dropbox, Google Drive, etc.) and your data contains personal data, make sure the information you provide in the Data Protection Notice about data migration matches your device settings. The use of commercial cloud services means the data will be transferred to third countries outside the EU.

5. Documenting the data and metadata

How would you describe your research data so that even an outsider or a person unfamiliar with it will understand what the data is? How would you help yourself recall years later what your data consists of?

5.1 Data documentation

Can you describe what has happened to your research data during the research process? Data documentation is essential when you try to track any changes made to the data.

To document the data, I will use:

A field/research journal ☐

A separate document where I will record the main points of the data, such as changes made, phases of analysis, and significance of variables ☑

A readme file linked to the data that describes the main points of the data ☐

Other, please specify: ☐

5.2 Data arrangement and integrity

How will you keep your data in order and intact, as well as prevent any accidental changes to it?

I will keep the original data files separate from the data I am using in the research process, so that I can always revert back to the original, if need be. ☑

Version control: I will plan before starting the research how I will name the different data versions and I will adhere to the plan consistently. ☑

I recognise the life span of the data from the beginning of the research and am already prepared for situations, where the data can alter unnoticed, for example while recording, transcribing, downloading, or in data conversions from one file format to another, etc. ☑

5.3 Metadata

Metadata is a description of you research data. Based on metadata someone unfamiliar with your data will understand what it consists of. Metadata should include, among others, the file name, location, file size, and information about the producer of the data. Will you require metadata?

I will save my data into an archive or a repository that will take care of the metadata for me. ☐

I will have to create the metadata myself, because the archive/repository where I am uploading the data requires it. ☐

I will not store my data into a public archive/repository, and therefore I will not need to create any metadata. ☑

6. Data after completing the research

You are responsible for the data even after the research process has ended. Make sure you will handle the data according to the agreements you have made. The university recommends a general retention period of five (5) years, with an exception for medical research data, where the retention period is 15 years. Personal data can only be stored as long as it is necessary. If you have agreed to destroy the data after a set time period, you are responsible for destroying the data, even if you no longer are a student at the university. Likewise, when using the university's online storage services, destroying the data is your responsibility.

What happens to your research data, when the research is completed?

I will store all data for five (5) years.

I will destroy all data immediately after completion, because:

It is sensitive client/organisational/vendor data. Think about PII's and GDPR.

I will destroy part of the data, but store part of it for xx years, because: N/A

If you will store the data, please identify where: N/A

Remember to keep the data management plan updated throughout the research project.

Description of the collected data.

This study collects three types of empirical data during this period.

1. **Exploratory survey data**

   The survey's responses are about tacit knowledge challenges in IT outsourcing and managed service platforms. The data includes roles and responsibilities, perceived challenges, and optional open response comments. The internal survey has been conducted at a big four company itself using Microsoft Forms and therefore can't be shared outside of the environment. An external survey has been created using Google Forms, which has been shared through a LinkedIn Post. No personally identifiable information (PII) such as names, email addresses, or IP addresses was collected, thus distributed in anonymous mode.

2. Semi-structured interviews – including notes/transcriptions

Interviews are done at one of the Big Fours consultancy firms, SME consultancy firms, vendors (IT outsourcers/ MSPs), and clients (organizations that outsource their process). Although only summaries are being made available as appendix, still sensitive information has been left out as this contains mainly internal information. No personally identifiable information (PII) such as names, email addresses, or IP addresses was collected, thus distributed in anonymous mode.

3. Secondary data (internal documents)

   Internal documents and scientific articles are used to find out about any type of knowledge management systems that are currently put in place. The data includes company sensitive information, challenges, idealizations, and use cases. The internal documents are searched through one of the Big Four companies itself. Therefore, it cannot be shared outside of the organization. No personally identifiable information (PII) such as names, email addresses, or IP addresses was collected.

4. Delphi Study (multiple rounds)

   Considering the Delphi study, multiple rounds are being conducted to collect initial and evaluated thoughts on the artifact. This helps the researcher to improve the artifact, customized for the specific realm of tacit knowledge loss during IT Outsourcing or MSPs. No personally identifiable information (PII) such as names, email addresses, or IP addresses was collected, thus distributed in anonymous mode.

Access rights

The researcher is solely responsible for all primary data and access to the thesis; The thesis supervisor has access without editing rights for validation and guidance purposes. Other individuals besides the researcher and supervisors have no access to raw data, including the organization that provides interview/survey participants.

Data Retention

All raw data such as survey response, interview transcript and secondary data analysis will be kept until the end of the thesis which includes formal evaluation and acceptance. After approval, all the data will be deleted permanently from all storage locations. Only anonymised data will be kept as appendices.

Ethical compliance

The Data Management Plan follows the University of Turku Guidelines for research data management guide for students, click on this link. All participants were informed of consensus and data handling practices procedures prior to participation.

Appendix 2: Survey email request

Hi xxx,

As part of my thesis research, I am conducting a short survey to better understand how XXX is trying to capture tacit knowledge (knowledge that is hard to articulate due to experience and just a "feeling") during any outsourcing, managed service projects, or audits.

XXX is currently out of office and will return on the 23rd. I would like to ask you instead if you could help me by sending this survey to the Technology Risk team on my behalf.

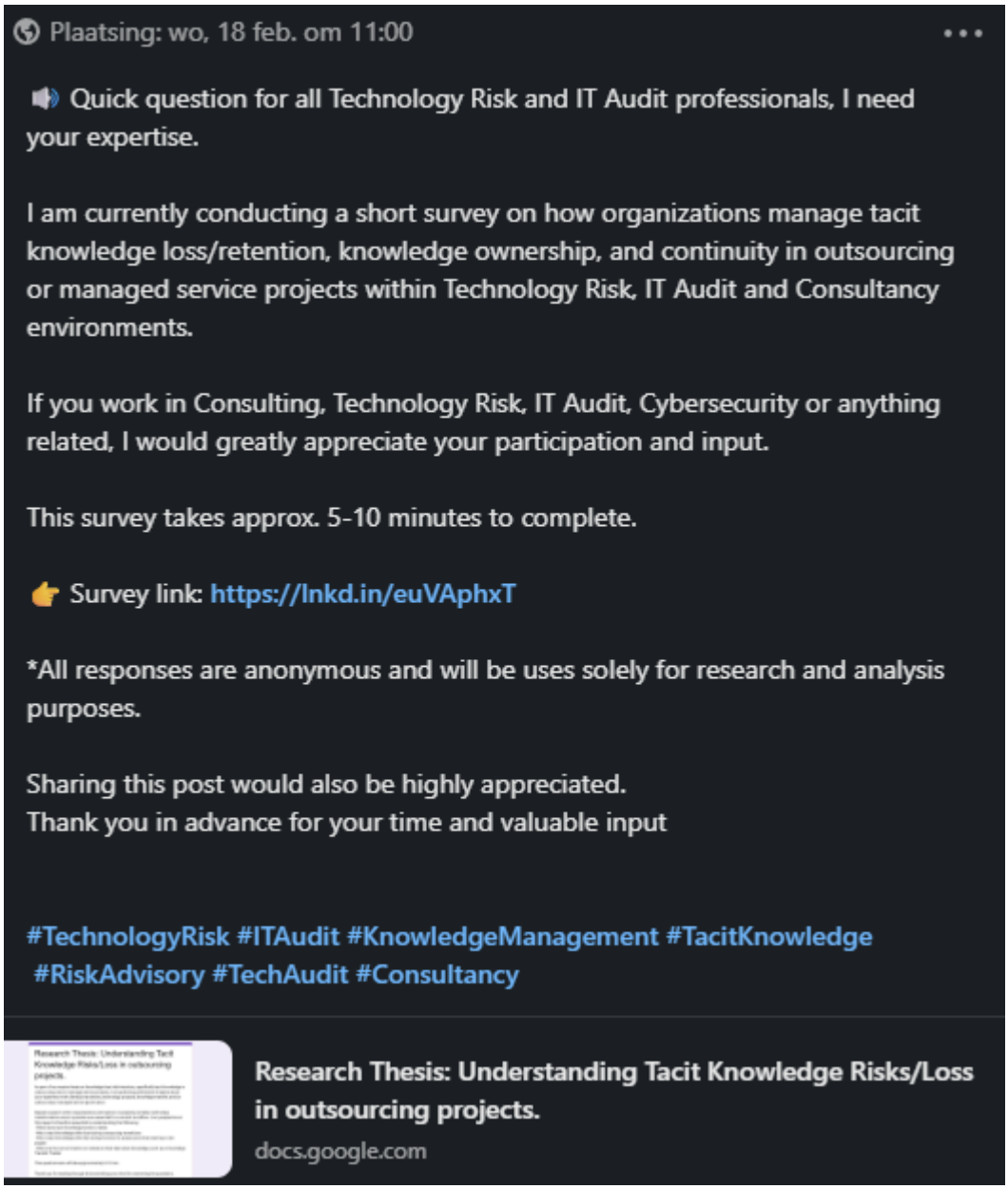
The survey link is included below: Research Thesis: Understanding Tacit Knowledge Risks/Loss in outsourcing projects - Formulier invullen

Thank you in advance for your time and support. If there is anything from you that needs to be addressed, feel free to let me know.

Best Regards,

XXX | Intern

Appendix 3: LinkedIn Post



Appendix 4: Survey Content

Research Thesis: Understanding Tacit Knowledge Risks/Loss in outsourcing projects – Intern

As part of my master's thesis on outsourcing and knowledge loss/risk/retention, I am gathering preliminary insights about your experience with client(s) transitions, technology projects, knowledge transfer, or outsourcing governance.

Tacit knowledge: Tacit knowledge will refer here to skills, ideas, experiences that an individual possesses, but find it hard to articulate, document or transfer to another party. This could be considered professional judgement.

Outsourcing/ managed service: In this survey, the term outsourcing and managed service are any activities that you do at the client side, so client-work

At EY, regular support within organizations and teams in navigating complex technology transformations and/or questions that are essential for a smooth workflow. Your perspective on this regard is therefore essential in understanding the following:

- Where does tacit knowledge tend to reside

- Why is tacit knowledge often lost during outsourcing transitions

- Why is tacit knowledge often lost during the end of a project and a new project

- How does this loss of tacit knowledge contribute to operational risk and vendor lock-in

- What are the current metrics or indicators that help retain knowledge, such as the 'Knowledge Transfer Tracker'.

---

1. Background

What is our current role within the organization

1. Partner
2. Director
3. Senior Manager
4. Manager
5. Senior Staff
6. Staff

Which pillar do you primarily work in/for?

1. Assurance (FAIT)
2. Attestation & Certification

3. Advisory
4. Other

How many years of experience do you have in outsourcing or managed service projects?

1. 0-1
2. 1-3
3. 3-5
4. 5-10
5. 10+
6. None

Have you participated in client projects that has involvement of outsourcing transition?

1. Yes
2. No
3. Maybe

Have you worked in other companies comparable to a Big Four before? You are not required to answer this.

1. Yes
2. No

---

2. Tacit Knowledge & Knowledge Transfer during transitions

The questions below are all related to tacit knowledge transfer during **transitions**. In this context transitions mean the following: "A transition is the structured period during which responsibility, knowledge, systems, and operations are moved from the client organization to the outsourcing vendor (or between vendors, or back in-house)".

Tacit Knowledge is the knowledge that is difficult to articulate, codify, and transfer

How frequently do client teams depend on undocumented knowledge during transitions

1. Never
2. Rarely
3. Often

4. Always

Which type of undocumented knowledge have you observed during client transitions?

1. System workarounds
2. Legacy code insights
3. Troubleshooting steps used in practice, but not documented
4. Role-specific knowledge
5. Business process details
6. I have not observed any undocumented knowledge.

How clearly do clients define knowledge transfer responsibilities at the start of a transition/project

1. Very clear
2. Somewhat clear
3. Neutral
4. Somewhat not clear
5. Not clear
6. Not defined

Which method do CLIENTS use to transfer knowledge? Select multiple options if applicable

1. Shadowing sessions
2. Step-by-step handover sessions
3. Written documentation
4. Recorded demonstrations
5. Workshops
6. Pair troubleshooting
7. I have no Idea
8. Others

Which method do YOU use to transfer knowledge? Select multiple options if applicable

1. Shadowing sessions
2. Step-by-step handover sessions
3. Written documentation
4. Recorded demonstrations
5. Workshops
6. Pair troubleshooting

7. I have no Idea
8. Others

What frameworks/assessments do you use to capture tacit knowledge for any projects. E.g. the account managed framework or the 6-box framework?

How often do you observe incomplete knowledge transfer?

1. Always
2. Often
3. Sometimes
4. Rarely
5. Never

Rate the frequency of the following issues during transitions:

	1 – least frequent	2	3	4	5 – most frequent
Errors due to missing knowledge					
Delays caused by lack of knowledge					
Dependency on a single expert					
Inconsistent procedures after the handover					
Vendor misunderstanding client systems					
Wasted time because of constant clarification					

Is there something else besides the above-mentioned issues during transitions? If yes, please mention from most to least frequently and try to rate it.

---

3. Governance, Risk, and Vendor Lock-in

Vendor lock-in occurs when an organization becomes dependent on the vendor, resulting in switching to another vendor bringing risk, cost and operational disruptiveness.

How well do your clients track ownership of critical IT or Business-process knowledge?

1. Staff/employees leaving before transition is completed
2. Limited documentation
3. Short transitions timeless
4. Insufficient client oversight
5. Vendor unfamiliarity with legacy systems
6. Lack of detailed knowledge ownership
7. I have not observed any knowledge loss during outsourcing transitions.
8. Others

Please explain if you select 'Other'

To what extent does incomplete knowledge transfer increase vendor dependency?

1. Substantial increase
2. Significant increase
3. Moderate increase
4. Slight increase
5. No increase
6. I have no idea.

Which condition create vendor lock-in during transitions? Select multiple options if applicable.

1. Client loses technical knowledge
2. Vendor gains exclusive operational knowledge
3. Legacy system complexity
4. Missing documentation
5. Limited internal technical capabilities
6. None of the above
7. Other

Please list and explain if you select 'other'

How effective are client governance mechanisms in preventing knowledge gaps?

1. Very effective
2. Somewhat effective
3. Neither effective nor ineffective

4. Somewhat ineffective
5. Very ineffective
6. Not used
7. I have no Idea

Measurement and (possible) future solution e.g. Dashboard/ Framework/ Assessment

Currently, there is a knowledge transfer tracker available, please click on the link.

Do you know this exist?

1. Yes
2. No

Have you used this Knowledge Transfer Tracker?

1. Yes
2. No

What do you think about this Knowledge Transfer Tracker?

Which measurements would be most valuable for such a tool? Select multiple options if applicable

1. Knowledge risk score per IT function
2. Rating of undocumented knowledge
3. Vendor dependency score
4. Expert dependency map
5. Transition readiness score
6. Post-transitions stability indicator
7. None of the above
8. Other

Please explain if you select 'other'

What kind of features would support your work for tracking knowledge loss, especially tacit knowledge? Select multiple options if applicable

1. Heatmaps showing knowledge gaps
2. Automated risk assessment
3. Tracking of Knowledge transfer progress
4. Vendor-Client alignment indicators
5. Suggested Mitigation Actions
6. Other

If you choose ‘other’, please explain why this would support your work for tracking tacit knowledge loss.

What are the concerns you will have for using a tacit knowledge measurement tool? Select multiple options if applicable

1. Data accuracy
2. Data availability
3. Client approval
4. Model complexity
5. AI concern
6. Other

Please explain if you select ‘other’

Open Responses

These next questions are open response questions which you can write down anything that you think is important, but have not been mentioned throughout this survey

What challenges do you most often face/see in preserving undocumented knowledge loss?

What steps should organizations take to reduce knowledge loss before the start of a new project?

What features or measurements would strengthen the tacit knowledge framework or dashboard?

Is there anything else that comes up? If yes, please write it down below.

Appendix 5: Consent Form

Consent form for participation in scientific research

Quantifying the Intangible: A Design Science Approach Measuring and Mitigating Tacit Knowledge Loss in IT Outsourcing.

Name: Vincent Leung

Study: International Master in Management of IT (IMMIT) – Triple degree

- Université Aix Marseille
- Turku University
- Tilburg University

Email: vk….ng@gmail.com

Purpose of research - Interview edition

You are invited to an interview for my master thesis about tacit knowledge loss in outsourcing or managed service projects. Prior to this interview, you have filled in a preliminary survey about your experience and pain points. After checking all the survey responses, you are picked out for deeper insights regarding your answers on the survey.

Participation Details:

- ☐ Participation is voluntary
- ☐ The interview will last approximately 45-60 minutes
- ☐ You can withdraw from research at any time, without any negative consequences
- ☐ Your response(s) will be anonymized and kept strictly confidential across all documents and results
- ☐ Personal Identifiable Information (PII) won't be published
- ☐ You give permission to audio record the interview
- ☐ Audio recordings will be used solely for transcription and analysis. After completion, audio recordings will be deleted.
- ☐ A copy of the thesis may be requested upon completion.
- ☐ The thesis will be made publicly available across university (online) libraries

The interviewee declares that:

- ☐ You have read and understood the information about the research
- ☐ You have had the opportunity to ask questions about the research
- ☐ You can voluntarily participate in the research
- ☐ You can withdraw from research at any time, without any negative consequences
- ☐ You give permission to audio record the interview
- ☐ You give permission to process the information they provided
- ☐ You allow us to store the anonymized/pseudonymized data for 5 years.
- ☐ You give consent to participate in this research interview.

Name of Participant: ____

Date: ____

Signature:

Appendix 6: Requirement(s) Table

Category	Requirement	Reason	Traceability – Survey Question + Interview XX
FR 1	The artifact must quantify exposure to undocumented business-process details, role-specific knowledge, workarounds, and troubleshooting heuristics.	Approximately 70-80% of survey respondents reported frequent reliance on undocumented knowledge or so-called professional judgement	Q2, Q10-Q15, A, B, C, D, E, H
FR 2	The artifact must include indicators that measure whether knowledge has been full transferred before, during, and after transitions.	90% of the respondents mention incomplete knowledge transfer	Q13, Q17, Q14, Q15, A, C, D, E, H
FR 3	The artifact must measure the level of expert dependency and highlight critical person-risk	Vendors tend to rely on their own expertise, but an exit strategy is needed to reduce vendor lock-in in case.	Q14, Q23, Q24, A, D, G, H
FR 4	The artifact must compute a vendor-dependency risk score informed by the extent of undocumented knowledge and knowledge transfer gaps	Quantifying this is needed to calculate the weight/score what the risks	Q12, Q20, Q28, A, D, G, H
FR 5	The artifact must incorporate metrics assessing clarity of roles, responsibilities, and knowledge transfer ownership	Assessing the clarity of roles is important to have an understanding of roles and ownership where knowledge can be transferred	Q13, Q21, Q23, A, B, C, D, H
FR 6	The artifact must integrate key indicators into an overall readiness score to inform transition planning and risk assessment	Readiness is important to consider as this shows the organization what its vulnerability is during these transitions.	Q10-Q15, A, D, H
FR 7	The prototype must include at least one visual representation of knowledge gaps or risk levels	The request of visibility tools is needed to remove the effort of reading and just looking at what is at risk	Q29, Q31, A, B, E, F, H
FR 8	The artifact should output concise governance recommendations	Mitigation actions are requested by 30-35% of the respondents to know exactly what to do in specific situations	Q31, Q33, B, F, G
FR 9	The artifact must capture and classify judgement-based tacit knowledge	Professional judgement differs per manager, which impact the efficiency of reporting and decision-making.	Q10-Q14, A, B, C, D, H
NFR 1	The artifact must operate with a limited set of inputs to reduce overstimulation of the practitioner	With too many inputs and indicators, the practitioners don't know what to focus on anymore. It also reduces the data accuracy and availability	Q33, A, C, E, H
NFR 2	The artifact's calculations must be transparent, with simple formulas that can be validated easily.	Indicators and metrics need to stem from reasonable formula's that can be traced back in case it shows wrong KPI's	Q33, B, D, H
NFR 3	The artifact must be easily understandable by practitioners	Assuming all practitioners to know everything is wrong, Therefore, making	Q13, Q15, A, C, E, H

	and usable in knowledge transfer sessions	it as simple as possible is the key to success and adoption	
NFR 4	The artifact must operate using generalized indicators	Like a Risk Assessment, these ratings will indicate the readiness of the tacit knowledge loss retention/transferring/loss.	Q29, Q31, B, C, F, H
DR 1	The artifact must have simple ratings like the Likert-Scale (1-5)	Basic meta data is standardized and easy to filter and to cover what is still left to ask. It also helps to categorize per “engagement group” or “types of reporting”. This makes it easier to find similar ratings if needed for other projects.	Q10-Q15, All Interviews
DR 2	The artifact must have basic meta data such as project, teams, duration	By limiting the option to only Yes/No, it can be filled in quickly without hesitation. Comments will be added for additional information if needed by the practitioner	Q1-Q5, Q20-Q28, C, F, G
DR 3	The artifact must have an option to input Yes/No whether its present or not.		Q18, Q20, Q29, Q31, Q33, A, B, D, E, F, H

Appendix 7: Semi-Structured Interview Draft for evaluating Knowledge Transfer/Retention/ Loss

Pre-Interview preparation

- Test recording equipment and get the Consent form signed.

Introduction Script

Thank you for participating in this research interview. As discussed in the email/ Teams chat, I've

This interview will take between 45-60 minutes. I'd like to record this interview to capture your responses as accurately as possible with your permission. All the information that is being used from the interview will be kept confidential and used only for research purposes.

Interview questions First round

This interview will take around 45-60 minutes and is about knowledge transfer/retention/loss during projects, whether starting a new project or during any phase of the project.

Introduction/ Background/ Role/ Context

1. **Could you describe your current role, responsibilities and typical project involvements, particularly in relation to knowledge-intensive work?**
    a. **What is your day-to-day work?**
    b. **Do you work with clients, vendors or internal teams?**
    c. **How often do you depend on undocumented insights?**
    d. **How long have you been in this role?**
2. **How long have you worked in environments where expert knowledge/ professional judgement is critical? Think of any expertise, and maybe the exposure to environments where "knowing how" matters more than "knowing what".**
3. **What type of knowledge do you feel is most important in your work? Think of knowledge like analytical reasoning, decision heuristics, relationship knowledge, process knowledge, professional judgement and so on…**

Understanding Tacit Knowledge in Practice

Tacit knowledge is knowledge that stems from expertise and "feeling". You can't really document or articulate this, because you just "know it". E.g. speaking your native language without thinking of the grammatical rules or

1. **What does "tacit Knowledge" mean to you in the context of your work? Think of professional judgement, mental models and intuition, workarounds and shortcuts, "knowing what NOT to do"**
2. **Can you give examples of tacit knowledge you or your team rely on every day?**
3. **Which part of your job rely the most on tacit knowledge rather than documented procedures?**
4. **In your experience, why is tacit knowledge hard to articulate or document?**

Knowledge transfer processes

1. **How is knowledge typically passe on within your team or organization?**
2. **Which method do you personally find most effective in transferring tacit knowledge? IF so, can you rank them.**
3. **Can you recall a situation where tacit knowledge was transferred exceptionally well? Why did it work?**
4. **Can you also recall a situation where tacit knowledge failed to transfer. What went wrong?**
5. **Do you think your organization formally recognizes the importance of tacit knowledge? Think of policies, training programs, tools or frameworks, or actual behaviour vs written expectations.**
6. **When a new team member joins, what type of tacit knowledge do you think they struggle with most?**

Barriers to knowledge transfer

1. **What are the biggest obstacles that prevent tacit knowledge from being transferred effectively?**
2. **How does communication style affect tacit knowledge transfer in your team?**
3. **How does organizational culture affect tacit knowledge retention?**
4. **Does remote/hybrid work impact tacit knowledge transfer? If yes, how/why?**

Knowledge retention & Loss

1. **In your experience, when does knowledge loss tend to occur most often?**
2. **Can you recall a concrete example where the loss of tacit knowledge caused problems?**
3. **What types of tacit knowledge are most vulnerable to being lost?**
4. **How well do you think your organization retains critical knowledge when people leave**

Current Tools & Opportunities

1. **What tools, processes, or practices currently exist to capture or retain knowledge? Are they effective?**
2. **What types of tacit knowledge remains uncaptured or "invisible" despite these tools?**
3. **I've seen some Agile in EY Posters, does your team or project use the Agile method? IF so, how does sharing knowledge work when applying Agile in projects for you?**
4. **If you could redesign how your organization handles knowledge transfer or retention, what would you improve?**

Measurement & Future Insights?

1. **Do you think tacit knowledge can be measured or approximated? Why or why not?**
2. **If you had to create some indicators to estimate tacit knowledge levels or risk of loss, what would you include?**
3. **What early-warning signs would tell you that tacit knowledge erosion is happening?**
4. **What do you think if AI is implemented to help capture this tacit knowledge(s)?**

Closing

1. **What advice would you give to an organization that wants to reduce knowledge lost?**
2. **Is there anything we haven't covered that you think is important about tacit knowledge transfer, retention or loss.**

Mention about recording and emailing them the transcribed version of the interview, if needed.

Appendix 8: Interview Summaries

Note, some interview summaries are excluded due to sensitive information

Interview Categories/Themes:

Category/ Themes	Problem	Description	Traceability – Interview XX
Knowledge Ownership & Responsibility	Unclear knowledge transfer responsibilities	Processes are ambiguous, which causes reliance on interpersonal judgement based on roles, responsibilities and ownership instead of structured protocols	A, B, C, H, I
Expert Dependency & Knowledge Density	Single expert dependency, legacy expertise	Most of the dependency is heavily on the individuals (clients, vendors) who are holding on to undocumented heuristics, tribal knowledge or legacy skills. As a result, losing them causes major operational gaps.	A, D, G, I
Vendor-Client Asymmetry	Asymmetry, vendor lock-in, sub-vendor opacity	Vendors usually accumulate an extensive amount of knowledge on operations compared to clients, which creates reliance, limited transparency, delays, and decreased ability to challenge	C, F, G, I
Ineffective Communication & transfer methods	Ineffective interpersonal transfer	Tacit knowledge transfer often happens informally such as verbally, ad-hoc, walkthroughs, unstructured Q&A which results in a shallow understanding of the process or operation	A, C, E, H, I
Inconsistent & Fragmented Knowledge Transfer Practices	Undocumented routines, inconsistent methods	Individuals and teams differ in how transferring knowledge. Routines and workarounds remain undocumented, which leads to the variety of quality.	B, C, E, F, I
Incomplete knowledge transfer across a project lifecycle	Incomplete transfer during transitions or after staff turnover	Knowledge gaps increase during onboarding, transitions, or when staff is leaving without any structured handovers. This leads to errors and extra time to “fix” problems	A, D, H, I
Tacit-Gap Operational Disruptions	Operational issues, caused by tacit knowledge gaps	Errors, delays, clarification cycles, mismatched evidence, and misunderstanding surfaces when tacit knowledge is missing or eroding.	A, B, E, H, I
Legacy Risk & system Fragility	Loss of legacy-system knowledge and shrinking expert pool	COBOL systems depend on aging experts. When these experts leave, critical technical knowledge is disappearing, threatening continuity	G, F
Tooling/ Process Complexity	Overly complex tools, inconsistent guidance from internal systems	Internal methodologies do not capture tacit nuances. It overwhelms new joiners and pushes them to use the “copy and paste” behaviour. AI can help, but it cannot replace judgement	A, C, E, H, I

Interview A

Participant A works in IT Audit, performing execution-level work: carrying out engagements, ensuring quality, results, and planning. Tacit Knowledge is essential for professional judgement, client understanding, audit process details, and practical work methods (PDF tricks, Excel Tricks, Tooling, AI).

Participant A mentioned that tacit knowledge stems from knowing how the client works, experience with previous audits (from the same engagement), understanding the risk and asking the right questions, and understanding how each manager wants documentation structured. Knowledge transfer occurs through TPE during kick-off meetings, and ad hoc support from those who hold tacit knowledge. New team members struggle because expectations are not written down and documentation varies per engagement. Knowledge loss happens mostly during staff turnover, causing inefficiencies and wasted time because other staff needs to take over its work. Tools like OneNote are used for participant A to write down new knowledge. GAP/UADP are standardized documentations which are used, but tacit knowledge remains undocumented. The main reason that employees of a Big Four company need to justify the allocated time for the different engagements.

- **Key Pain Point(s)**

1. Tacit knowledge remains undocumented – Not everything is seen as relevant to document, documentation standards differ per engagement and manager, and expectations are not written down.

2. Lack of time and prioritization – The time for time system leaves little space for tacit knowledge to be transferred, and overdraft takes time that isn't always available due to deadlines.

3. New staff struggle significantly – They must figure out many things themselves, leaving inconsistency in documentation, resulting in confusion.

4. Knowledge loss during transitions – When staff leaves, new staff lose days on tasks that would normally take minutes, and senior knowledge does not transfer effectively.

5. Tools are insufficient – OneNote is person, not standardized. Internal system covers methodology, but not tacit experience. Thus, a practical tool capturing tacit knowledge remains difficult.

Interview B

Participant B is a senior auditor working at a Big Four working mainly with year-end audits, internal controls and AI Governance-related engagements. It requires significant reliance on tacit knowledge, especially when observations must be interpreted beyond documentations. Participant B emphasizes that professional judgement is essentially understanding the processes from the clients and your expectations, especially when documented is incomplete or inconsistent. The real understanding mainly comes from the accumulated experience, interaction with clients, and repeated exposure to these kinds of environments. Tacit knowledge often fills in gaps where documentation or evidence is not sufficient. Participant B gave an example of understanding what "normal" looks like is required prior engagements, pattern recognition, and context built from multiple clients. Outsourcing arrangements usually crates vulnerabilities, such as knowledge gaps that increases when staff at the vendor are changing, acquiring evidence becomes slow, and clients often loses historical context for a smooth audit execution. Additionally, tacit knowledge grows organically through conversations, prior-year comparisons, pattern spotting, and team discussions, but unfortunately disappears during turnover or new joiners that lack foundational understanding.

Lastly, participant B highlights that although documentations templates exist, they do not capture the experiential nuances that auditors depend on. AI tools help to structure these documents, but auditors must remain alert to potential overreliance because it can misinterpret or overly detailed content that needs to be reviewed.

- **Key Pain Point(s)**

    1. Observation-driven auditing is necessary but under-supported – Participant B often must rely on professional judgement or ad-hoc questioning when documented is not enough. Tacit judgement and seasoned pattern recognition isn't captured well currently

    2. Documentation-reality mismatch – Documentation from Clients is sometimes outdated, or not reflective of the 'de facto' process, forcing teams to rely and thus increases the dependency on tacit knowledge to cover the gaps.

    3. Outsourcing created friction in evidence and memory – when a vendor changes (whether as a whole or just a staff member) or team collaboration, evidence retrieval is slow and erodes the institutional memory.

4. Slow, uneven tacit onboarding for new joiners – New staff often lack the tacit layer and need "years" to fully internalize the various methodology and client context. Currently there is no systematic way to transfer this layer effectively.

5. AI helps with structure but not judgement – While AI can help with the overall structure of the document, (professional) judgement is needed to interpret context. Therefore, it remains essential for its work.

6. Reliance on prior documentation is a risk – It's helpful for orientation, but it encourages employees to "copy and paste". You always need to have professional scepticism to detect profess drift and new risks.

Interview C

Participant C just transitioned into a senior role and works with IT controls within financial audits, client process, and coordination audit documentation. A deep process understanding is essential to avoid overreliance on professional judgement. According to participant C, tacit knowledge is created from repeated exposure to client environments, observing how it works in practice, and subtle learning from client-specific behaviours where documentation alone isn't enough, Tacit knowledge insights allows auditors to identify various links across systems, asking the right follow-up questions, and interpret ambiguous evidence more effectively.

He also mentioned that knowledge transfer differs substantially across managers, clients, and teams. Walkthroughs are the foundation of quality because it eliminates a large portion of issues, but on the other hand, poor or outdated walkthrough questions can lead to misinterpretation of risk, and inconsistency. Tacit knowledge loss becomes most visible when teams switch clients or when staff leaves, because they leave undocumented expectations and missing context that is difficult to reconstruct. Tacit knowledge learning happens across project experience, informal questions, and repeated patterns across engagements, but not capture automatically anywhere.

- **Key Pain Point(s)**

1. Missing or outdated process knowledge – When staff rotates or documentation is outdated, they often lack context, leading to incorrect assumptions, inefficient testing, and rework. New client doesn't understand the expectations of auditors from the Big Four.

2. Outsourcing delays and unclear vendor responsibilities – Vendors frequently take extended time to provide simple evidence such as bridging letters. Often it is unclear who at the vendor is responsible, which causes looping communication delays.

3. Inconsistent expectations across managers – Documentations expectations vary significantly between engagement teams and managers. These differences create confusions for staff.

4. High onboarding burden for new staff – New joiners struggle to understanding the documentations. The lack of tacit knowledge increases dependency on seniors, who spend time mentoring.

5. Tool Complexity and Cognitive Overload – Internal tools for auditors are detailed and difficult to navigate and often provides literal or irrelevant guidance. AI tools now will help to simplify this methodology, but it requires manual interpretation.

6. Tacit Knowledge not transferred effectively when switching – When changing clients or engagements, team loses knowledge about expectations, context, and client-specific nuances. It might lead to repeated errors and inefficiencies that could have been avoided with proper transfer.

Interview D

Participant D works at a Big Four across SOC reporting, ISAE3402/IC reporting, and IT components of financial audits and begun contributing to advisory projects that are focused on implementing IT control frameworks. He emphasizes that professional judgement is the core of audit work and developed primarily through exposure to many different environments, rather than training. The internal audit methodology does not fully cover the variety of client-specific configurations, expectations and behaviours encountered across real-life settings. Tacit knowledge is crucial with tasks like determining sampling/population, assessing the effectiveness of a design, reading between lines, and identifying control gaps. It is often client-specific, specifically for niche systems. Fortunately, when there is a long-term engagement relationship leaving, this knowledge does not exist anymore, which causes confusion, onboarding delays, testing errors, and increased rework. Tacit knowledge transfer rarely happens systematically. Documentation structure, expectations and methodology interpretation differs across managers, which leaves new joiners confused what “good” looks like. Walkthroughs are the most important steps in for an IT Audit process. When walkthroughs are done poorly, teams become copy machines (reusing prior-year files without understanding the underlying risks). Thus, this weakens the professional scepticism. Overall, time pressure during busy

seasons further limits the opportunities for proper knowledge transfer. The heavy workload that managers often face rely on speed more than education. So, a direct answer is usually faster than explaining its reasoning. As a result, the new owners are unable to learn properly and tacit knowledge surfaces across engagements. Lastly, Participant D mentioned that AI must be complementary but not replace its professional judgement.

- **Key Pain Point(s)**

1. Loss of client-specific Tacit knowledge During Staff Turnover – When seniors/managers with a lot of experience including unwritten routines, control nuances, and context of client relationships, this tends to disappear. Therefore, the slow onboarding, errors during testing (sampling/population) and reword causes problems because no structured handover is available.

2. Inconsistent expectations and documentation quality across managers – Documentation structure, depth, and interpretation of methodology vary across managers, which increases confusion and repeated rework for staff.

3. Overreliance on prior-year files – Instead of reassessing risks, teams rely sometimes too much on prior-year documentation, which leads to shallow reasoning, wrong sampling or design conclusions, and lower quality in terms of comments

4. Walkthroughs are essential for quality – To have quality work, walkthrough are essential for understanding design and evidence logic. When one is rushing or is being too superficial, misinterpretation will resurface later, which creates repetitive mistakes.

5. Busy-season time pressure limits tacit knowledge transfer – The high workload drives managers to provide quick answers instead of explaining their judgement logic. This slows down the development of a new joiner.

Interview E

Participant E is a staff-level auditor at a Big Four who works primarily on IT General Controls (ITGC) testing, application controls, and audit execution within financial statement audits. The daily work/routine require extensive reliance on professional judgement because client evidence is frequently incomplete, inconsistent, or provided in formats that are misaligned with the methodology. Tacit knowledge becomes essential whenever auditors interpret unusual situations, evaluating unclear documentation, or determine any other sufficient evidence. Knowledge transfer usually happens

through walkthrough sessions, shadowing, manager feedback, and information Q&A. However, expectations vary across managers, so it's difficult what is "good". Busy season pressure intensifies this problem, because seniors and managers often lack the time to explain in more detail. Tacit knowledge becomes eroded and visible with the repeated review comments on documentations such as errors across engagements and delays caused on arrangements of complicated evidence retrieval.

Outsourced systems and MSP environments further increase the tacit knowledge challenge. Usually, evidence is circling around third-party service providers. Because of this, client's understanding of the operation becomes limited, and communication tends to be delayed because auditors require to rely on informal experience-based heuristics rather than documentation. While AI could be potentially a tool for summarizing review comments and retrieving methodology more efficiently, human judgement remains irreplaceable because it can't capture nuances that are tied to client history nor relationships.

- **Key Pain Point(s)**

1. Incomplete or Inconsistent client documentations – Evidence that is provided from the clients often is missing, unclear or not updated after system or process changes. This forces Auditors to rely heavily on tacit knowledge determining what happens in practice.

2. Variability in manager expectations and documentation standards – Preferred way of transferring knowledge and format of documentations varies across managers. Inconsistency creates confusion for new joiners, creating inefficiencies and (possibly) repeated work

3. Busy Season workload reduced capacity for knowledge transfer – During peak audit periods, high pressures arise which limits one-on-one coaching and explanation. This results in staff frequently repeating the same error in testing logic, population definition and documentation quality.

4. Outsourced environments cause evidence delays and knowledge gaps – Evidence is delayed or incomplete when clients rely on service providers in which clients often lack understanding the systems. Auditors unfortunately must compensate with professional judgement due to this knowledge gap between client and vendor.

5. Tacit knowledge remains undocumented – While insights, explanations, and heuristics are transferred through informal methods such as shadowing, walkthroughs, shadowing, or Q&A.

these are rarely captured nor documented. As a result, repeated explanation is needed, especially when staff are rotating between projects.

Interview F

Participant F is an IT Risk consultant for SME's and spans his work around risk management, cybersecurity, internal audit and advisory engagements. Unlike the Big Four companies, participant F comes as a hybrid consultant with a small focus on MSPs, offering insights how clients, vendors and outsourcing service providers contribute to tacit knowledge gaps. Documentation quality is the main foundation of a good governance, yet in practice documentation is missing, outdated or mismatched. Organization relies heavily on assumptions, interpretations, and experiential tuition, particularly when it comes down to outsourcing transitions. Tacit knowledge is essential to connect what is described formally with reality. The differences between terminology, maturity levels, and communication patterns often create misalignment, especially when multiple vendors or sub-vendors are being involved. Participant F personally encountered these situations where clients are unaware of it, which introduces knowledge asymmetry that clients rarely notice until a failure or audit occurs.

How knowledge is being transferred depends heavily on the organizational culture and supervisor style. Some clients use structured walkthroughs and shadowing, while others use informal discussions and ad-hoc. Junior staff often struggle with it due to the lack of tacit understanding of context, rationale, or historical decisions. Participant F explains further that tacit knowledge is especially vulnerable when IT managers are leaving, creating a gap in undocumented insights from architecture, incident history, or workarounds. While AI can help with tacit knowledge discovery, it is not a tool to replace it, purely as support. AI and NLP can summarize meetings, detect recurring patterns, interpret themes across evidence sets, and structure informational overload. However, AI must always be validated by humans, because tacit knowledge/ reasoning is about ethical considerations and situational context, which cannot and should not be fully automated.

- **Key Pain Point(s)**

1. Lack of transparency into vendor/ sub-vendor dependencies – Clients frequently do not know which sub-vendor handle operations, leaving clients in a blind spot during transitions

2. Documentation gaps and mismatched process description – Documentation for key processes, responsibilities, and data flows are not present or outdated, which forces consultants to rely on tacit interpretation and assumptions

3. Inconsistent knowledge transfer practices and communication – Organizations use various methods to transfer knowledge, which results in uneven onboarding and frequent misalignment of expectations.

4. Tacit knowledge loss when domain expert leave – Specialist leaving an organization leaves clients with instant losses, such as historical decisions, workarounds, and contextual knowledge

5. Outsourcing creates process friction and slows understanding – Vendors often respond slowly to requests, whereas clients frequently lack insight into how outsourced systems work, creating knowledge asymmetry.

Interview G

Participant G is a Partner at a Big Four, who is responsible for IT Audit, Data & Digital Audit enablement and AI competency initiatives. The role of a partner is more on a strategic, ecosystem-level perspective on how organizations lose tacit knowledge during IT outsourcing and MSP transitions. Years of outsourcing caused many organizations to lose the ability to operate their own infrastructure, and as vendors operational knowledge is being accumulated while clients lose theirs. Participant G distinguishes explicitly between documented knowledge and tacit technical knowledge and argues that the latter to the be the most fragile form of knowledge and the first to disappear when outsourcing takes place. Clients rarely document the practical "how it really works" because it's learned through exposure and vendors generally don't share these types of knowledge unless asked for explicitly. Even if asked, it is often incomplete.

Vendor staff turnover is a major, underestimated risk, because the client instantly loses customer-specific tacit knowledge about their integration, customizations, or edge-case configurations. The same risk applies for the decline of legacy experts, especially when it comes down to financial systems using COBOL. As workforce ages, the systemic single point of failure increases exponentially. Without continuous retention mechanisms, clients are becoming fully dependent on vendors for any problem-solving and understanding the system. The increased issue of vendor lock-in due the tacit knowledge from the vendor's side, especially with large cloud providers such as azure, google cloud, aws, etc. The exit strategies exist often on paper, but it is not operationally realistic. Organizations underestimate the deeply embedded vendor-specific tacit knowledge across all cycles of the project. Frameworks such as DORA and NIS2 indirectly require organizations to assess tacit knowledge risk through dependency mapping, impact assessment, and critical vendor analysis. In the

eyes of participant F, AI can be seen as a potential enabler capturing tacit knowledge during project discussions, retrospectives, and meetings with both clients and vendors or auditors. AI must remain an assistant, not a replacement for human reasoning, especially when interpreting becomes critical.

- **Key Pain Point(s)**

1. Loss of internal technical capability due to long-term outsourcing – When clients are having their business unit(s) outsourced, the internal know-how starts to erode. If the outsourcer leaves the organization, the organization will not be able to run or troubleshoot their own infrastructure, resulting in loss of autonomy.

2. Tacit technical knowledge is undocumented and thus fragile – Critical knowledge about system behaviour such as error patterns, undocumented limitations, integration tricks, etc are rarely documented and tends to disappear quickly when vendor staff rotate/leave.

3. Vendor lock-in and dependency risks are underestimated – Clients underestimate how dependent they are on cloud providers and MSPs. Theoretical exit strategies are present, but not tested, which limits the ability strategic flexibility of the organization

4. Legacy systems expertise is dense and shrinking – Environments that are created with COBOL are dependent on aging experts. If these experts are leaving, the risk of continuity becomes prominent. Currently organizations lack to plan capturing or transferring this knowledge before it vanishes.

5. Lack of transparency and resistance from vendors – Vendors resist recording, transcription or AI-assisted analysis, which blocks the opportunities to capture tacit insights during stand-ups, retrospectives, and troubleshooting sessions.

Interview H

Participant H is a Senior at a Big Four with five years of experience across Financial Audit IT, Advisory, and Attestation/Certification and works mainly on various ITGC, cybersecurity, and internal control engagements. With a background in business administration and digital business allows participant H to approach IT Risk as interconnected processes, where tacit knowledge is the practical foundation of decision making. Professional judgement is used almost daily because auditors constantly encounter situations where documentation is incomplete, ambiguous, or not comparable towards what happens in practice. Tacit knowledge is deeply embedded in risk assessments, document review, interpreting client evidence, and client relationship management. The team relies

heavily on Participant H to understand the client's "real" processes beyond what is written. The operational, client-specific knowledge is only and solely learned through experience. Such as how controls truly operate, which issues recur, where risk hotpots are, etc.

Across outsourced environment, assurance reports from service providers are often used without genuine scrutiny. Teams often fall back to "prior-year reliance", assuming if something was accepted last year, it must be valid. This is a risk as outsourced processes change rather quickly. Participant H experience a Partner correcting him for not reading the service provider reports deeply enough, showing how experience and tacit judgement are passed down informally rather than clear documentation. Tacit knowledge loss is especially visible when people are leaving, when seniors are gone, replacements often lack context about client process, control behaviour, and vendor interaction. Even when documents exit, they often lack tacit process knowledge require to perform the work. It forces new joiners to make assumptions or finish work quickly without understanding the risk that implies. According to Participant H, handovers are often limited to email with pending tasks.

Participant H noticed within MSPs and Outsourced processes, that turnover also leads to tacit loss, affecting the service quality. Advisory work where vendor expertise is heavily dependent on, reminding that this concerns the continuity and effectiveness of control. Knowledge gaps become apparent when something goes wrong and the missing tacit understanding is being exposed if outsourced processes are not run smoothly. A mix of shadowing, walkthroughs, coaching, live client interaction, and ad-hoc Q&A are being used by participant H but differ widely in style. Time pressure also pushes seniors to delegate quickly and except fast learning, making tacit transfer inconsistent. Participant H is optimistic about AI-assisted transcription and pattern retrieval, which can prevent repeated questions and create a usable knowledge base. Still, information can give the wrong picture, maybe because the data is outdated that can mislead auditors. Clients mostly accept recordings, but service providers often resist being recorded and therefore limits tacit-knowledge capture.

- **Key Pain Point(s)**

    1. Tacit knowledge loss during staff turnover – When employees leave, new team members lack context about client processes, control behaviour, and vendor interaction. Thus, existing documents do not cover tacit elements, leading to assumptions.

    2. Overreliance on prior-year documentation – Teams often assume outsourced processes and controls are unchanged, but this is not the case. This leads to a shallow understanding and weak professional scepticism when evaluating

3. Missing or incomplete handovers – staff leaving usually provide a short list of tasks, but tacit knowledge is not included. It forces new members to relearn these through trial-and-error

4. Knowledge asymmetry and dependency on outsourced environments – Whether outsourced controls truly operate as expected depends on vendor turnover, consistency MSP staffing, and transparency. Knowledge gaps only surface when incidents are happening and tacit understanding is required.

5. Inconsistent knowledge transfer practices and time pressure – Knowledge transfer methods vary across managers. Combined with the time pressure during busy season leads to uneven tacit knowledge development and increased repeated mistakes and clarification cycles.

Interview I

Participant I is a Product Manager for cloud solutions at a Telecommunication Company in France, working closely with R&D, Sales, and customers. The core responsibilities are developing cloud features, supporting the sales team, and ensuring customers receive the best possible service and experience. Being deeply involved in the Proof of Concept (PoC) phase, evaluating whether their newly established software solved problems for the client, and guiding product development relies heavily on deep telecommunication expertise, understanding household network behaviours, and applying "gut feeling" to diagnose issues during implementation. As a product manager, tacit knowledge plays a big role, as the ability to analyse household networks without all the metrics available relies on intuition and pattern recognition from experience. Knowledge transfer within the team is mostly ad-hoc due to immediate needs. As of this moment, they don't have a structured expectation to document tacit knowledge, because the managers don't do it themselves and so others are not obliged to do it. Attempts to creating tutorials or documentations were unsuccessful due to the lack of engagement and distrust early stage.

Knowledge sharing stems mainly from informal discussions, case-based meetings and troubleshooting sessions. Tacit knowledge required only when mistakes are made, reflecting it as learnings. Documentations do exist, although it does not capture the interpretative reasoning required for the specific diagnosis. Tacit knowledge becomes visible though through repeated questions, unclear explanations towards customers, and inconsistent problem-solving outcomes. Participant I does not believe that tacit knowledge is quantifiable and stated "you don't know what you know" that stems from Polanyi's view.

On the operational side, responsibilities differ per deployment. Overall, SaaS issues remain at the vendor, while hardware issues are organizational problems. SLAs are planned but not yet implemented and the PoC calculations are unclear at this time. This is because the new software is "new" and so they are testing it on customer now. The participant's work depends a lot on expertise and judgement, which are critical elements to tacit knowledge.

- **Key Pain Points**

1. Tacit knowledge is not documented – Managers do not document their knowledge, so employees don't feel obliged to do so as well. Documentation is reused but lacks depth. Tried to create tutorials but failed due to resistance.

2. Knowledge transfer is ad-hoc and inconsistent – teaching occurs only when needed and it depends on who is available. But no structure exists in the process

3. Experience and "gut feeling" dominate decision-making – Expertise is built through mistakes and intuition, thus difficult to articulate or document.

4. Repeated questions and inconsistent client explanations – The tacit knowledge gaps become visible when staff repeats their questions or fails to explain the software to the clients.

5. Low trust and limited engagement in early document efforts – A lack of clarity who owns the issues and how PoC performance should be interpreted. This increases the dependency on tacit expert judgement.

Appendix 9: Delphi Study Round(s)

9.1 Delphi Study – Round 1 (Type – ~~Scenario-building Panel~~/ Survey)

Tacit Knowledge Loss Quantification Model (TKLQM) Round 1- Master Thesis

I am currently conducting my Master's Thesis Research on tacit knowledge loss during IT outsourcing and/or Managed Service Provider (MSP) transitions. Tacit Knowledge refers to experience-based know-how (undocumented routines, professional judgement, and problem-solving heuristics), which is difficult to formalize/document/articulate but critical for operational continuity. This research addresses the following question: "To what extent can an artifact quantify tacit knowledge loss in IT outsourcing and Managed Service Providers and help reduce vendor lock-in?" To (try) to answer this, I am developing a Tacit Knowledge Loss Quantification Model (TKLQM), which comparable to a risk assessment (threat x impact). I need your expert validation in order for me to get validated indicators that help quantify this model. To do this, I am conducting a Delphi Study which consist of at least 2 rounds for evaluation and fine-tuning the model.

Round 1: Rating the importance per indicator + open feedback
Round 2: Feedback summary with median rating from round 1 + re-rating
Round 3: TBD

Purpose: This Delphi Study aims to validate a model for accessing tacit knowledge transfer quality during IT-outsourcing or MSP transitions. The model consist of indicators that capture behavioural, relational, experiential, and knowledge-stabilization aspects of transfer quality.

Your Role: You have been selected based on your experience in:
- IT Audit/ Technology Risk- IT Outsourcing Operations
- Managed Service Transitions- Client/Vendor Governance
Your role is to evaluate the relevance, importance, and help ensure that the model is reliable, relevant, and practically applicable.

Confidentiality:
All responses are anonymized. No individual names or organizations will be reported.

Time Required:
10-15min.

Definitions + Universal Indicator Ratings

Tacit Knowledge: Knowledge that is experiential, judgement-based, difficult to articulate or document, often embedded in routines, workarounds, and expert intuition

Transition Phase: A period where responsibility, operations, and knowledge shifts between client <-> vendor or vendor <-> vendor

Indicators:

Signals that approximate tacit knowledge loss (e.g. undocumented routines, expert dependency, incomplete knowledge transfer)

The indicators are as followed:

- Undocumented Knowledge Dependency (UKD)
- Knowledge Transfer Responsibility Ambiguity (KTRA)
- Errors/ Delays due to Missing Knowledge (EMK)
- Single Expert Dependency (DSE)
- Vendor misunderstanding Client Systems (VMCS)
- Knowledge Ownership Weakness (KOTW)
- Incomplete Knowledge Transfer (IKTF)
- Vendor Lock-in Conditions (VLC)
- Inconsistent Procedures (ICON)
- Time Wasted on Clarification (CLAR)

Instructions:

In this section, you will rate how important each indicator is for estimating tacit knowledge loss during outsourcing or MSP transitions.

These indicators apply to all stakeholder groups.

1. Which domain best described your role?

- IT Audit/ Technology Risk
- IT Outsourcer/ Managed Service Provider (MSP)
- Client-side IT Management/ IT Owner

2. Undocumented Knowledge Dependency

Statements	Not important	Low Importance	Slightly Important	Neutral	Fairly Important	Very Important	Extremely Important
Teams rely on unwritten procedures							
Teams rely on workarounds							
Teams rely on tacit expertise							
Lack of clarity about who owns knowledge transfer							
Incidents, rework, or failures caused by missing tacit knowledge							
Critical reliance on one or two key individuals							
Vendor lacks client-specific tacit understanding							

No clear ownership of process knowledge							
Handover gaps across phases (pre/during/post)							
Knowledge asymmetry leads to dependency							
Teams interpret procedures differently after handover							
Repetitive clarification due to missing context							

3. **Optional: Please briefly explain your rating in 1 or 2 sentences**

Indicators – IT Auditors/ Assurance

4. **Please rate the importance of the statements below**

Statements	Not important	Low Importance	Slightly Important	Neutral	Fairly Important	Very Important	Extremely Important
In IT Audits of outsourced or MSP-supported environments, auditors often need to rely heavily on professional judgement because documentation and evidence are incomplete, unclear, or not fully aligned with practice.							
There is frequently a significant gap between the documented and the actual way outsourced or MSP-supported processes operate, which increases reliance on tacit knowledge during auditing.							
The quality and depth of process walkthroughs (including ITGC/ITAC walkthroughs) strongly influence whether tacit knowledge about outsourced, or MSP-supported processes is captured or lost.							
Limited transparency from vendors or MSP (slow responses, restricted access, unclear responsibilities) makes it harder for auditors to understand tacit aspects of the outsourced environment and increases tacit knowledge risk.							
Repeated or recurring review comments on similar documentation or testing steps across previous years or engagements indicate underlying tacit knowledge gaps in how outsourced/MSP environments are understood and documented.							
Unclear ownership of knowledge transfer responsibilities between client, vendor, and internal teams often leads to gaps in audit evidence, inconsistent explanations, and increased reliance on auditor professional judgement.							

5. **Optional: Please briefly explain your rating in 1 or 2 sentences**

Indicators – For IT Outsourcing/ MSP operational leads/employees

6. **Please rate the importance of the statements below**

Statements	Not important	Low Importance	Slightly Important	Neutral	Fairly Important	Very Important	Extremely Important
In daily operations (incidents, changes, problem management), engineers rely heavily on informal troubleshooting heuristics and "tricks" that are not fully documented but are critical for service continuity.							
Cross-team handoffs (between functional and technical teams) often depend on informal, tacit routines, and personal relationships rather than fully specified procedures.							
Effective support of legacy or complex environments (e.g. old ERP landscapes, custom integrations) depends strongly on tacit familiarity built over time, rather than purely on written documentation.							
When part of the service is delivered by sub-vendor or subcontractors, critical operational knowledge often becomes transparent to both the main MSP and the client, increasing tacit knowledge risk.							
Over time, a large share of critical tacit knowledge about the client's systems, workarounds, and operational heuristics accumulates on the MSP/vendor side and is not effectively transferred back.							
There is often no clear ownership for maintaining, updating, and transferring operational knowledge back to the client, which increases long-term dependency on the MSP.							

7. Optional: please briefly explain your rating in 1 or 2 sentences

Indicators – Client-side IT Managers

8. Please rate the importance of the statements below:

Statements	Not important	Low Importance	Slightly Important	Neutral	Fairly Important	Very Important	Extremely Important
When IT services are outsourced or managed by MSPs, the internal team's ability to understand, absorb, and apply new technical and process knowledge tends to decline over time.							

Insufficient scoping and preparation of the transition (unclear knowledge transfer objectives, lack of defined roles, incomplete inventories) is a major driver of tacit knowledge loss.							
The departure of key internal staff leads to the loss of historical system knowledge (critical decision-making, workarounds, incident history), which is rarely fully documented.							
Governance models often do not clearly assign ownership for critical process and system knowledge (responsible for maintaining, updating, and transferring) which increases tacit knowledge risk.							
Over time, the client becomes so dependent on vendor/MSP expertise that internal teams can no longer adequately access, challenge, or replace the vendor, which is a sign of tacit knowledge erosion and vendor lock-in							
Vendor lock-in is typically not caused by a single issue, but emerges over time as undocumented knowledge, expert dependency, and incomplete knowledge transfer accumulate.							

9. **Optional: please briefly explain your rating in 1 or 2 sentences.**

Open-ended Questions.

In this final section, you can provide open feedback on which indicators matter most, which may be missing, and how the model could be refined.

This qualitative input is essential for improving the Tacit Knowledge Loss Quantification Model (TKLQM).

Indicators + Importance:

Signals that approximate tacit knowledge loss (e.g. undocumented routines, expert dependency, incomplete knowledge transfer) + The preliminarily importance

The indicators are as followed:

- Undocumented Knowledge Dependency (UKD) | **High Importance**
- Knowledge Transfer Responsibility Ambiguity (KTRA) | **High Importance**
- Errors/ Delays due to Missing Knowledge (EMK) | **Medium Importance**
- Single Expert Dependency (DSE) | **High Importance**
- Vendor misunderstanding Client Systems (VMCS) | **Low Importance**

- Knowledge Ownership Weakness (KOTW) | **High Importance**
- Incomplete Knowledge Transfer (IKTF) | **High Importance**
- Vendor Lock-in Conditions (VLC) | **Medium Importance**
- Inconsistent Procedures (ICON) | **Medium Importance**
- Time Wasted on Clarification (CLAR) | **Low Importance**

1. Do these relative importance levels broadly align with your professional judgement during any IT outsourcing/ Managed Service provider/ Service organization project?

   Yes/ Mostly Yes/ Mostly No/ No

2. Which indicator do you consider most critical, and are there any indicators you would rate higher/lower, and why?

3. Are any important indicators missing?

4. Are there indicators that should be removed/merged?

5. Any additional comments regarding the clarity, completeness, or practical applicability of the indicators?

9.3 Delphi Study – Round 3 (Type – Scenario-building Panel/ ~~Survey~~)[17]

Please read the scenario carefully.
Treat it as if this were a real engagement you are responsible for.
Based only on the situation described, complete the TKLQM Excel assessment as you normally would in practice

GROUP 1 — IT AUDITORS

Story A1: "The Control That Still Exists on Paper"

Sofia is a senior IT auditor assigned to the interim audit of **Valeris Insurance**, a mid-sized European insurer subject to regulatory oversight and outsourcing guidelines. Six months earlier, Valeris outsourced the majority of its infrastructure and application operations to a large, well-known Managed Service Provider (MSP). The outsourcing transition was formally closed, the contracts were signed, and service reporting had already begun.

From a documentation perspective, the transition appears mature. The incident management process is formally documented, aligned with ITIL practices, and embedded into the MSP's ticketing system. The control description states that all incidents must be logged, categorized by severity, escalated according to predefined thresholds, and resolved within SLA timelines. Responsibility for execution is contractually assigned to the MSP, while accountability formally remains with Valeris.

[17] The Stories are created with Co-Pilot and validated with a Senior Manager.

During the walkthrough, the MSP engineer confidently demonstrates the incident management tool. Sofia observes that tickets are timestamped, severity levels are assigned, and SLA clocks are visible. On the surface, the control design and execution appear compliant.

To test operational reality, Sofia asks a follow-up question that goes beyond the checklist: **"Can you show me a concrete example of a major incident where escalation was required — and explain why escalation happened at that specific moment?"**

The MSP engineer pauses. After searching the system, he selects an incident from three weeks earlier involving intermittent system instability. The ticket shows that escalation occurred quickly and resolution time was well within SLA. However, when Sofia asks what *triggered* the escalation — which metric crossed the threshold, or which predefined condition was met — the explanation becomes less precise.

The engineer explains that the issue "felt similar" to a past incident and that escalation was initiated based on experience rather than a documented rule. With further probing, it becomes clear that this pattern recognition came from a former in-house engineer at Valeris who had deep historical knowledge of the system. That engineer participated informally during the transition phase but left the organization shortly afterward. His escalation heuristics were never formally documented, nor embedded into the MSP's procedures or tooling.

Later that day, Sofia interviews Valeris's internal IT manager. Off the record, he admits that while the MSP is formally responsible, internal staff still occasionally engage in informal calls to "sense-check" incidents. These conversations are not logged, not governed, and not auditable. The IT manager acknowledges that escalation decisions still depend on shared understanding that no longer has a clear owner.

As Sofia documents her findings, she realizes that the incident management control technically exists, is executed, and produces evidence. Yet its **effectiveness depends on undocumented experiential knowledge**, informal judgment, and personal memory that sit outside formal ownership. The control works but only as long as the right people are still reachable.

Story A2: "The Walkthrough That Depends on Who Is Present"

At **Orion Bank**, the year-end audit focuses on IT change management following the outsourcing of infrastructure operations to an MSP eighteen months earlier. The audit team schedules multiple walkthroughs to understand how standard and emergency changes are handled in practice.

During the first walkthrough, the client's former change lead — now acting as an internal liaison — participates alongside the MSP. He explains the documented process clearly but also adds important nuance. For example, when emergency changes occur late at night, informal pre-approval checks often happen via phone or chat before formal authorization is logged. These checks are not documented but are described as "how we avoid bad surprises."

Two days later, the audit team conducts a second walkthrough with a different group: MSP representatives only, without the client liaison present. This time, the explanation is strictly procedural. Emergency changes follow the documented steps exactly. When the auditors ask whether informal checks or exceptions ever occur, the response is firm:

"If it's not in the process, it doesn't happen."

The audit team now has two walkthroughs for the *same control*, both plausible, both internally consistent — yet fundamentally different. When asked which version reflects reality, both parties agree that the documented process is correct but also concede that practice sometimes diverges under pressure.

No one can clearly explain: How often do these informal steps occur, Who authorizes them, Whether they are consistent across teams, Or who is responsible for ensuring alignment with the documented process

The auditors notice that the **quality of audit evidence fluctuates depending on who attends the meeting**. When tacit knowledge holders are present, the process appears nuanced but fragile. When they are absent, the process appears clean but possibly incomplete.

As the team finalizes its working papers, it becomes clear that the control design is stable, but **control operation depends on unevenly distributed tacit understanding**. The walkthrough outcome is not determined by the process — but by the people in the room.

GROUP 2 — IT OUTSOURCERS / MANAGED SERVICE PROVIDERS

Story B1: "We Followed the Runbook—And Still Failed"

Daniel is the service delivery manager at an MSP that recently took over IT operations for a large logistics company. The transition phase lasted three months and included documentation handover, access provisioning, and formal escalation lists. The go-live milestone was declared successful.

Three weeks later, a recurring system slowdown escalates into a major incident. Daniel's team follows the incident runbook precisely: monitoring alerts are acknowledged, diagnostics are executed, and remediation steps are applied. The system stabilizes — temporarily.

Within days, the issue reappears. Again, the team executes the same documented steps with the same outcome. Each incident is resolved within SLA, yet the root cause remains unclear.

During the third incident call, the client's former senior engineer, now working in a governance role joins the discussion. After listening briefly, she suggests investigating a rarely used integration point that behaves differently during month-end processing. This dependency is not mentioned anywhere in the documentation.

She explains that years ago, the team learned through repeated failures that this integration becomes unstable under specific timing conditions. It was never documented because it was considered "obvious" to those who had experienced it.

Daniel realizes that his team is operating correctly but **without the intuition to recognize early warning signals**. The MSP technically owns the service, but operational confidence still resides with individuals who are no longer part of daily operations.

Over time, Daniel notices a pattern: incidents are resolved, but understanding does not deepen. His team depends on ad-hoc clarifications from people who no longer formally own the service. The service appears stable on paper — but remains fragile in practice.

Story B2: "The Rotation Problem"

At **NovaCloud Services**, staff rotation is a standard operational practice. Engineers are regularly moved between client accounts to balance workload, prevent burnout, and support career

development. From a management perspective, this rotation is considered low risk because every client account has extensive documentation, standardized runbooks, and shared tooling.

Julia is assigned as the new lead engineer for a healthcare client whose infrastructure NovaCloud has managed for over three years. The client environment is considered stable and compliant, and the handover is formally completed in one week. Julia receives a detailed handover package containing architecture diagrams, incident procedures, escalation thresholds, and a list of known issues. No major risks are highlighted.

On her first on-call shift, Julia receives an alert indicating abnormal but still "within threshold" system behaviour. The dashboards show no breach of documented escalation criteria. Based on the runbook, she classifies the alert as low severity and continues monitoring.

Approximately one hour later, the system crashes, causing a service disruption that affects patient scheduling systems. During the incident call, senior engineers join and resolve the issue quickly. However, during the post-incident review, a key insight emerges.

Previous engineers explain that the system often shows subtle early-warning patterns that are *not* reflected in the metrics. These patterns were recognized through repeated exposure to similar incidents over the years. When these patterns appeared, engineers would proactively intervene — even if thresholds were not technically breached.

These heuristics were never documented. They were considered "obvious" by the team members who had worked on the environment for a long time. Over successive rotations, this experiential understanding was informally passed along in conversations — but never systematically transferred or validated.

Julia realizes that despite receiving complete documentation, she was **operating without the tacit context needed to interpret signals correctly**. The system did not fail because procedures were ignored — it failed because procedures alone were insufficient.

From NovaCloud's perspective, the service remains contractually compliant. SLAs are met, documentation exists, and incident reports are complete. Yet operational maturity never fully stabilizes. Each rotation slightly resets the team's understanding, forcing relearning through failure rather than prevention.

The client, meanwhile, perceives the service as increasingly person-dependent. Confidence in "the team" subtly shifts toward confidence in "specific individuals," increasing long-term dependency and operational risk for both parties.

GROUP 3 — CLIENTS (USERS OF MSP SERVICES)

Story C1: "We Outsourced the Work, Not the Understanding"

Martin is the CIO of a multinational retail company that outsourced its IT operations to a Managed Service Provider two years ago. The decision was driven by cost predictability, access to specialized skills, and pressure to modernize legacy systems. From a governance perspective, the outsourcing arrangement is considered successful: uptime is high, SLAs are met, and monthly performance reports are delivered consistently.

During the first major incident review following a system outage, Martin joins a post-incident meeting with the MSP. The incident report is thorough. Timelines are clear, actions are logged, and resolution steps align precisely with the agreed procedures.

When Martin asks whether alternative solutions were considered during the incident, the response is confident but narrow:

"The response followed the agreed runbook and escalation process."

Martin probes further, asking whether the root cause points to a deeper architectural issue or whether similar incidents might recur. Again, the response refers back to procedure compliance rather than contextual assessment. Martin notices something unsettling. While the MSP explains *what* was done, no one discusses *why* certain decisions were preferable given the company's specific business cycles, customer behaviour, or operational priorities. Before outsourcing, these discussions would have involved internal debate, trade-offs, and experience-based judgment.

Over time, Martin realizes that his internal IT team no longer has enough hands-on exposure to challenge the MSP meaningfully. They understand the reports but not the operational nuances behind them. Questions are raised less frequently, not because everything is clear — but because no one feels confident enough to challenge decisions grounded in "technical correctness."

Gradually, decision authority shifts. The MSP controls not only execution but interpretation. Governance meetings become shorter, and discussions increasingly end with "this is the standard approach."

Martin recognizes that knowledge has not disappeared abruptly. Instead, **understanding has slowly migrated outward**, reducing the organization's ability to assess risk, question assumptions, or evaluate alternatives. The company outsourced the work — but unintentionally outsourced its operational understanding as well.

Story C2: "The Last Person Who Knows"

Eva is responsible for IT governance at a manufacturing firm that outsourced its infrastructure and application landscape two years ago. The outsourcing transition was completed successfully, and most of the internal IT operations team was phased out shortly afterward. Only one senior architect remained, retained to ensure continuity and act as a liaison between the business and the MSP.

Over time, Eva notices a recurring pattern in governance meetings. Whenever complex issues arise — performance degradation, architectural changes, or integration failures — discussions naturally turn toward this architect. Stakeholders wait for his assessment before decisions are made. When he is unavailable, meetings are postponed or outcomes are deferred.

On paper, documentation exists. Architecture diagrams, process descriptions, and historical incident logs are stored in shared repositories. Yet during discussions, it becomes clear that many critical decisions made in the past were driven by contextual constraints that are not captured anywhere: why certain shortcuts were taken, which tradeoffs were accepted, and which risks were deliberately tolerated.

The architect provides this context from memory. He explains not just *what* the system looks like, but *why* it evolved that way. The MSP relies heavily on his explanations to understand edge cases and legacy behavior.

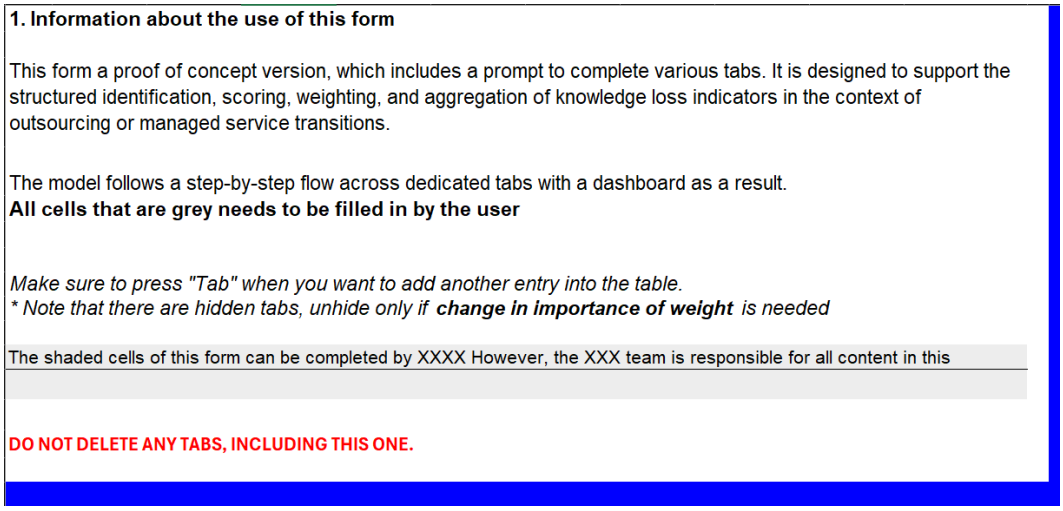
When the architect announces his intention to retire within the year, Eva becomes concerned. There is no clear plan to transfer his experiential understanding. Documentation reviews reveal that while technical details are recorded, the reasoning behind decisions is missing.

Eva realizes that the organization's operational understanding lives largely in conversations rather than systems. The outsourcing contract defines responsibilities and SLAs, but it does not account for the loss of historical judgment embedded in individuals.

As retirement approaches, governance meetings become increasingly cautious. Decisions are delayed, and risk tolerance decreases — not because systems changed, but because the organization is losing its last internal source of contextual confidence.

Appendix 10: Dashboard Screenshots

Tab 1 Readme:



1. Information about the use of this form

This form a proof of concept version, which includes a prompt to complete various tabs. It is designed to support the structured identification, scoring, weighting, and aggregation of knowledge loss indicators in the context of outsourcing or managed service transitions.

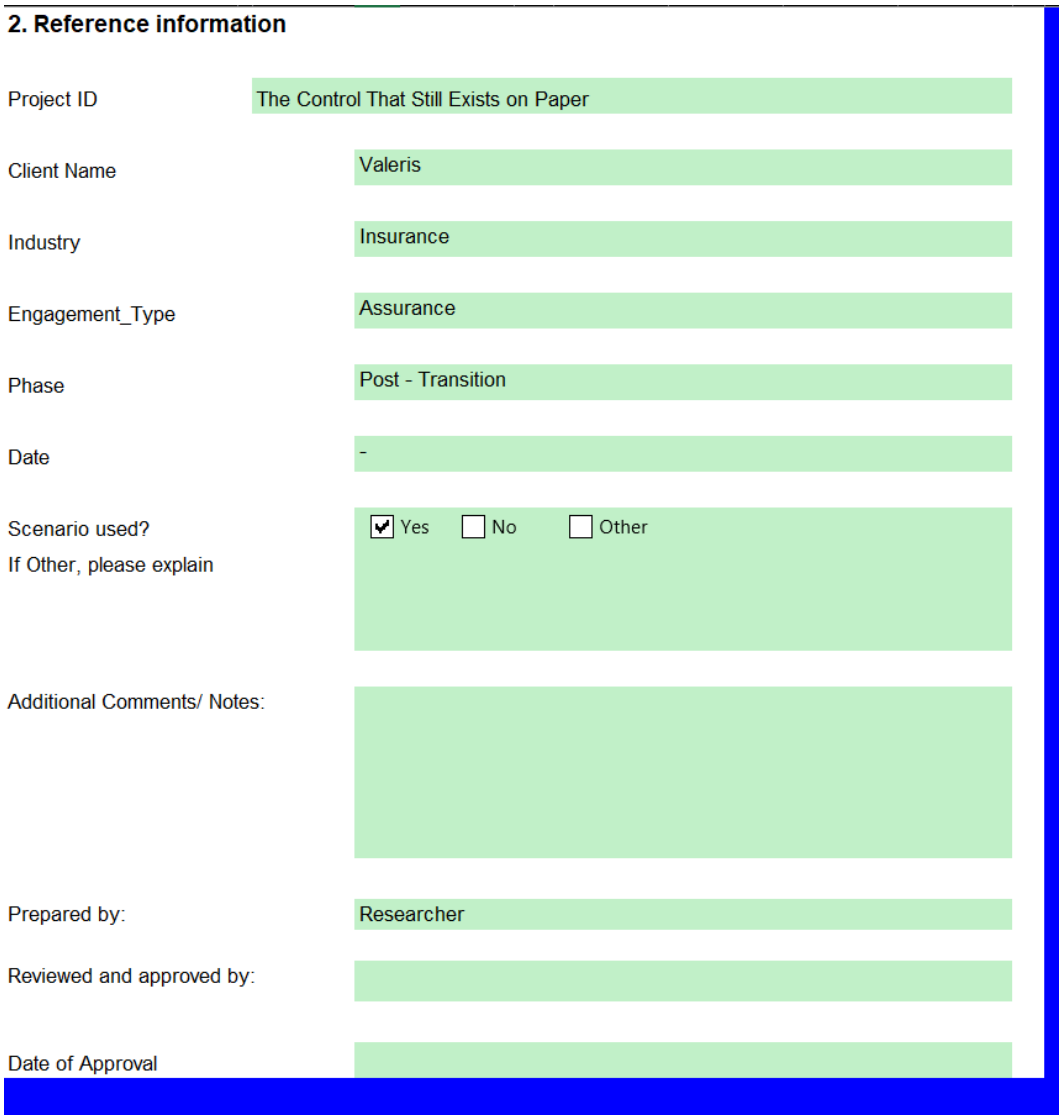
The model follows a step-by-step flow across dedicated tabs with a dashboard as a result.
All cells that are grey needs to be filled in by the user

Make sure to press "Tab" when you want to add another entry into the table.
** Note that there are hidden tabs, unhide only if **change in importance of weight** is needed*

The shaded cells of this form can be completed by XXXX However, the XXX team is responsible for all content in this

DO NOT DELETE ANY TABS, INCLUDING THIS ONE.

Tab 2 Project_Information



2. Reference information

Project ID	The Control That Still Exists on Paper
Client Name	Valeris
Industry	Insurance
Engagement_Type	Assurance
Phase	Post - Transition
Date	-
Scenario used?	☑ Yes ☐ No ☐ Other
If Other, please explain	
Additional Comments/ Notes:	
Prepared by:	Researcher
Reviewed and approved by:	
Date of Approval	

Tab 3. Indicator Input

3. Report Importance per Knowledge Loss Indicator

In the grey boxes below, please rate how prominent this indicator is within the process. Note that the rating are different based on the description. Rate 1 = Not Significant Rate 5 = Significant

(I) Text of report qualifications, if any (II) Additional comments, if any

Insert additional rows as needed by pressing on 'TAB' at Column K, Row 18...

	Name	Description	Min Rating	Max Rating	Base Rating	Normalized Si (Base)	Risk Level	Notes:
UKD	Undocumented Knowledge Dependence	The extent to which teams rely on undocumented routines, workarounds, and experiential know-how to perform daily operations during IT outsourcing or MSP transitions. This includes reliance on tacit expertise that is not formally captured in procedures, documentation, or knowledge repositories, making operations vulnerable when individuals leave or roles changes.	1	5	4,00	0,75	***Significant***	
KTRA	Knowledge Transfer Responsibility Ambiguity	The degree of unclear or undefined ownership for knowledge transfer activities between client, vendor, and internal teams. High ambiguity exists when roles, responsibilities, and accountability for transferring, maintaining, and updating knowledge are not formally assigned, leading to gaps, inconsistent handovers, and reliance on informal judgement.	1	5	3,00	0,50	***Slightly Significant***	
EMK	Errors due to Missing Knowledge	The frequency and impact of operational errors, rework, or delays that occur because required tacit knowledge is missing, incomplete, or unavailable. This indicator captures the observable consequences of tacit knowledge erosion, such as incorrect execution, misinterpretation of procedures, or failure to resolve incidents efficiently.	1	5	4,00	0,75	***Significant***	
DSE	Dependency on Single Expert	The extent to which critical processes, systems, or decisions depend on one or a small number of individuals who hold unique, experience-based knowledge/ High dependency indicates a concentration of tacit knowledge in individuals rather than in transferable organizational structures, increasing vulnerability during staff turnover or outsourcing	1	5	3,00	0,50	***Slightly Significant***	
VMCS	Vendor misunderstanding Client Systems	The degree to which vendors or MSPs lack sufficient client-specific tacit understanding of systems, processes, and operational context. This includes misunderstandings of legacy environments, undocumented configurations, historical decisions, or system behaviour that are not fully captured in formal documentation.	1	5	2,00	0,25	***Not Significant***	
KOTW	Knowledge Ownership Weakness	The lack of clearly assigned ownership for critical process(es) and system knowledge within the organization. Weak ownership exists when no individual or role is responsible for maintaining, updating, validating, and transferring knowledge, resulting in fragmented documentation, outdated information, and gradual erosion of organizational memory	1	5	4,00	0,75	***Significant***	
IKTF	Incomplete Knowledge Transfer Frequency	The frequency with which knowledge transfer activities during outsourcing or MSP transitions are incomplete, rushed, or superficial. This includes missing context, insufficient handovers, limited shadowing, or lack of post-transition validation, leading to persistent knolwedge gaps across transition phases (pre-, during, and post-transition)	1	5	4,00	0,75	***Significant***	
VLC	Vendor lock-in Condition	The extent to which accumulated tacit knowledge asymmetry between vendor and client creates dependency that limits the client's ability to challenge, replace, or disengage from the vendor. Vendor lock-in emerges gradually as undocumented knowledge, expert dependency, and incomplete knowledge transfer compound over time.	0	1	0,45	0,45	***Not Significant***	
ICON	Inconsistent Procedures after	The degree to which procedures are interpreted or executed inconsistently after knowledge handover or transition. This occurs when teams rely on local routines, personal interpretations, or tacit assumptions rather than shared and stabilized practices, resulting in variability in executing quality and control the effectiveness.	1	5	3,00	0,50	***Slightly Significant***	
KLD	Knowledge Loss Drivers	Underlying structural and organizational factors that accelerate tacit knowledge erosion, such as staff turnover, time pressure, poor scoping, insufficient preparation, lack of reflection or post-project reviews, and limited absorptive capacity. These drivers influence how quickly and severly tacit knowledge is lost before, during and after transitions.	0	1	0,38	0,38	***Not Significant***	
CLAR	Wasted Time due to clarification	The amount of time lost due to repeated clarification, follow-up questions, and re-explanation caused by missing context or undocumented tacit knowledge. High levels indicate inefficient knowledge transfer and serve as a practical signal of tacit knowlege gaps affecting daily operations.	1	5	2,67	0,42	***Not Significant***	

Insert additional rows as needed.

[1] Formula for Si: **(Ri-Rmin)/(Rmax-Rmin)**

[2] The Threshold whether an indicator is considered Slgihtly Significant >=0.5 and Significant if >0.60

Tab 4. Weights Indicator

4. Report Weight per Knowledge Loss Indicator[1]

Assign value (10–100%) to reflect the importance of each indicator (Wi)

(I) Text of report qualifications, if any	(II) Additional comments, if any

ID	Name	Weight / Importance	Notes
UKD	Undocumented Knowledge Dependence	70%	
KTRA	Knowledge Transfer Responsibility Ambiguity	70%	
EMK	Errors due to Missing Knowledge	65%	
DSE	Dependency on Single Expert	100%	
VMCS	Vendor misunderstanding Client Systems	20%	
KOTW	Knowledge Ownership Weakness	85%	
IKTF	Incomplete Knowledge Transfer Frequency	95%	
VLC	Vendor lock-in Condition	65%	
ICON	Inconsistent Procedures after	50%	
KLD	Knowledge Loss Drivers	50%	
CLAR	Wasted Time due to clarification	45%	

Insert additional rows as needed.

[1] The weights can be adjusted according to the requirements and needs of the project and/or process.

Tab 5 TKL Calculation

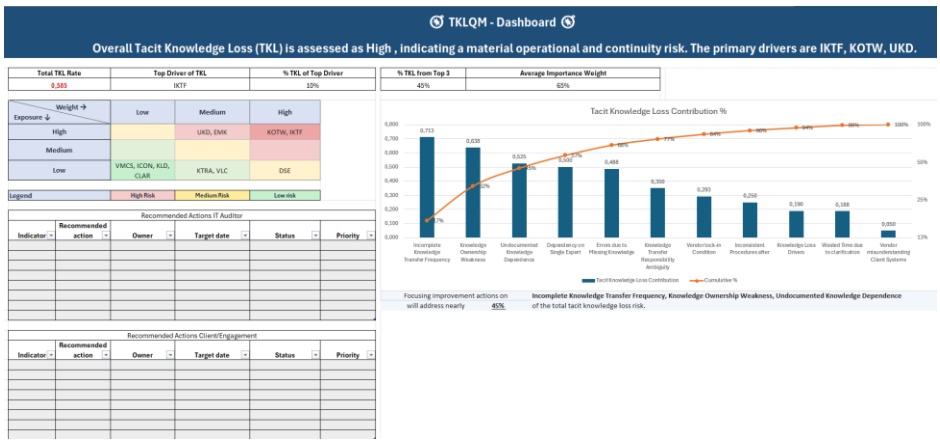
5. TKL Calculation Table

Formula for TKL = ***Si x Wi***

ID	Name	Normalized Si (Base) - Exposure	Wi - Weights	Tacit Knowledge Loss Contribution
UKD	Undocumented Knowledge Dependence	0,75	10%	*0,073*
KTRA	Knowledge Transfer Responsibility Ambiguity	0,50	10%	*0,049*
EMK	Errors due to Missing Knowledge	0,75	9%	*0,068*
DSE	Dependency on Single Expert	0,50	14%	*0,070*
VMCS	Vendor misunderstanding Client Systems	0,25	3%	*0,007*
KOTW	Knowledge Ownership Weakness	0,75	12%	*0,089*
IKTF	Incomplete Knowledge Transfer Frequency	0,75	13%	*0,100*
VLC	Vendor lock-in Condition	0,45	9%	*0,041*
ICON	Inconsistent Procedures after	0,50	7%	*0,035*
KLD	Knowledge Loss Drivers	0,38	7%	*0,027*
CLAR	Wasted Time due to clarification	0,42	6%	*0,026*

[1] The ID's will be automatically added

Tab 6 TKLQM Dashboard



Appendix 11: Use of Generative AI Tools

11.1 Technology Statement

The usage of generative AI tools will be described below for the development of the thesis. The AI tools are solely used to support writing and editing academically and searching for scientific articles. Creativity, critical thinking, data interpretation, drafting overall layout and survey creation are solely done by the researcher of this thesis.

During the preparation of this work, Vincent Leung used Co-Pilot Premium to review and analyse text generation. The following parts of the thesis were affected/generated by AI tool usage: Introduction, Literature Review, Research methodology, Artifact Design, Evaluation & Findings, Discussions, and Limitations. After using this tool/service, Vincent Leung evaluated the validity of the tool's outputs, including the sources that generative AI tools have used, and edited the content as needed. As a consequence, Vincent Leung will take full responsibility for the content of the work.

11.2 Logbook for the Usage of AI Tools

Introduction

Research Stage:	Writing the Introduction
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to improve clarity, structure, reduce redundancy, and improve readability across the introduction sections.
Critical Reflection or Responsible Usage:	I read the sections where AI showed improvements and critically reviewed and manually edited to ensure it shows flow and alignments with my intended research scope. All the arguments, sentences and structure remain the researcher's own wording to ensure full ownership of the content.

Literature Review

Research Stage:	Literature review
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to brainstorm, used keywords to search for (possible) literature that would've been of added. Keywords used are tacit knowledge, SECI, knowledge loss, outsourcing risk, MSP knowledge.
Critical Reflection or Responsible Usage:	Based on these first few keywords, I used more as I read through the Literature by focusing first on the Abstract, Introduction, Result, Discussion/Conclusion. If I find them relevant for my research, I will add them to the list to make time to read the article by itself to make sure it is really relevant. I checked the literature on

	Websites scholar.google.com for example to make sure AI gave me the correct articles. I also made sure it was peer-reviewed.

Methodology

Research Stage:	Methodology Development
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to structure the methodology a bit better so that it aligns chronologically and to make sure it reads easier while the academic tone was kept.
Critical Reflection or Responsible Usage:	I used AI to see if there is a link where Design Science Research methodology could be combined with something else to make sure that my research was relevant practically and useable during testing to have validated answers from experts. The decision on the methodology was checked with the researchers' own research direction. I was ensuring the direction of the methodology was aligning with previous similar papers found on scholar.google.com to ensure it was the appropriate to use

Artifact Design

Research Stage:	Artifact Design
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to think on what kind of (possible) formulas would be useful to have for the TKLQM. I also refined the wording and enhances the readability in an academic tone.
Critical Reflection or Responsible Usage:	AI created the formulas for me. I checked whether the formulas were appropriate to use and see if they would fit the overall TKLQM. I only used the formulas that felt are of added value and are simplified instead of long and difficult formulas.

Evaluations & Findings

Research Stage:	Evaluations & Findings
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to summarize the interviews and to categorize the various problems based on a list that the researcher itself created.
Critical Reflection or Responsible Usage:	After the recording of the interview, I used CoPilot to summarize this for me. With a fresh mind and being able to remember the overall interview, I was able to critically assess whether the summary was correct and whether the categories are correctly done. I made sure that the summary or categories were unbiased from AI.

Limitations

Research Stage:	Limitations
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to change the tone of my writing to a more academic way and concisely written where it is needed.
Critical Reflection or Responsible Usage:	I read the sections where AI showed improvements and critically reviewed and manually edited to ensure it shows flow and alignments. AI rephrases my limitations part more academically and double checked whether no hallucinations were generated. All the arguments, sentences and structure remain the researcher's own wording to ensure full ownership of the content.

Conclusion

Research Stage:	Conclusion
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company to check if the conclusion I have written aligns with the main points from the overall thesis.
Critical Reflection or Responsible Usage:	Using AI, I recreated some sentences that felt out of place by making it more concise and academic. I used my own written conclusion and checked with the AI see what sentences were highlighted. After the highlighted sentences, I critically reviewed to check whether it aligns with my own overall conclusion.

General writing support

Research Stage:	Evaluations & Findings
Purpose of AI Use and Tool Used:	I used Microsoft CoPilot from my internship company occasionally for grammar checking, reducing all redundancy, shorten some paragraphs, restructuring sentences and improve readability across sections. More importantly, using CoPilot to make sure the flow from chapters are smooth.
Critical Reflection or Responsible Usage:	All AI-assisted changes were reviewed and manually edited. No large sections/paragraphs/chapters were automatically generated and copy pasted. It all remains the content of the researchers' original work. I made sure to adhere to the academic guidance of Tilburg University and University of Turku for rigor and quality.