Effective capture and reuse of knowledge between projects

An exploratory study

PRADEEPTHI THIMMAPA

"How can previously captured knowledge be reused in current and future projects?"

AN EXPLORATORY STUDY

Authored by

PRADEEPTHI THIMMAPA

Master of Science in Construction Management and Engineering

Delft University of Technology at the Faculty of Civil Engineering and Geosciences

CME2000 Master Thesis

November 2023

Graduation Committee

Committee Chair: Prof. Dr. Hans L.M. Bakker

Faculty of Civil Engineering and Geosciences

Department of Materials, Mechanics, Management & Design (3Md)

Section of Integral Design and Management

Email: h.l.m.bakker@tudelft.nl

First Supervisor: Magchiel van Os

Department of Materials, Mechanics, Management & Design (3Md)

Faculty of Civil Engineering and Geosciences

Email: m.vanos-1@tudelft.nl

Second Supervisor: Dr. Ir. J.S.J. Koolwijk

Faculty of Architecture and the Built Environment

Department of Management in the Built Environment

Email: j.s.j.koolwijk@tudelft.nl

Company Supervisor: Niels van 't Oever

Project Manager/Architect, Project Management & Consultancy, Multinationals

Royal Haskoning DHV

Email: niels.van.t.oever@rhdhv.com

List of abbreviations

BPM – Business Process Mapping

I&B – Industry and Buildings

KM – Knowledge Management

PM&C AG – Project Management and Consultancy Advisory Group

PM – Project Manager

RHDHV – Royal Haskoning DHV

Preface

This thesis marks the culmination of my 2 year journey in the Masters of Construction Management and Engineering course at TU Delft. I came to the Netherlands in 2021 as a wide-eyed girl with no idea how to go about living by myself. But the last 2 years and especially the thesis duration has transformed me into a self-assured adult, for which I must thank some wonderful people.

I am ever grateful to my TU Delft graduation committee for their unwavering support. To Magchiel, my first supervisor – I am thankful not only for his sharp insights but also for his kindness and empathy as a mentor. I owe a debt of gratitude to Jelle, my second supervisor – he has been the voice of reason at every milestone and I can confidently say that my report would be nowhere close to what it is today, without his guidance. Lastly, to Prof. Hans Bakker, the committee's chair – I am grateful for his straightforward feedback, his endless patience, and commitment to reading every word I wrote in each draft – I consider it a privilege to have collaborated with an academic of his stature.

To Niels, my supervisor at RHDHV – I cannot begin to thank him enough for bringing me into RHDHV, and helping me navigate everything from interviews, documents, and the research itself. He was my soundboard throughout the thesis and I am extremely grateful for his support. I am also thankful to all the interview participants at RHDHV, for being generous with their time and knowledge.

To my wonderful CME friends: Mrinal, Likitha, Shivam, and Rohith – thank you for the laughs, the shoulders to cry on, and the solid advice. To Sana and Bablu – thank you for being my home away from home. To Anju – thank you for being my rock through the highs and lows.

This thesis brought on some of the most turbulent times in my life so far and my family was and continues to be my biggest source of strength through it all. To my parents, Thriveni and Srinivasulu Reddy, and my sister Prashanti – I hope I've made you guys proud. This one's for you, *Amma, Nanna, and Minnu*!

Lastly, to you – the reader, thank you for deeming my thesis worthy of your time. Happy reading!

Executive summary

Introduction

Contemporary project-based organizations are increasingly recognizing the importance of learning from past projects to achieve competitive success (Chronéer & Backlund, 2015). Leveraging knowledge from previous projects can lead to time savings, reduced design revisions, improved project quality, and enhanced collaboration (Zhang & Li, 2016). Although sharing knowledge has been shown to boost an organization's financial performance, challenges persist in capturing and reusing knowledge effectively.

Research has identified a gap in understanding how knowledge is reused in project-based organizations and the role of social interactions in this process (Yap et al., 2021; Bakker et al., 2011; Bartsch et al., 2013). This research addresses this gap by identifying drivers and barriers to knowledge reuse and exploring the relationship between social interactions, knowledge capture, and reuse.

The main research question is:

"How can previously captured knowledge be reused in current and future projects?"

To answer this, the research will investigate the current state of knowledge capture and reuse, key drivers and barriers, and strategies to promote knowledge reuse.

Methodology

The research was conducted in collaboration with the engineering consultancy firm Royal Haskoning DHV (RHDHV), which offers various services across diverse sectors. The study employed a qualitative approach, including a literature review, semi-structured interviews with practitioners at RHDHV, and a case study.

The case study focused on RHDHV's knowledge reuse practices and explored how knowledge is shared and applied within the organization. Interviews with project managers, discipline leads, senior management, and the corporate QHSE manager provided insights into the organization's knowledge reuse processes. Data collected from documents, literature, and interviews was studied using a thematic analysis, and identifying common themes to address the research questions.

Results

The research findings reveal key insights into knowledge reuse and learning within organizations. Collaboration emerges as an effective means of reusing knowledge and driving continuous learning, with key stakeholders playing the role of "co-creators" in the process. Team interactions between junior and senior professionals, characterized by mutual respect and a willingness to learn, promote knowledge exchange.

The study highlights the importance of collaboration, and effective communication, as they facilitate seamless knowledge sharing. The research also emphasizes the impact of cultural

factors on knowledge sharing and reuse, as close collaboration can enhance cross-project learning. Furthermore, it is concluded knowledge is primarily shared through interactions among individuals and underlines the role of personal networks in identifying the right people for knowledge capture. Trust, interpersonal relationships, and social interactions are fundamental to effective knowledge-sharing and learning.

In addition, learning on the job is a significant source of knowledge creation, emphasizing the value of actively using knowledge in project-specific contexts. Lessons learned sessions, however, tend to be reactive and unstructured, indicating the need for a more systematic and proactive approach to capturing and sharing knowledge.

Based on the drivers and barriers to knowledge reuse in projects, identified from the case study and interviews, driving principles are developed for promoting knowledge reuse and learning. They are – ownership, personal network, collaboration, proactive learning, social interactions, and trust. These principles can help organizations overcome barriers such as lack of motivation, resistance to change, information overload, issues of transferability due to project context, time constraints, lack of awareness, absence of learning goals, and lack of standardization.

Practical advice for executives

Executives aiming to maximize knowledge reuse within their organization can initiate several actionable steps. First, they should establish a comprehensive database cataloguing completed/ongoing projects, based on scope, phase, and other relevant categories. Encouraging project managers to tap into networks of experienced counterparts to gather insights, document discussions, synthesize these insights with internal resources, and actively share these findings within their teams can significantly enhance knowledge reuse. Regular reviews, active communication with knowledge sources, and phase-wise "lessons learned" sessions can foster a culture of continuous learning and facilitate the reuse of past knowledge across projects. Though challenging, adapting this process to fit project schedules can prevent failures and lead to repeated successes.

Moreover, executives can strengthen Communities of Practice (CoPs) by aligning learning objectives with strategic organizational goals. Encouraging collaborative learning within CoPs, breaking knowledge silos by promoting cross-departmental collaboration, and monitoring their progress using defined metrics aligning with broader organizational objectives can significantly strengthen knowledge reuse. Lastly, establishing a centralized knowledge repository, implementing structured evaluation processes, and assigning dedicated personnel to maintain these systems ensure the seamless storage, retrieval, and relevance of lessons learned, promoting continuous improvement and knowledge reuse.

Limitations and scope for future research

This research has several limitations that should be considered. It focuses on project-based organizations without specifying a particular industry, potentially leading to inconsistencies in understanding industry-specific characteristics. The findings are based on a single case study with a limited sample of interviews, restricting their generalizability. Encouraging the replication of this study across various contexts or industries could validate and enhance the

relevance of its findings. The research acknowledges the role of leadership in fostering a learning culture but lacks details on leadership responsibilities and strategies. The influence of technology on knowledge reuse is not included, and the applicability of guiding principles to smaller organizations is not addressed.

These limitations can serve as the foundation for further studies. Future research can explore the impact of knowledge reuse on cost and schedule management, validate the guiding principles empirically, and extend the focus to different industries like safety and healthcare. This would help address the limitations and provide a more comprehensive understanding of knowledge reuse and learning mechanisms.

Table of contents

List of figures

List of tables

Chapter 1 Introduction

This chapter sets the stage for this MSc. thesis. It begins by establishing the research background and identifying the research problem, highlighting the existing knowledge gap. The primary research question is also introduced within the context in which the research will take place. Additionally, a reading guide will be presented to assist readers in navigating the research material.

1.1 Setting the scene

In contemporary project-based organizations, the significance of learning from projects is growing steadily to attain competitive success. By leveraging the lessons learned from previous and ongoing projects, organisations can benefit from managing learning within and across projects effectively. Therefore, it is important for organizations, to proactively allocate resources and establish mechanisms to manage and promote learning from previous projects (Chronéer & Backlund, 2015).

According to Zhang & Li (2016), reusing previously captured project knowledge offers several advantages. For example, it can lead to time savings in the design phase and reduce the need for design revisions. Additionally, previous projects can serve as valuable references for similar projects, ultimately improving the quality of project deliverables. Moreover, according to Kamara et al. (2003), “live capture and reuse” of knowledge has the potential to enhance the efficiency of managing successive project phases. They also emphasize that it can improve planning and foster inter-organizational collaboration by sharing lessons learned from previous phases or projects.

Numerous studies have shown that knowledge sharing is essential for improving an organization's financial performance (Collins & Smith, 2006; Rezaei, et al., 2017). Increased profitability, a larger market share, and a stronger return on investment are all advantages of knowledge sharing. Wang & Wang (2012) reinforce this claim by demonstrating that sharing tacit knowledge enhances both financial and operational performance. Although explicit knowledge sharing largely improves financial performance, it needs to be in line with internal organizational systems to produce good performance results.

Organizations have dedicated significant resources, both in terms of money and personnel, to develop repositories that store project information. These repositories essentially give people access to knowledge that can be used in other projects. However, different individuals have varying knowledge needs, and these repositories often lack the structure to accommodate these differences. Markus (2001) pointed out that successful knowledge reuse requires addressing the “costs” of creating effective repositories and databases and providing “incentives” to knowledge contributors. Hence, there is a necessity to systematically organize and streamline effective endeavours to leverage captured knowledge for future use.

1.2 Research problem

Due to the transient nature of projects, team members often split away once a project is over and regroup only to solve problems anew instead of drawing on previous project learnings (Scarbrough et al., 2004). Consequently, the conclusion of a project signifies the end of collective learning, and the team members either transition to new projects or reintegrate into their respective line functions. Schindler & Eppler (2003) argue that consequently, "organizational amnesia" sets in if their specific knowledge from that project is not immediately required. This indicates a missed opportunity to enhance organizational performance between consecutive projects.

Research shows that the most common activity associated with project-based learning within an organization is reflecting on the experiences after a project is finished. These reflective sessions are known by various names like "lessons learned sessions", "project reviews", and "project postmortems". The findings of these sessions are documented in an organization-wide database where future project teams can access them (Julian, 2008). This activity is done with the expectation that knowledge will be shared across projects and that "reinventing the wheel" can be prevented. The burden on employees to complete projects on time and within budget restricts their ability to dedicate effort to sharing previously gained knowledge and experiences. Consequently, valuable knowledge and lessons learned are dispersed and left uncaptured, creating barriers to learning and utilizing knowledge in future projects (Sergeeva & Duryan, 2021).

1.3 Research gap

Existing literature predominantly studies the effectiveness of KM processes (Sun et al., 2019; Bigliardi et al., 2014), tools, and techniques (Poleacovschi et al., 2019; Yap & Lock, 2017). Limited research has been conducted on learning scenarios and project knowledge that can be reused. Furthermore, a significant part of new knowledge generated in learning scenarios is tacit i.e., cannot be articulated, and is embedded in social exchanges between individuals (Yap et al., 2021).

In their study, Paver & Duffield (2019) draw attention to a significant issue within organizations: the failure to learn from past mistakes, despite the abundance of research on lessons learned models and their application (Schindler & Eppler, 2003). They further argue that this challenge is exacerbated by the lack of consensus on its theoretical foundation, primarily due to the multi-disciplinary nature of knowledge management. Moreover, research studies have highlighted that applying captured knowledge remains an enduring challenge for many organizations (Wiewiora et al., 2020; Bakker et al., 2011; Bartsch et al., 2013).

As a result, a research gap exists regarding the reusability of knowledge within project-based organizations. This research aims to address the gap by identifying potential drivers and barriers to knowledge reuse within organizations, and prescribing ways to overcome them.

1.4 Research question

To achieve the research aim, this thesis attempts to answer the following main research question:

"How can previously captured knowledge be reused in current and future projects?"

The research question has been broken down into smaller, more focused questions that are meant to be answered sequentially. The answers to these questions will eventually help answer the main research question:

1. What is the current state of capturing and re-using knowledge in projects?
2. What are the key drivers and barriers to effectively reusing captured knowledge?
3. How can knowledge reuse be promoted in projects?

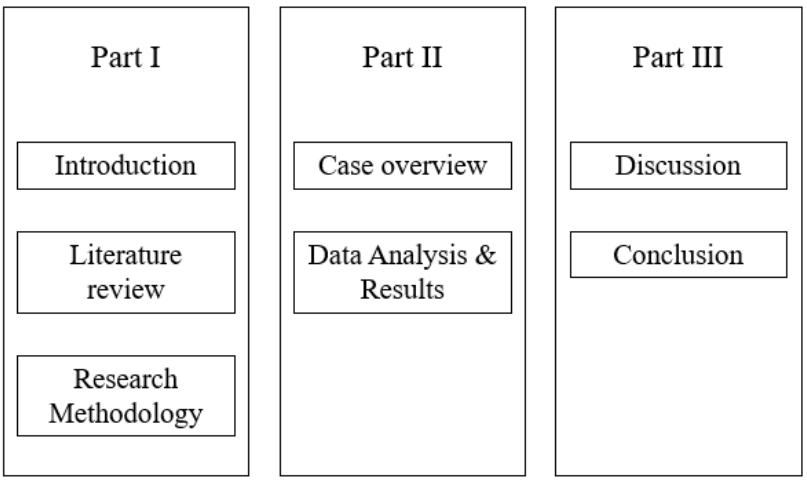
1.5 Research context and outline

This research project is conducted in collaboration with the engineering consultancy firm Royal Haskoning DHV (RHDHV). RHDHV harnesses the collective expertise and experience of its colleagues worldwide, uniting global knowledge with local insights to provide a comprehensive range of consultancy services across various sectors, including aviation, buildings, energy, industry, infrastructure, maritime, mining, rural and urban development, and water (Royal Haskoning DHV, 2023). RHDHV serves as the focal case study organization to identify the learning mechanisms it employs and assess the drivers and barriers within the organization. To ensure the validity of the observations and to contextualize the results, two specific projects have been selected for inclusion in the case study.

This thesis report is organized into three parts as outlined in the reading guide presented in Figure 1. Part 1 sets the scene for this research along with a background literature study to validate the research gap, additionally, it also includes the research methodology. Part 2 is centred on gathering data and analysis. Lastly, Part 3 consists of the main discussions of the research along with the conclusions.

Figure 1

Chapter-wise outline of the thesis report



Chapter 2 Literature Review

2.1 Knowledge management: Sub-processes and significance

Although extant literature points out clear differences between "knowledge" and "information", the terms are often used synonymously. Information is essentially the transmission of messages whereas knowledge is developed through the processing of information, founded on the holder's perception. This emphasizes the connection between knowledge and human cognition (Machlup, 1983; Dretske, 1981). Knowledge is broadly classified into two types (Nickols, 2000) –

- *Tacit knowledge*; knowledge that cannot be converted into codified forms. This knowledge resides in the heads of individuals and it is often intuitive.
- *Explicit knowledge*; knowledge that can be documented through multiple media (best practices, process standards, etc.).

Utilizing knowledge involves sub-processes that researchers have perceived in several ways. Suresh et al. (2016) discovered 41 terms associated with knowledge management (KM) sub-processes and reorganized them into eight individual KM sub-processes as shown in Table 1. These sub-processes were further grouped under three main headings namely "knowledge acquisition", "knowledge exploitation", and "knowledge evaluation".

Table 1

Knowledge management sub-processes

S.No.	Process	Sub-process	Description
1.	Knowledge acquisition	Identify	Find sources and types of knowledge for organizational gain
2.		Capture	Record sourced knowledge for reuse
3.		Codify	Gathering knowledge efficiently for reuse
4.		Store	Knowledge retention in organizational databases
5.	Knowledge exploitation	Access	Locating and retrieving knowledge easily
6.		Exploit	Optimized usage of knowledge for individual and organizational gain
7.		Create	Continuously generate and discover new knowledge
8.	Knowledge evaluation	Assess	Measure KM outcomes in the organisation

Note. This table demonstrates a condensed interpretation of the knowledge management sub-processes adapted from "Impact of knowledge management on construction projects," by S. Suresh, R. Olayinka, E . Chinyio, & S. Renukappa, 2016, Proceedings of the Institution of Civil Engineers – Management, Procurement and Law, 170(1), p. 28-29. Copyright 2016 by ICE Publishing.

This study places its primary focus on the challenge of knowledge exploitation i.e., knowledge reuse because the potential value of knowledge can only be realised if it is reused (Tan, et al., 2007). Several organizations invest significantly in knowledge management initiatives and systems, yet often struggle to realize significant returns (Chua & Lam, 2005). One major contributing factor to this issue is the perceived ineffectiveness of knowledge reuse (Minbaeva et al., 2003). Liu et al. (2013) distinguish reusable knowledge based on its tacit nature and value. They state that reusable knowledge typically includes "engineering solutions, process innovations, engineering know-how, etc.". Furthermore, they classify knowledge reuse into two types, namely –

- problem-driven knowledge reuse: this knowledge reuse is prompted by the necessity to resolve a specific issue and is therefore time-bound
- knowledge-driven knowledge reuse: driven by "continuous improvement", where individuals pursue constant improvement of their capabilities and knowledge

2.2 Learning from projects

Bakker et al., (2011) state that project-based learning usually includes two main components: 1) knowledge generation through project endeavours, and 2) the documentation and transfer of this knowledge to a lasting context. The distinctive significance of project-based learning lies in the unique implications that projects have regarding this process. On the other hand, Tonia & Pessot (2021) define organizational learning as a collaborative endeavour undertaken by individual project teams within the broader strategic framework of project-based organizations. It encompasses acquiring knowledge from both within and across (Xu, Deng, & Liang, 2017) specific projects, as well as generating, capturing, and formalizing new project-level knowledge intended to be shared within the ongoing context, both officially and informally.

Lessons learned are knowledge or understandings obtained by experience, which must be seen as having a substantial influence on future operations to enhance organizational learning (Carrillo & Ruikar, 2013). However, numerous studies have uncovered dissatisfaction with existing approaches to capturing and utilizing lessons learned. The literature also highlights that organizations frequently prioritize identifying lessons rather than effectively disseminating them. It is a common misconception that the process concludes once lessons are captured; in reality, the true value of lessons learned from projects emerges during subsequent practices (Yang et al., 2020). It is important to distinguish between identified and stored lessons and the actual lessons learned that must be implemented and reused. The application and implementation of knowledge often necessitate substantial effort, commitment, and a comprehensive understanding of individual and organizational behaviour (Weber et al., 2001).

Bakker et al. (2011) highlight the existence of a "learning paradox" within projects. On one hand, projects serve as generative grounds for knowledge creation and innovation. However, on the other hand, the transient nature of projects presents a barrier to the seamless embedding of this knowledge. This challenge arises from the fact that, upon project completion, the team disperses as members move to new projects or assignments.

This creates a challenge in bridging the gap between project-specific insights and their integration into the broader organizational context.

2.3 Types of learning

2.3.1 Codification and personalisation

Organizations can enable knowledge sharing through two main approaches: documenting knowledge in repositories and databases, or through direct personal interactions. This is known as codification and personalization, respectively, and the choice depends on the type of knowledge being shared. Tacit knowledge, which is difficult to articulate, is best shared through personal interactions. Whereas, explicit or codified knowledge is better suited for sharing through documentation (Cabrera & Cabrera, 2002; Nonaka, 1994).

Codification involves extracting knowledge from individuals or groups who developed it and storing it in a centralized database for broader accessibility. This method is commonly employed in business sectors dealing with products and services where similar problems require consistent solutions. For instance, in the field of engineering design, new challenges are tackled by enhancing existing design knowledge (Iyer et al., 2005). While codification streamlines the sharing process and resource allocation in such scenarios, it must be noted that codified knowledge can become outdated with rapidly changing times (Mukherji, 2005). Furthermore, maintaining an up-to-date knowledge database through documentation can be resource-intensive, and often, the materials stored there are not revisited.

Personalization promotes the usage of "people as a mechanism" to share knowledge (Argote, 2012). Although there is a possibility that the knowledge being shared may lack context, through personalization, individuals can articulate their experiential knowledge suitable to the specific context of a given situation or project (Allen, 1984). This approach emphasizes learning through practical involvement, causing the acquired knowledge to become deep-rooted in the minds of individuals. Additionally, personalization enables the seamless transfer of tacit knowledge and encourages insightful conversations that could lead to the creation of new knowledge (Prencipe & Tell, 2001). As a result, personalization inherently encourages innovation, making it suitable for industries that create state-of-the-art products or services.

2.3.2 Exploration and exploitation

March (1991) identified two types of organizational learning—exploration and exploitation. While exploitation focuses on making use of already existing knowledge, exploration requires the formation of new knowledge. These two modes of learning have major distinctions, which makes managing them both at the same time difficult. Furthermore, integrating explorative and exploitative learning becomes even more difficult when it comes to the 'unique' context of projects inside organizations. Exploration and exploitation both require making important decisions about "what to do" and "what not to do". According to Turner et al. (2014), this decision-making process includes decisions like whether to start from scratch and develop a new product, or make use of an existing one.

Balancing exploration and exploitation faces a significant hurdle at the interface between projects and parent organizations. This barrier impedes the transfer of project-acquired knowledge into the larger organizational context (Formentini & Romano, 2011). To address this, Eriksson & Leiringer (2015) identified four knowledge governance mechanisms that, when combined, enhance both explorative and exploitative learning: creating and maintaining a lessons-learned database, developing and sustaining project management standards and methods, facilitating consultation and education, implementing strategic management.

2.4 Learning processes

2.4.1 Experience accumulation

Learning from experience can be classified into "learning by doing" and "learning by using" (Levinthal & March, 1993). Learning by doing refers to accumulating knowledge through direct actions and personal experiences. Whereas, learning by using refers to the usage of tools or systems to draw knowledge. Nelson & Winter (1982) state that these processes are characterized by knowledge based on organizational procedures rather than deliberate decision-making.

2.4.2 Knowledge articulation

According to Schön (1984), knowledge can be articulated in the practical context of experience-based learning. Knowledge articulation can be achieved at an individual level through "learning by reflecting" and "learning by thinking" (Zollo & Winter, 2001). They argue that knowledge articulation serves two roles - In the beginning, it offers a context for justification, enabling people or groups to explain and justify their knowledge and actions. Second, it is a cognitive process including reasoning that enables people and communities to comprehend the viability of carrying out various actions. Zollo & Winter (2002) and Schön (1984), emphasize the notion of collective knowledge articulation. Organizational members can express their knowledge through dialogue and discussion, which offers a space for double-loop learning where people and groups can question presumptions and challenge current practices (Argyris & Schön, 1978).

2.4.3 Knowledge codification

While articulation can be thought of as the extension of codification, the latter goes one step further by enabling the externalization of knowledge into language and symbolic representations. Processes for codifying knowledge demand a lot of work and might be expensive. The goal of codifying articulated knowledge through explicit documentation is often to create better connections between actions and results (Zollo & Winter, 2001). According to Foray & Steinmueller (2001), codification not only involves transforming tacit information into explicit forms but also has the power to alter knowledge hierarchies by converting knowledge into written form. As suggested by Zollo & Winter (2001), codification not only necessitates a significant cognitive commitment in the process of learning by writing and rewriting, but also enables companies to learn by putting codified information into practice, reproducing it, and adapting it.

2.5 Learning approaches

Hartmann and Dorée (2015) challenge the predominant sender/receiver approach to learning in project-based environments, which assumes knowledge to be a transferable commodity separate from the context of its origin. They argue that this approach may not be as effective as intended due to contextual limitations in project-based sectors. Instead, they propose the social learning approach as a valuable alternative that can provide insights into learning between projects that the sender/receiver approach cannot capture. This section will briefly discuss both approaches based on the existing literature.

2.5.1 Sender/receiver approach

In the sender/receiver approach, knowledge transfer from one entity (individual/project) to another (individual/project) is dependent on several conditions (Lin et al., 2005). Firstly, the sender's expertise and willingness to share knowledge. Secondly, the receiver's absorptive capacity and ability to estimate the relevance of the shared knowledge. Lastly, the usage of a shared vocabulary while sharing knowledge ("common lexicon"). This approach primarily relies on documented and codified knowledge that can be stored, transferred, and accessed through various means such as electronic databases (Lam, 2000).

2.5.2 Social learning approach

The social learning approach is based on the social learning theory, which emphasizes the significance of the contextual aspect of learning. It highlights that learning occurs through interactions among individuals, rather than solely within the minds of individuals (Easterby-Smith et al., 2000). This perspective emphasizes the idea that “learners are social beings” who develop their understanding and acquire knowledge by engaging with other practitioners within a specific sociocultural setting (Edmondson, 1999).

In line with the principles of social learning, building "communities of practice" (CoPs) to exchange best practices and learn from one another is beneficial to many organizations. A community of practice is an association of people with common interests in a particular field of study who regularly collaborate to share knowledge (Wenger et al., 2002). These people are motivated by the shared goal of learning from one another. Furthermore, capable CoPs know how to strike a balance between trying out new techniques and making the most of ones that already work (Probst & Borzillo, 2008).

2.6 Driving factors for reusing knowledge in projects

Interestingly, existing literature placed more emphasis on barriers than drivers of learning. Nevertheless, this section summarizes the key factors that facilitate knowledge transfer and learning within organizations. While not an exhaustive list, the commonly recognized drivers identified in the literature review have been included.

2.6.1 Collaborative exchanges

Researchers have recognized communication and collaboration between individuals as a crucial element to share and knowledge, highlighting its function in social interactions and as

the cornerstone of effective knowledge transfer (Davenport & Prusak, 1998; Hendriks, 1999). It has been determined that both formal and informal methods of communication can effectively convey knowledge. Training sessions (Desouza & Awazu, 2006), lessons-learned forums, and project management offices (Müller, 2013), are examples of formal communication approaches that encourage regular interactions, better member engagement, and more opportunities for knowledge transfer – as a result, project performance is improved (Alavi et al., 2006). Formal communication between projects at the project level makes it easier for similar initiatives to share knowledge and experiences. On the other hand, through casual get-togethers and coffee breaks informal communication promotes stronger bonds and trust among interactive teams (Xu et al., 2017).

2.6.2 Willingness to share knowledge

Abdulkarim et al. (2009) argue that the intention to share knowledge plays a critical role in the knowledge transfer process. Influential factors classified as individual and organizational have been the subject of previous studies. Transfer intention is influenced by personal characteristics such as attitude, subjective norms, perceived behavioural control, and self-efficacy (Chen et al., 2012; Bock & Kim, 2002). Strong relationships are fostered by organizational characteristics such as organizational environment, trust, and supervisor support, which in turn promote transfer intention (Abdulkarim et al., 2009). Knowledge transfer is also impacted by project factors like similarity which promotes knowledge sharing between project teams (Javernick, 2011).

2.7 Barriers to reusing knowledge in projects

Bartsch, et al., (2013) state that the unique and sporadic characteristics of projects create barriers to effective learning beyond project boundaries, impeding the three fundamental mechanisms of managing knowledge: “opportunity”, “motivation”, and “capability”. Within organizations, projects function as independent entities, often limiting chances for project teams to interact with colleagues outside their specific projects.

Sergeeva & Duryan (2021) identified that one of the widely recognized barriers to learning is the broad scope of projects, that requires insights from multiple disciplines that prioritize their individual goals over sharing knowledge effectively. Moreover, there is an inclination to depend on data repositories to facilitate project-based learning but merely storing knowledge and information does not foster learning. Nevertheless, project-based organizations must emphasize human systems, recognizing that innovation and knowledge dwell in individuals (Blackman, 2005).

While the following discussion does not encompass all possible barriers to learning, it highlights the most commonly listed and significant ones identified in the extant literature.

2.7.1 Lack of motivation

Knowledge sharing can be perceived by employees as an additional burden on their existing workload. The inclination to share or receive knowledge can stem from either internal factors or external factors, such as rewards provided by the organization (Hauke, 2006; Bartsch et al.,

2013). The lack of interest in learning is also a result of unclear incentives ("What's in it for me" (Disterer, 2002)).

2.7.2 Time constraints

Due to the time-boundness of projects, it becomes difficult to effectively capture and retain experience and knowledge, among other responsibilities (Disterer, 2002). Additionally, team members tend to disperse and quickly join new project teams once a project is finished, which hinders the ability to systematically review, revise, and document the acquired knowledge and experiences.

According to Carrillo et al. (2013), their engagement with focus groups representing three different construction sites revealed that project teams are primarily focused on completing their assigned tasks while delegating other activities to a secondary priority. Consequently, there is insufficient time available for sharing experiences and lessons learned. This leads to project reviews being conducted only when forced upon the teams.

2.7.3 Blame culture

Examining failure and gaining insights from mistakes is beneficial for the learning curve of organizations. Nevertheless, successful stories must not go unnoticed – neglecting to highlight successful instances of knowledge sharing can lead to resistance among individuals towards contributing to the learning process. Unfortunately, organizations often fail to foster an environment that encourages constructive and open discussions about errors made by project team members (Disterer, 2002). Another obstacle in large organizations is the lack of support from senior management (Carrillo et al., 2013). Managers play a crucial role in cultivating a positive environment within an enterprise. They can achieve this by establishing a solid technical infrastructure, allocating time for meetings, and motivating staff to participate in knowledge discussions (Hauke, 2006).

2.7.4 Organisational structure

According to Harmon (2007), silo thinking (vertical hierarchy in organizations), is adopted to optimize individual departments' efficiency but they often tend to overlook issues that affect the organization at large. During their interaction with focus groups from various construction sites, Carrillo et al. (2013) observed that the site teams exhibited limited interaction with other project teams within their business unit. Moreover, they had isolated connections with the main and regional offices. However, the groups acknowledged the value of interacting with site teams confronting similar challenges and issues.

The lack of motivation in individuals along with the time-boundedness of projects can inhibit knowledge exchange in certain organizational structures. In line with this remark, past studies show that formal structures and systems, coordination mechanisms, and behaviour shaping characteristics of the organizational outlook have an impact on knowledge transfer efforts and their success (Bartlett & Ghoshal, 2002).

2.7.5 Reliability of knowledge

Knowledge shared by an expert or a relatively knowledgeable member of the team has a higher chance of being well-received. If the person sharing the experience or lesson is not regarded as trustworthy or dependable, the knowledge imparted is more likely to be contested (Szulanski, 1996). Furthermore, project personnel are often in doubt about the relevance and usefulness of the knowledge produced outside of the context in which it was created (Bresnen, et al., 2003).

2.8 Key takeaways

This chapter synthesizes the main findings from the literature review, including organizational learning, classical knowledge management theories, and insights from projects. It underlines that knowledge is inherently linked to individual interpretation. The study outlines eight knowledge management sub-processes, specifically focusing on the challenge of reusing knowledge. Despite the crucial role of lessons learned in future projects, their inadequate capture often leads to the real value emerging only during implementation.

Furthermore, the extant literature stresses the importance of social learning, attributing its significance to the contextual relevance it imparts to knowledge transfer. Social learning advocates for establishing communities of practice, facilitating collective learning through shared experiences and ideas. Consequently, drivers for knowledge reuse, including effective communication, willingness to share, and project similarity, play instrumental roles.

On the contrary, barriers such as lack of motivation, time constraints, blame culture, silos, and unreliable knowledge impede knowledge exchange and reuse. In conclusion, this literature review highlights the challenges of managing knowledge across projects and underscores the pivotal roles of social learning, effective communication, and supportive organizational structures in ensuring successful knowledge reuse. The main concepts identified in the literature review have been presented in Table 2. These concepts serve as the starting point for analysing the data gathered in further stages of the research.

Table 2

Key concepts from literature review

Category	Authors	Key concepts
Knowledge capture and reuse methods	Desouza & Awazu (2006), Wenger et al. (2002), Lam (2000), Probst & Borzillo (2008), Easterby-Smith et al. (2000)	Formal and informal communication methods, Communities of practice (CoPs), Lessons learned, Post-project reviews, Social learning
Learning from projects	Hartmann and Dorée (2015), Lin et al. (2005), Easterby-Smith et al. (2000), Edmondson (1999), Wenger et al. (2002), Probst & Borzillo (2008), Levinthal & March (1993), Nelson &	Codification, Person-to-person learning, Tacit knowledge, Explicit knowledge, Exploration,

	Winter (1982), Schön (1984), Zollo & Winter (2001), Foray & Steinmueller (2001), Cabrera & Cabrera (2002), Nonaka (1994), Iyer et al. (2005), Prencipe & Tell (2001), March (1991), Turner et al. (2014), Formentini & Romano (2011), Eriksson & Leiringer (2015)	Exploitation, Learning by doing, Learning by using
Drivers to knowledge reuse	Abdulkarim et al. (2009), Chen et al. (2012), Javernick (2011), Alavi et al. (2006), Xu et al. (2017)	Collaboration (P), trust among individuals (I), Willingness to share knowledge (I), Social interactions (O)
Barriers to knowledge reuse	Bartsch et al. (2013), Sergeeva & Duryan (2021), Carrillo et al. (2013), Harmon (2007), Disterer (2002)	Lack of motivation (I), Lack of trust in knowledge source (I), Time constraints (P), Blame culture (O), Knowledge silos (O)

Note. The drivers and barriers have been categorized on 3 levels, namely – individual (I) level, project (P) level, and organizational (O) level.

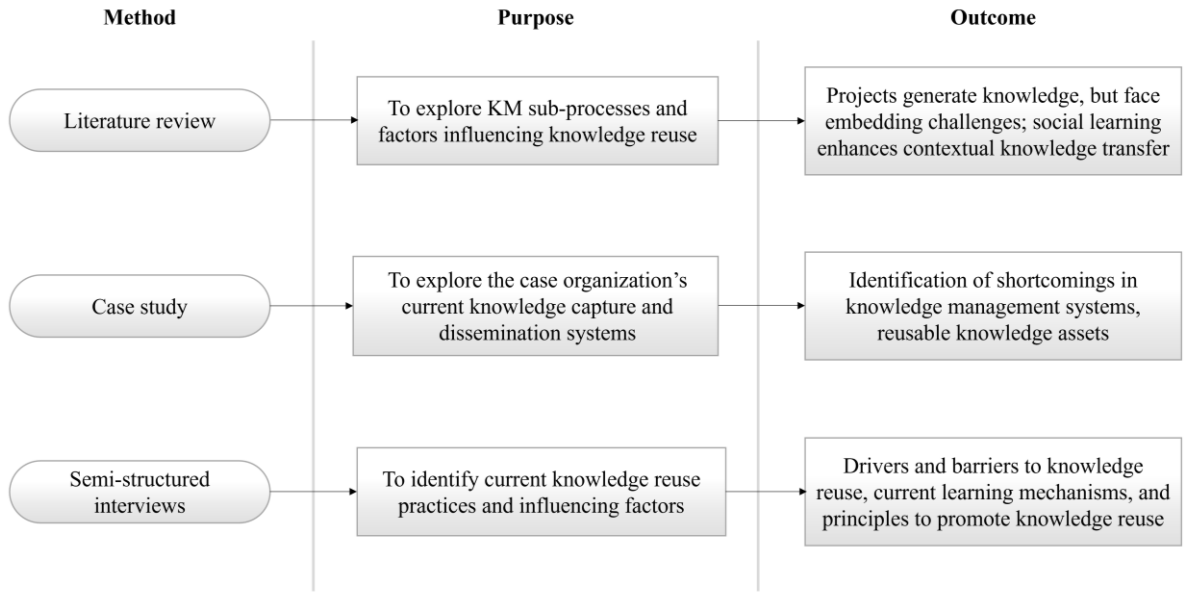
Chapter 3 Research methodology

Ahmad & Karim (2019) highlight that quantitative methods are predominantly used research methodologies in existing knowledge-sharing studies. Nonetheless, they underline the importance of qualitative research to discover the "procedural, contextual, and experiential aspects of knowledge-sharing processes," which have been insufficiently explored.

This research aims to identify the central elements of knowledge reuse within project and organizational contexts. Knowledge generated in projects is intrinsically tied to its specific context, and as a result, the individuals involved serve as the carriers of that contextual knowledge. Figure 2 illustrates the research methodolgy used; this Master's thesis adopted a qualitative approach consisting of a literature review, a case study, and semi-structured interviews with practitioners. The research design serves as an action plan to answer the research question, and this chapter provides a deeper understanding of the research methods used in the study.

Figure 2

Research design of the study



3.1.1 Conception

The conception phase established the research focus through a preliminary literature review. This phase provided essential context for the research problem and serves as the foundation for subsequent qualitative research.

The researcher studied peer-reviewed publications using various databases, including ScienceDirect, JSTOR, Scopus, and Google Scholar. The search utilized a combination of keywords, such as – "learning between projects", "knowledge capture", "knowledge reuse",

and “project-based learning”, to gather suitable literature. Subsequently, the results were refined by carefully reviewing the abstracts. The findings of the literature review were presented in Chapter 2.

3.1.2 Case study

Numerous organizations have increasingly turned to electronic databases to facilitate knowledge sharing and storage. However, the practical application of this knowledge has encountered challenges. Boh (2008) underscores the significance of knowledge reuse within consulting firms as a means to reduce redundancy. Nevertheless, the primary challenge lies in effectively connecting new problems with previously developed solutions. To address this, the a case study was conducted on Royal Haskoning DHV (RHDHV). Furthermore,

In line with case study research methodology, this study investigated a phenomenon within its specific context, particularly when the boundaries between the two are not entirely distinct (Yin, 2009). This method is aptly suited to the complex nature of learning and knowledge reuse across projects, which constitutes the central focus of this research.

The researcher was positioned within the Project Management and Consultancy Advisory Group (PM&C AG) within the Industry and Buildings (I&B) business line of the organization. Therefore, data was gathered by accessing the organization's internal database through document reviews and conducting semi-structured interviews.

The importance of the social aspect in learning and the reuse of knowledge has been a recurring theme in literature. Therefore, this research investigated the processes of capturing, sharing, and reusing knowledge within projects while preserving the context of the knowledge. For this purpose, two projects were identified within the PM&C AG (see Table 3), facilitating a deeper assessment of the learning mechanisms, social interactions, and reusable knowledge assets.

Table 3

Overview of projects chosen for analysis

S.No.	Client code	Project code	Description	Status
1.	A1	P1	Fertiliser manufacturing plant, site relocation	Completed
2.	A2	P2	Brownfield brewery expansion	Ongoing

Note. This table has been adapted from the corresponding project data present in the internal records of RHDHV

3.1.3 Interviews

Two exploratory interviews were conducted to understand the perception of knowledge management in RHDHV. These interviews were not recorded, but the researcher made notes of the key points as and when discussed. The interviewees were encouraged to openly discuss the knowledge capture and sharing practices in the organization. The findings from the interviews are not included in this report as they were rather informal and lacked substantial contributions to the outcomes of the thesis.

Considering the context-specific nature of this research, it is rational to interview practitioners about their perspectives on learning mechanisms, drivers, and barriers to knowledge reuse within projects. The interviewees were selected from both project teams P1 and P2, as well as senior management professionals, for a comprehensive overview. Additionally, senior management personnel at the corporate level were also included, to provide an organizational standpoint on the subject. Moreover, the corporate QHSE manager was interviewed to assess inconsistencies within internal repositories and data management systems. The interview protocol and questionnaire can be found in Appendix A. Table 4 provides the complete list of semi-structured interview participants.

Table 4

List of interviewees

S.No.	Code	Interviewee role	Positioning	Location
1.	X1	Project Manager	P1	Netherlands
2.	X2	Assistant Project Manager	P1	Netherlands
3.	X3	Architect	P1	Netherlands
4.	X4	Project Manager	P2	Netherlands
5.	X5	Design Manager	P2	Vietnam
6.	X6	Director	PM&C AG	Netherlands
7.	X7	Associate Director	PM&C AG	Netherlands
8.	X8	Associate Director	PM&C AG	Netherlands
9.	X9	QHSE Manager	Corporate	Netherlands

Note. Interviewees are coded X1 to X9 for anonymity

The interviews typically went on for about 60 minutes and were recorded after obtaining prior consent from the participants. The researcher transcribed the interview recordings and summarized each transcript, which were verified by the interviewees to ensure the research's credibility. Additionally, the interview summaries have been included in the Appendix B for the research supervisors to audit when analyzing the conclusions drawn from the interview data in later stages of this study (Guba, 1981).

3.1.4 Data analysis

Consistent with the qualitative approach adopted in this research, a thematic analysis method was chosen to identify common patterns or "themes" within the data gathered from the interviews. Vaismoradi et al. (2016) argue that identifying underlying themes from raw data is fairly intuitive. Moreover, they assert that qualitative analysis is a recurring process requiring researchers to revisit gathered data throughout the analysis phase to strengthen the emergent themes.

The researcher used deductive coding to classify the data under code groups derived from the interview protocol, the main research question, and the main concepts in the literature review (see Table 2). According to Braun & Clarke (2006), deductive coding is done when a researcher maps data to code to a specific research question, as seen in this case. For instance, the

interview questions were designed to encourage the interviewees to reflect on specific topics such as organizational culture, current practices, drivers, and barriers (refer to Appendix A for the interview questionnaire).

In line with Braun & Clarke's (2006) method, the initial phase of conducting thematic analysis involved coding the interview data (see Table 5) after becoming familiar with it. The data was systematically coded using ATLAS.ti software (version 23). Codes were then combined into themes based on their frequency across interviews and their interrelations. These themes were further refined by ensuring sufficient data supported them. Finally, the refined themes were labelled and used to address the second sub-research question.

Table 5

List of codes assigned to interview data

Code group	Codes assigned
Learning processes	• Social interactions • By collaborating • On the job
Knowledge exchange	• Communication • Cooperation • Mutual respect • Responsibility • Team dynamics
Drivers	• Ownership • Personal network • Collaboration • Trust-based culture • Willingness to share knowledge • Proactive learning
Individual barrier	• Lack of motivation • Resistance to change
Project-specific barrier	• Information overload • Project context • Time constraints
Organizational barrier	• Lack of awareness • No learning goals • Lack of standardization • Employee turnover • Knowledge silos
Organizational culture	• Openness • Working together • Cross-discipline collaboration

Organizational support	• Mentoring • Low hierarchy • Knowledge repository • Knowledge sharing initiative • Document control system • Post-project review • Lessons learned session • Communities of practice
Knowledge types	• Tacit knowledge • Process knowledge
Miscellaneous	• Multi-disciplinary team • Competitive advantage • Client satisfaction • Project type • Working style

Note. The miscellaneous code group serves as a collective category for codes that do not fit within any specific grouping

Chapter 4 Case Overview

4.1 Unlocking knowledge reuse: Learning in the organisation

RHDHV recognizes the importance of learning from previous experiences to build a credible knowledge base for future projects. This is evident in how knowledge is structured and disseminated through well-defined mechanisms and initiatives. Nonetheless, this section will address specific shortcomings in the structure and working standards that hinder how effectively knowledge is captured and shared, along with the current learning practices.

4.1.1 Knowledge groups

The knowledge network connects various knowledge groups, including those specific to the I&B business line, and across other business lines. The Technical Coordination team in I&B is a key knowledge resource, serving as "informal leaders" who provide guidance, and design expertise, and ensure consistent project delivery in line with the organization's goals.

Interestingly, knowledge groups within the organization are dispersed among different departments but centred around specific disciplines. For example, architects engaged in diverse projects like building constructions, and industrial developments developed a community to exchange insights and address shared challenges. This setup is similar to the concept of a community of practice, fostering a space where architects collaboratively share knowledge and use it to enhance their individual work endeavours.

The knowledge groups provide opportunities for professionals of the same discipline across business lines to engage, exchange ideas, and collaboratively address challenges. The PM&C knowledge group actively organize multiple interactive learning sessions throughout the year, with comprehensive meeting records documented on the organization's intranet for easy accessibility to all members.

The researcher observed some gaps and sources for concern:

- Not all individuals may actively participate in knowledge group discussions. Therefore, there is a need to motivate passive individuals by explicitly stating the benefits of engaging in these sessions.
- The meeting recordings and presentations are available on the organization’s intranet, but it is unclear how often they are updated.

4.1.2 Lessons learned

Lessons learned captured through interviews with project managers were found on the PM&C knowledge group’s intranet page. While these lessons are easily accessible, they are mostly generic and sometimes lack the context required for effective application. For instance, one of the lessons learned related to cost was simply stated as “submit timesheets and invoices on time”. Furthermore, lessons were also captured from various forms of the management system but could not be traced directly. At the moment it is not clear how these lessons are obtained,

processed, and audited so the corporate QHSE manager was interviewed in the later stages of the research to clarify this.

4.1.3 Learning tools and initiatives

4.1.3.1 Project Health Check

Every month, project managers should reflect on the progress of their projects. They are encouraged to address potential problems or concerns that could cause schedule delays, using a Health Check Report or Dashboard as a guide. Upon identifying these issues, project managers are required to outline specific actions to prevent the issue from occurring. The Health Check uses a system of color-coded traffic light indicators to assess different project-related factors. Warning signals in the form of yellow or red indicators indicate serious risks that the project may be facing (Insight, 2023). In this situation, good reporting depends on creating a culture of openness and trust in the organization, where project managers are at ease disclosing red or yellow indicators. This responsibility falls on organizational leadership to create a culture of ‘no blame’ where project managers can openly disclose pitfalls without fear of consequences. Furthermore, a no blame culture has a strong impact on the efficacy of teams (Koolwijk et al., 2020).

The Health Check also has a section where project managers can report any lessons learned during that month. When inquired about the destination of these lessons, the QHSE manager confirmed that, at present, they are not stored within the management system. This highlights a gap in converting learning opportunities to reusable knowledge assets.

4.1.3.2 Project Management Intervision

Project Management Intervision sessions are informal gatherings for senior project managers to address issues and exchange insights. During each meeting, one member presents a personal project management challenge, and fellow project managers contribute ideas to tackle it. These sessions are characterised by open communication and trust. Moreover, a "safe space" is created for project managers to express their opinions freely without being documented or recorded (Edmondson, 1999).

While the intervision sessions facilitate learning through social interactions, the lack of documentation could prevent knowledge from being shared with other project managers who are not a part of this ‘elite’ group. Therefore, without structured documentation and sharing of the knowledge generated in these sessions, the potential for its reuse may be limited.

4.1.3.3 Business Process Mapping

RHDHV uses several processes for client services, but many of these processes lack clear descriptions. This can lead to issues like losing knowledge when a colleague leaves, inconsistent results for clients due to the absence of standardized processes, and a need to reinvent the wheel each time (Royal Haskoning DHV, 2023). To address these issues, the organization introduced the Business Process Mapping (BPM) initiative.

The perceived benefits of BPM include:

- Establishing “one way of working” to enhance collaboration among different teams (interface management) and meet client expectations for consistency
- Retention of critical knowledge, in case a colleague departs
- Linking data to project outcomes and enabling learning in future projects

While this initiative reduces redundancies in project execution, it must be acknowledged that implementing BPM can invite resistance from employees who are probably comfortable with the existing way of working. In some cases, the BPM may not be consistently followed, resulting in fragmented knowledge management.

4.1.3.4 Mentor-mentee coaching

RHDHV follows a 70-20-10 Learning Model, where 70% of learning occurs on the job (experiential learning), 20% through mentorship and peer interactions (social learning), and 10% via training programs (formal learning) (Johnson et al., 2018). In this structure, experienced professionals with extensive expertise are carefully selected and assigned as mentors to colleagues with limited professional experience, to foster personal and professional growth. The main criteria for mentorship are trust and mutual respect between the mentor and the mentee.

To ensure the effectiveness of this mentorship approach, a check-in is scheduled at the six-month mark of the mentoring process. These are for deliberation on whether to continue, stop, or change the mentor if necessary. The mentor is different from the employee's direct manager, which facilitates the building of trust without concerns about potential consequences.

4.2 Project analysis

4.2.1 Project 1 (P1)

4.2.1.1 Project Overview

The client A1 had to relocate their fertilizer manufacturing plant from Amsterdam due to the city council's redevelopment plans for the existing site. RHDHV was hired to provide conceptual design (approve project approach, organize resources, conceptualize the execution) and basic design (final investment decision, agreed scope, and execution plan) services for the new plant. During the conceptual design phase, a preliminary construction cost estimate (CCE) and a basis of design (BoD) for the production equipment were developed. For the civil, structural, and architectural (CSA) specifications of the project, and the subsequent basic design phase, the project was handed over to a different team in the PM&C AG.

To preserve critical knowledge from the previous phase, two members of the conceptual design team continued in the basic design phase. Despite this effort, a significant deviation of -15/+25% in the CCE had emerged. This rendered the project financially unviable, ultimately leading to its termination.

4.2.1.2 Lessons learned session

A comprehensive lessons-learned session lasting three hours was conducted as part of the project close-out. This session involved all discipline leads and the core project management

team. Before the session, team members were provided with a user-friendly template to capture their lessons learned, focusing on "What went well?" and "What can be improved?" The template included team members' names, promoting individual accountability and enabling them to provide explanations during the session.

Fostering a safe environment for team members to share ideas has been demonstrated to have a positive impact on team performance (Bradley et al., 2012). In line with this, some meeting ethics were outlined at the start of the session, emphasizing productive and respectful discussions. For instance, some ethics mentioned were – "think before speaking", "attack the problem, not the person", and "respect each other's opinion". These guidelines established a conducive atmosphere for the entire session, where the team members felt valued for their input and not singled out.

The lessons learned session revealed many insights out of which some are limited to the project and cannot be applied in other cases as easily. The researcher identified lessons that can serve as reusable knowledge assets in Table 6. The information presented in Table 6 has been categorized based on the content analysis outline developed by Yap et al. (2021).

4.2.2 Project 2 (P2)

4.2.2.1 Project Overview

The client (A2) is planning to increase the production capacity of its brownfield brewery in Malaysia from the current 1.6 million hectolitres per year to 3 million hectolitres per year. The project includes the necessary modifications to process equipment, storage facilities, and packaging lines, as well as improvements in site logistics. In line with a transition to renewable energy, the client aims to utilize the rooftop space of the brewery for photovoltaic installations.

The client initiated this project three years ago during the feasibility stage from RHDHV's Netherlands office, where the initial scope was established. Following this, they tendered the full project design, which they were awarded. The proposal manager, who later assumed the role of project manager, was responsible for the design phase. During this phase, the preliminary design was carried out in the Netherlands, and the detailed design and construction design were conducted in collaboration with colleagues in Vietnam. There was close coordination with the team in RHDHV's Vietnam office, throughout this process. As the design phase neared completion, the client requested support for construction management. A proposal was prepared and subsequently awarded, and the project is currently in this phase. Management and supervision are primarily conducted in the Netherlands, with continuing support from the team in Vietnam and on-site personnel in Malaysia.

4.2.2.2 Lessons learned session

A2 maintains a longstanding partnership with RHDHV, collaborating on numerous projects, so a cluster of experienced project managers is assigned to handle all projects from the A2 account. In 2022, these project managers took the initiative to capture lessons learned from their respective ongoing projects, consolidating them into a localized repository. This repository was structured using an Excel file and organized under various disciplines based on three questions – "What is good?", "What needs improvement?", and "What follow-up actions

are required?". Furthermore, suggesting actions to follow up on lessons learned will enhance their reuse value by presenting potential solutions. While these lessons are accessible through the organizational intranet, it remains unclear whether other professionals within the organization are aware of them.

Although some of these lessons are specific to individual projects, some of the project management lessons offer broader reuse value across different contexts. These lessons can be found in Table 6. The critical learning situations provide insight into what kind of situations and events prompt learning from past experiences (Yap et al., 2021).

To effectively integrate these lessons into the organizational and individual systems, it is essential to apply them. Consequently, the semi-structured interviews will determine whether any of these lessons have been successfully reused within the organization.

Table 6

Analysis of lessons learned captured from P1 and P2

Description	Lessons learned	
Reusable knowledge	*P1*	*P2*
Scope management	• Monitor scope changes and their impact on the project timeline actively • Clear scope division regarding sub-disciplines	• No changes should be made to the design once the contractor begins work
Stakeholder engagement	• Early involvement of CSA in the concept design phase could have prevented the deviation in cost estimate • Discuss budget constraints clearly at the beginning of the design phase, with the client • Meet often with the design team for better alignment (start early)	• Engage actively with suppliers and contractors in the design phase • Avoid shifting blame – in case of schedule delays, cultivate trust to share responsibilities • Main contractor must take responsibility for sub-contractor safety standards
Communication	• Numbering documentation in a way that everyone understands • Address inconsistencies proactively to avoid late discoveries • More sessions with the process team to understand production processes better • Communicate cost overrun openly with the client	• Reactive communication (only when something goes wrong) hampers stakeholder relationships – communicate issues proactively at all levels • "Do what you say, say what you do" – offer information before it is asked • Agree on document format with all stakeholders
Cost control	• Continuous monitoring of budget changes • Include all discipline perspectives for cost calculations	• Timely escalation of budget overruns • Align cost estimation with client methodology

	• Get feedback from the client about the work budget for the next phase • Engineer with the objective – best value for money	• Track global market prices actively in case of long gaps between phases. Renew estimates accordingly • Value based engineering
Resource allocation	• In case of switches in the project team, ensure successful knowledge transfer • Commit human resources according to scope (pre-planning)	• Flexible workforce mobilization in case of tight schedules
Roles and responsibilities	• The role of project manager vs design manager must be made clear	• Define the responsibility of List of Outstanding Items (LOI) between project team and end-user
Others	• Design process should be flexible to accommodate scope and planning changes	• Understand local construction culture • Research local contractor capabilities to manage the procurement process • Lessons learned from previous (local) permitting procedures should be consulted

Critical learning situations	P1	P2
Accidents due to compromised safety	–	"Clear safety pre-qualification of sub-contractors: Main contractor is responsible for any oversights that lead to fatal accidents"
Client expectations	"Too expensive", "cost estimate exceeded client's budget constraints"	"RHDHV should align with client drivers"
Project review meetings	"Meet once a week in person to discuss progress and issues, per discipline"	"In weekly meetings, review day-to-day tasks"
Sharing experiences	"Visit site project office frequently and talk to contractor"	"Understand each other, structural is not geotechnical, architectural is not building physics"

4.3 Case study takeaways

- The case study reveals several challenges in knowledge sharing and reuse within the organization. The intervision sessions lack documentation, hindering knowledge sharing beyond the participating group.
- Distributed across business lines but unified by discipline, the knowledge groups facilitate cross-collaboration and mutually beneficial conversations among individuals. This structure effectively prevents the formation of knowledge silos, fostering an inclusive approach to learning that breaks organizational boundaries.
- After studying both projects, it is evident that the organization lacks a standardized project close-out procedure. Project managers have the discretion to conduct these sessions as they see fit. Furthermore, Project P2 is ongoing, with regular progress reports tracking project execution and key metrics being reported. However, recurring reflective sessions for discussing lessons learned are notably absent.
- The documented lessons from both projects lack sufficient context to effectively apply the learnings across different projects. This underscores the necessity for a more comprehensive method of documenting these lessons to transform them into reusable knowledge assets.
- There is a clear absence of a centralized location for lessons learned, which adds to the difficulty of retrieving them for future use.

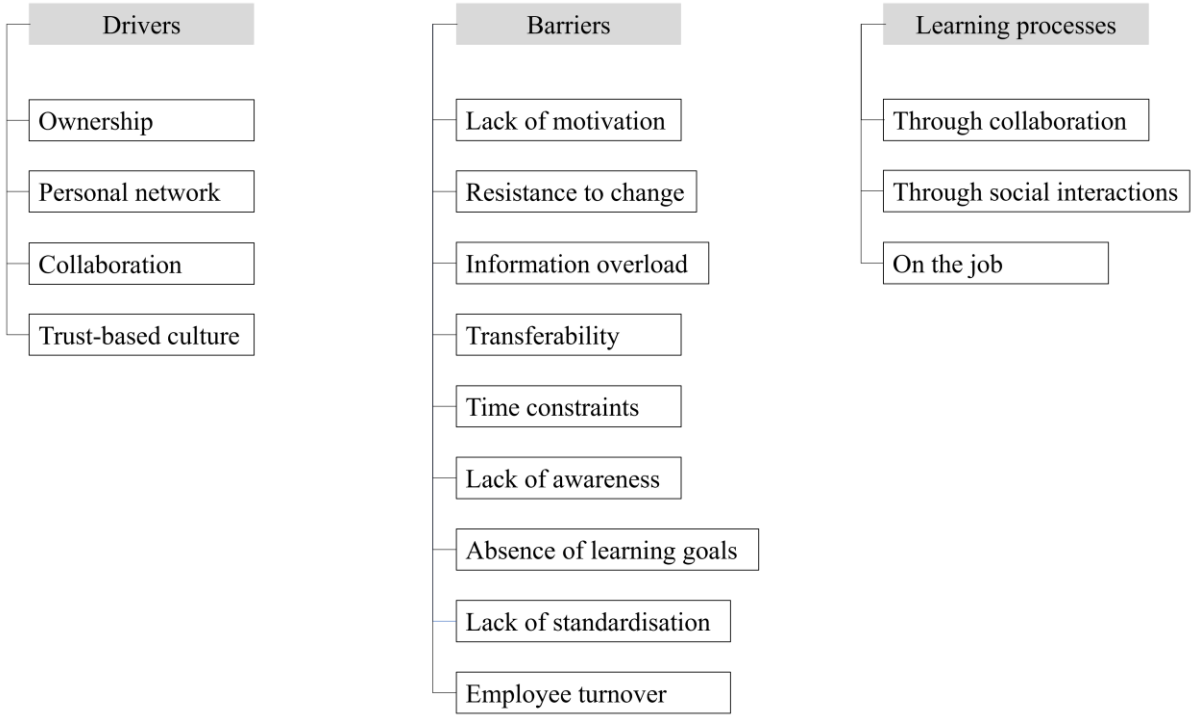
Chapter 5 Data Analysis and Results

5.1 Interview outcomes

In this chapter, the outcomes of the semi-structured interviews with practitioners in the case organization are presented. The researcher sorted the interview data to display the learning mechanisms, barriers, and drivers. Through thematic analysis using ATLAS.ti software, the researcher clustered codes to create themes. These themes are depicted in Figure 3 and will be explored in greater detail in the following sections.

Figure 3

Themes obtained from data analysis using ATLAS.ti



5.1.1 Current learning processes

5.1.1.1 Learning through collaboration

The interviews showed that collaboration is an effective means of reusing knowledge and also a driver for continuous learning in the organization. In line with this observation, the Associate Director (X7) who led the BPM initiative asserted that early stakeholder involvement was fundamental to improving the effectiveness of the initiative. Furthermore, the stakeholders were regarded as ‘co-creators’ of the process, enabling active participation in developing the initiative and collaborating to enhance its utility. Mahr et al. (2014) highlighted the significance of utilizing the diverse knowledge held by various stakeholders to engage in both exploratory

and exploitative learning when collaborating on a joint endeavour. This was further emphasized by the interviewee:

"We try to get as many key stakeholders from the different teams of people who will actually be using this tool. We found that if you bring the people together early enough, and they start co-creating, they get enthusiastic and understand why this (BPM initiative) is important." (X7)

Project teams often consist of individuals with different levels of experience, presenting opportunities to exchange knowledge and learn from each other. These interactions are characterised by mutual respect between both individuals, a desire to learn, and the willingness among senior managers to share their experiences. The interviewee stated:

"The younger person learns from the more senior managers but it benefits both ways because the younger person can maybe do certain things more quickly and has a fresh perspective, but the senior PM must be open for that." (X6)

Project P1 involved two different teams from different business lines, assigned to the conceptual design and basic design phases. Although key personnel from the first phase were continued in the second phase, the client expressed dissatisfaction with the communication and coordination between both teams, to which the Assistant Project Manager responded:

"We delivered the cost estimate previously, but it was another project team, so the communication wasn't really easy for us. Of course, we are one company, but in the end, we were not responsible for the previous cost estimate as a project team." (X2)

This response indicates some defensiveness and distancing from the previous team's deliverable. Furthermore, "we are one company" suggests the client may have expected that both teams being a part of the same organisation would naturally lead to seamless collaboration. Consequently, this situation emphasizes the importance of collaboration supported by effective communication regarding client expectations, especially when multiple teams are involved across different project phases.

In addition, the project manager of P2 was asked about any communication and coordination issues that arose owing to the dispersed geographical locations of the teams – project management team in the Netherlands, the on-site team in Malaysia, and design expertise from Vietnam. Interestingly, she emphasized that it was easier to coordinate with the team in Vietnam than with her team in the Netherlands. According to her:

"Honestly, I feel that they have more of a team feeling than we do here. They always work together in the same office and sit together for discussions even when they are working on different projects. We don't do that often here so it's a bit challenging to coordinate." (X4)

This statement indicates that close collaboration and teamwork can make knowledge sharing seamless. The Vietnamese team's practice of sharing experiences even on different projects can strengthen cross-project learning. These observed differences could be influenced by cultural factors which can impact how effectively knowledge is shared and reused within teams.

5.1.1.2 Learning through social interactions

Within RHDHV, knowledge is shared primarily through interactions between people. These interactions depend on the personal networks established in the organization, which can assist in identifying 'the right people' for knowledge capture. One of the interviewees emphasized the importance of these networks, particularly in the context of a group designed for like-minded professionals under the age of 35. This network serves as a platform for face-to-face and online events, enabling the exchange of ideas and expertise among peers. Furthermore, he emphasized that the choice to learn ultimately lies with the individual:

"There are many face-to-face and online events where you get to know people and exchange ideas. It's really up to you if you want to learn." (X2)

Although the organization has various tools to capture knowledge, its reuse to enhance learning is limited. For instance, the complete context of project knowledge to increase its transferability from one project to another can be difficult to capture for repository-based reuse. This sentiment was corroborated by an interviewee:

"You can't write down everything in a database. It's hard to capture nuances so putting a face to the data always helps with that." (X6)

The inability to codify these nuances could lead to the question of whether knowledge repositories are effective in realizing their intended purpose. Alternatively, it could be interpreted that the organization's formalized systems lead to the creation of social learning opportunities. Therefore, databases should not be completely discarded, because they can offer the means to identify individuals involved in similar projects. Consequently, they make the job of finding the "right people" much easier. This was also indicated by an interviewee:

"I want a way to search for people. If there is a canning line, can I get someone else who did that? Can they help me find what are the things to look for and pay attention to in my project? What problems will my design manager or structural engineer face?" (X4)

Another key factor required for successful social learning interactions was found to be 'trust' in the credibility of knowledge sources. One of the interviewees mentioned the importance of seeking trusted individuals when trying to solve a project-related issue:

"If I can't sufficiently describe the problem myself, I'll go find somebody else that I trust and I know they have some experience in solving those problems." (X8)

To summarize, these responses from the interviews highlight the key role of trust, personal networks, and interpersonal relationships in the success of knowledge capture and reuse. Social interactions are the foundation for effective learning and knowledge sharing within the organization.

5.1.1.3 Learning on the job

Projects act as sites for 'knowledge creation', presenting individuals with opportunities to learn. Although resources within and outside the project environment contribute to individual growth, a substantial part of knowledge is gained through learning on the job. It often involves a cycle

of trial, error, and improvement, exemplifying a culture that values learning from mistakes, as asserted by an interviewee:

"I think you have to do some projects to gain experience and feel like it's getting easier. You're making mistakes but then of course you're learning not to repeat them." (X3)

However, just gathering knowledge is not enough to build individual learning capabilities. It requires active usage to effectively integrate that knowledge. This process relies on reusing knowledge within project-specific contexts, which was put forth by an interviewee:

"When you execute the knowledge, you really thrive. So the learning curve shouldn't always be steep, but you should have some time to evaluate and to use it actively. This way you put it in your system, which is also important." (X2)

These responses indicate that 'learning on the job' is not limited to knowledge capture but extends to its actual usage, sharing previous project experiences through lessons learned, and skill development.

Furthermore, regarding how lessons learned and project evaluations are structured, one of the interviewees stated:

"We do lessons learned sessions or evaluations but only when something goes wrong. We don't do them for all projects. Depends on a lot of things like its size, scope, etc. Sometimes, we have evaluations, and the next year, another project team faces similar issues. And if I run into them then we share ideas. So we are learning by coincidence." (X8)

This statement indicates that the evaluations are only conducted for projects that meet certain criteria. Furthermore, it leads to the conclusion that learning is a 'reactive endeavour' as opposed to being 'proactive'. Additionally, the interviewee highlights the need for a more structured and active approach to capturing and sharing lessons learned.

5.1.2 Drivers

5.1.2.1 Individual drivers

Ownership

The BPM initiative showed that co-creation resulted in a sense of involvement among the stakeholders. This ownership mentality increased their enthusiasm to enhance the effectiveness of the initiative. Furthermore, it emphasizes the importance of promoting individual ownership and motivating contributions to project-based learning. An interviewee confirmed this sentiment when asked about the location of lessons learned in the monthly health check reports:

"Honestly, I don't know. I would like to see them go somewhere. What is being done with these lessons?" (X4)

Additionally, the project manager who led P1 was the driving force behind the lessons learned session. He shared the template with quality assurance professionals for organization-wide dissemination, but it remains unclear whether it was disseminated to other project managers or if they were even informed of its effectiveness.

Personal network

Several interviewees cited that they rely on their personal networks within the organization to access knowledge and experiences. They also highlighted the practice of seeking insights by connecting with individuals who might have had similar experiences in previous projects. Additionally, one interviewee emphasized leveraging trusted personal networks to access broader organizational connections:

"I depend a lot on my management team for connections with other disciplines of the organization for any issues. So it is not just my immediate network, but theirs too." (X4)

However, building these networks can be difficult, because they depend on an individual's tenure within the company. Therefore, project managers with limited experience often face challenges in identifying "the right person" in case of any problems (X2). To address this, one of the interviewees indicated that organizational support is crucial in facilitating the development of networks across departments (X6).

5.1.2.2 Project-specific driver: Collaboration

Effective collaboration relies on a strong sense of trust among team members. This was evident in the case of project P1, where initially, the entire team showed some resistance to the weekly meetings, deeming them "too often". However, during the lessons learned session, they recognized the importance of these meetings which resulted in better alignment of each other's responsibilities. This shift in opinion displays the team's trust in each other and their readiness to admit misconceptions.

Additionally, the project manager (X1) introduced a project board for task allocation, and it was highly successful. When he transitioned to his next project, some of the P1 team members continued to work with him and promptly adopted the project board after witnessing its efficiency firsthand. This shows effective knowledge reuse from a previous project. Therefore, it can be concluded that a reciprocal relationship exists between collaboration and learning. Collaboration is both a means of learning (acquiring knowledge) and a skill that can enhance learning outcomes.

5.1.2.3 Organisational driver: Trust-based culture

The organization's 'family culture' (X7) encourages approachability and experience-sharing among its members. Senior project managers readily consult their junior counterparts for input, reflecting a culture of mutual respect (X2). As a network-based organization (X6), driven by people (X3), RHDHV maintains a relatively low hierarchy. This structure provides individuals with the autonomy to assess a situation before executing instructions, as indicated by one of the interviewees:

"When you are forced to follow instructions then that's not good for learning. Because then you don't think but just follow blindly. You will lose out on knowledge." (X2)

This open and collaborative culture was displayed in project P1, where weekly review meetings concluded with the question "Does anyone need help?". The question was worded deliberately

by the project manager to motivate team members to seek assistance freely, in an environment of trust and mutual respect (X1).

5.1.3 Barriers

5.1.3.1 Individual barriers

Lack of motivation

Although mechanisms for capturing and sharing knowledge do exist, there is a significant lack of motivation among individuals to actively engage in these processes. For instance, the project manager of P2 (X4) emphasized that ongoing projects always take preference over knowledge capture. The urgency and high priority assigned to projects discourage project managers from reflecting on learning opportunities. While previous attempts have been made to organize knowledge-sharing sessions within the organization, infrequent occurrences have led these sessions to "one-hour lectures" (X3). Furthermore, project managers do not perceive significant value in the potential reuse of this knowledge, which further decreases their motivation to conduct reviews and lessons-learned sessions.

Stubborn/ resistant to change

Project managers often resist adopting new ways of working, preferring to maintain their individuality. This was asserted by one of the interviewees:

“Project managers are a stubborn bunch. We don’t want to use templates made by others.” (X6)

The resistance to change acts as a barrier to consistent project execution in the organization and hinders learning capacities. This stubbornness was partially attributed by an interviewee, to RHDHV’s culture of favouring autonomy over enforcement:

“Just tell them to do it. You can’t keep entertaining complaints that a button is somewhere else.” (X1)

5.1.3.2 Project-specific barriers

Information overload

Information overload, due to an overwhelming volume of emails and project data, acts as a substantial barrier to knowledge reuse and learning within organizations. The flood of information can lead to confusion and hinder the identification of relevant knowledge. This sentiment was put forth by an interviewee:

“Who decides what should be captured, (and) what should be thrown away?” (X3)

Without a clear prioritization system, recognizing critical and reusable knowledge becomes challenging. Additionally, the question of how knowledge is captured invites concerns about the reliability and retention of knowledge.

Transferability

The context of knowledge created or shared in a project limits its reusability in another project. This aspect was extensively covered in extant literature as well. P2's project manager stated that while the lessons were documented for future use, she remained one of the few people who could actually apply them. This could be because she was also one of the authors and therefore, the context required to reuse that knowledge was clear to her (X4).

Another perspective, as articulated by interviewee X3, doubted the practicality of broadly reusing knowledge due to project heterogeneity:

"All these projects are completely different. How can I reuse that information? Because there are no copy-paste options. There is no one-size-fits-all. It's always other people. Other circumstances all the time." (X3)

However, he stated that project managers must take the lead in enhancing knowledge reusability, due to their broad team oversight and understanding of knowledge dynamics.

Time constraints

The interviewees acknowledged the value of learning from previous experiences but many cited project-imposed time constraints as a major barrier to knowledge capture and reuse. Furthermore, project managers are compelled to prioritize project execution and address immediate project-related issues (X2). Managing multiple projects further complicates resource allocation, making it difficult to set aside dedicated time for project reviews, especially when facing impending deadlines (X7). As the project reaches its end, final invoice payments and other administrative tasks take precedence, averting attention from reflecting on learning opportunities.

5.1.3.3 Organisational barriers

Lack of awareness

Regarding the documentation of lessons learned in the Health Check, only one interviewee (X4) confirmed its practice. The remaining interviewees showed a significant lack of awareness regarding this feature, despite performing/overseeing monthly Health Checks. In addition, the QHSE manager pointed out that most project managers are unaware of the location of these lessons given that they are set in the organization's data management system. She emphasized this by stating:

"It's like the national law, everyone should know it but nobody actually does." (X9)

This organizational shortcoming in raising the adequate level of awareness, limits project managers' ability to use knowledge capture systems effectively.

Absence of learning goals

The absence of well-defined learning goals hinders the identification of critical knowledge, resulting in disorganized knowledge management efforts. Consequently, the knowledge repository may become overcrowded with less important or outdated knowledge (X3). Furthermore, the QHSE Manager (X9) attested that lessons documented through various intranet channels remain unaudited and unreviewed. Additionally, in a dynamic organizational

setting, the misalignment between knowledge capture and evolving priorities can cause valuable insights to be lost.

One interviewee (X8) expressed concern about resistance to mandated close-out procedures. Nevertheless, emphasizing the expectation of capturing lessons learned and reflecting on learning opportunities, might be a more effective approach to counter any resistance. Therefore, a clear top-down directive has the potential to motivate individuals to align their work accordingly.

Lack of standardisation

A common source of dissatisfaction among the interviewees was the absence of standardized procedures for capturing knowledge and implementing consistent project practices. Currently, project managers have autonomy in structuring their projects, which results in a lack of consistency in multi-team projects (X8). In particular, there are three distinct document storage platforms – Asite, SharePoint, and Microsoft Teams; utilized at the discretion of the project team, often dependent on the project manager's preference (X1). Interviewees expressed a common desire for "one way of working", particularly regarding document storage, the organization of change management procedures, and templates for lessons learned (X1).

Moreover, an interviewee suggested that the absence of a standardized template for documenting lessons learned may de-motivate individuals from proactively engaging in this practice (X7). For instance, in Project P2, the project manager highlighted the standardization of certain procedures due to the organization's longstanding relationship with the client and the recurring projects in that account.

Employee turnover

At RHDHV, the impending departure of senior professionals presents a barrier to knowledge capture and reuse in the organization. These individuals have played a fundamental role in establishing organizational standards and authoring process manuals. Their knowledge is deeply connected to their experiences, which makes it challenging to transfer. Furthermore, this barrier highlights the organization's overdependence on a handful of experts. This was emphasized by an interviewee:

"If they (experts) leave tomorrow, what can we do? Their knowledge leaves with them. So we recognize that this (employee turnover) is an issue and we are working on succession management." (X6)

To mitigate this barrier, RHDHV has initiated succession management efforts, aiming to pair senior professionals with junior counterparts for knowledge transfer through shadowing (X8). Knowledge mining sessions are also being conducted to codify their accumulated expertise (X7). However, the threat of knowledge loss upon their departure demands continued attention and proactive strategies.

5.1.4 Evaluating knowledge management in RHDHV

The corporate QHSE manager's interview revealed some issues within the organization's knowledge capture and sharing systems. To begin with, there is a lack of awareness among

employees, particularly project managers, regarding the existence of knowledge capture tools. Moreover, integration issues exist between the knowledge systems, resulting in fragmented information storage and making it difficult for users to access and retrieve relevant data. For instance, the lessons learned are obtained through forms on the intranet but the final location of these lessons is not embedded well into the organizational data management system. Additionally, there is no structured process for evaluating or auditing the stored knowledge, leading to a lack of clarity on the usefulness or applicability of lessons learned. This absence of evaluation might result in outdated or irrelevant information remaining in the systems. The interviewee suggested that the company should focus on comprehensive training programs to raise awareness about these knowledge systems.

5.1.5 Co-occurrence of codes

ATLAS.ti allows codes that were mentioned together to be compared and analysed for interrelations. This is depicted in a 'code co-occurrence table' as shown in Table 7. The numbers indicate how frequently the codes occurred together in statements made by interviewees. Since the codes were quite large in number, only the frequencies greater than or equal to 3 have been included in this table.

Table 7

Co-occurrence table adapted from ATLAS.ti output

Codes	Collaboration	Social interactions	Trust	Ownership	Proactive learning	Tacit knowledge
Knowledge silos	3					
Lack of motivation	3			4		
Personal network		7	8			3
Project context		4				4
Resistance to change	5			3		
Time constraints					3	
Low hierarchy		4	3			
Openness		6	5			

These co-occurrences indicate a possible relation between the two codes. For instance, ownership co-occurred with collaboration and lack of motivation. It was interpreted that ownership strengthens individual identity and when contributions to knowledge capture are recognized by peers, it motivates individuals to participate proactively in future learning processes. When individuals feel a sense of responsibility for their learning contributions, they are more likely to overcome the 'lack of motivation' barrier. For example, the project manager

of P1 (X1) created a user-friendly lessons-learned template. Later on, other project managers contacted him to use his template in their evaluations. This clearly shows that the reuse of knowledge acquired in a past project is a direct consequence of taking ownership.

Collaboration in projects is closely associated with team members sharing knowledge and experiences for the benefit of the project and each other. This was evidenced by the lessons learned session in project P1, wherein, the project manager (X1) ensured that all discipline leads were consulted before capturing the lessons. This led to a comprehensive discussion and also created an environment of inclusion in the team, thereby motivating them to participate actively in the close-out session. Promoting collaboration can decrease the resistance of individuals to adopt new ways of working as witnessed in the adoption of the project board in P1.

Proactive learning could enhance team building by motivating team members to collaborate continuously, not just to solve issues (reactive) but to enhance the overall project outcomes by learning from each other. For example, in Project P2, the project manager (X4) expressed an interest in introducing a new practice for upcoming projects within the same client account. They plan to conduct lessons-learned sessions at the project kick-off to anticipate potential risks based on past project experiences. When project teams actively identify learning opportunities and take the initiative to learn before issues arise, they can manage time constraints efficiently.

Trust and personal networks are interrelated, crucial for identifying experienced managers and gathering insights. Cultivating a culture of trust within the organization is pivotal to bolstering these networks. Trust in leadership to embrace failures as learning opportunities and in team members to share mistakes fosters continuous learning without fear of judgment.

Lastly, low hierarchical organizations with an open culture support social interactions (Table 7), fostering trust among individuals—a vital component in promoting knowledge sharing and learning within an organization.

5.2 Guiding principles for knowledge reuse

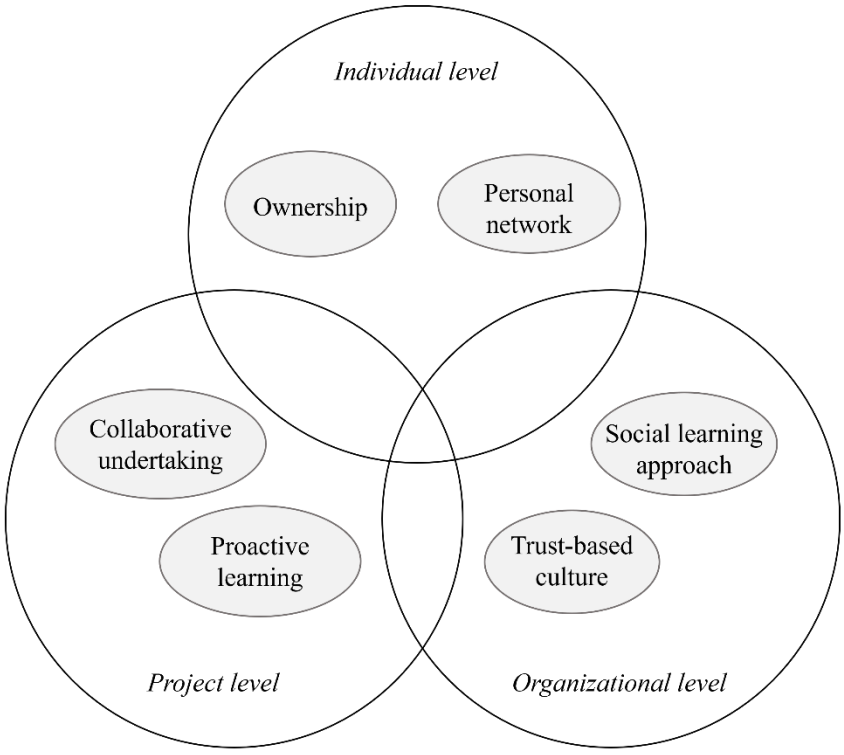
To enhance learning processes and improve the reuse of captured knowledge in organizations, the researcher identified ‘principles’ that can drive these efforts. These principles have been developed based on the drivers, barriers, and co-occurrence of codes discussed previously. These principles are designed for engagement at the individual, project, and organizational levels, granting flexibility to adapt and address specific learning needs. The visual representation of the principles is shown in Figure 4.

1. **Ownership**:
   It is meant to motivate individuals to take responsibility for their learning, actively share experiences, and embrace a culture of continuous improvement.
2. **Personal network**:
   It calls for the development of networks between individuals to foster cross-discipline collaboration and diverse knowledge access.

3. **Collaborative undertaking**:
   It establishes that learning is a collaborative undertaking and knowledge can be captured and shared better together.
4. **Proactive learning**:
   It calls for a shift from learning in response to problems (reactive), to actively identifying opportunities for knowledge reuse (proactive).
5. **Social learning approach**:
   It emphasizes that learning is a social endeavour, and necessitates organizations to facilitate frequent social interactions for individuals to share experiences and knowledge.
6. **Trust-based culture:**
   Trust among individuals necessitates open communication, mutual respect, and empathy for each other's learning needs.

Figure 4

Principles to promote knowledge reuse and learning



Note. These principles have been distinguished across the individual, project, and organizational levels in the same organization.

The driving principles are meant to guide organizations willing to streamline their learning processes and harness captured knowledge for reuse. In project environments, the boundaries of learning on the above-mentioned levels may not be demarcated. Furthermore, applying the principles together can improve the synergy of learning processes. This aligns with the

transition from a process-oriented approach to a principle-driven approach as indicated in Project Management Book of Knowledge (Project Management Institute, 2021)

In this study, it was recognized that individuals find social interactions to be the most effective way of sharing knowledge while keeping the context around it intact. This shows how social learning environments can improve the transferability of knowledge assets. Therefore, organizations must facilitate social learning environments where project teams and individuals can share experiences and mistakes without fear.

To foster a sense of ownership, organizations should institute systems that recognize and reward individuals actively contributing to knowledge capture and sharing. Empowering individuals through platforms where they can showcase their experiences and learned lessons will nurture a culture of continuous improvement. Encouraging cross-disciplinary forums and mentorship programs can strengthen personal networks, facilitating diverse knowledge sharing and collaboration among professionals from different departments. Establishing structured sessions for project teams to collaboratively capture and share their project experiences, emphasizing inclusivity and comprehensive discussions, aligns with the principle of collaborative undertaking.

Introducing proactive learning measures, such as pre-project kick-off sessions aimed at identifying potential risks based on past project experiences, and emphasizing continuous collaboration among team members beyond issue-solving, aligns with the principle of proactive learning. Encouraging storytelling sessions and creating social learning platforms where experiences and mistakes can be shared without judgment fosters an environment conducive to social learning approaches.

Conducting leadership workshops can promote the importance of trust-based cultures in the organization. Developing interactive platforms or forums that facilitate social learning through storytelling, discussions, and knowledge exchange can effectively put these measures into action, ultimately fostering a robust learning culture emphasizing knowledge reuse, collaboration, and proactive learning in organizations.

5.3 Expert Validation

The research incorporated an expert interview with the Line Manager at PM&C AG to validate the research findings and assess their practical applicability. The choice of the interviewee was founded on his experience in the project management field (13 years) and thus, his ability to offer reflective insights into the research. This section presents an overview of the interview process, significant findings, and the feedback provided to the researcher.

5.3.1 Interview Procedure

The interview was recorded with prior consent, and it involved presenting the research results as outlined in the thesis, including the current learning mechanisms, drivers, barriers, and guiding principles. The approach for obtaining feedback was structured, with questions asked after each research segment to ensure that feedback was collected progressively rather than at

the end. This feedback was gathered through questions such as "What are your thoughts?" "What can be improved?" and "Is this valid?".

5.3.2 Expert Feedback

- While the interviewee agreed with the research results, he emphasized the need for actionable measures to leverage the principles for knowledge reuse.
- Moreover, the interviewee suggested expanding on specific aspects, such as "lack of awareness" and the significant role played by "knowledge groups" in the effective reuse of captured knowledge.
- Lastly, the interviewee asserted the role of leadership in facilitating a culture that prioritizes learning and he is of the opinion that the change in mindset must be driven from the top-down.

The feedback provided by the interviewee has been addressed by the researcher in the following section.

5.4 Measures for knowledge reuse

5.4.1 Leveraging existing knowledge for projects

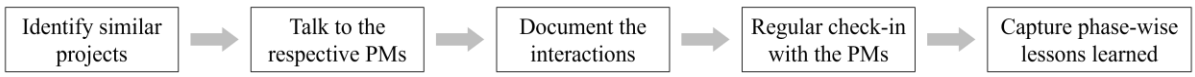
- **Identify similar projects**: All completed/ongoing projects must be categorised based on scope, area, business case, project phase, and other relevant details. This compilation should be reviewed regularly by a quality control team to ensure that it remains updated. The purpose of this compilation is to enable project managers to identify similar past projects in the organization before they initiate a new project.
- **Tap into PM networks**: The project managers should reach out to experienced project managers who have previously handled similar projects. Following that, they must initiate meetings or discussions with the identified project managers. Some important topics that could be discussed are – organizing the project, risk management, document control system, client communication, successful strategies, and lessons learned.
- **Document experiences**: These conversations can be noted down or recorded (with consent) and the gained insights can be summarized for future reference.
- **Synthesize and share knowledge**: The tacit knowledge from these discussions can be combined with the documents gathered from the organization's database, for a complete picture of that project. After charting out potential issues, best practices, and anticipated results, the project manager must share these findings with their team. This stimulates critical discussions and could potentially lead to new strategies, risk mitigation plans, and contingency approaches.
- **Review and reuse**: Maintain open lines of communication with the knowledge sources (experienced PMs) to facilitate active reuse of past knowledge to solve current issues. Regularly reviewing project plans and seeking additional support when facing challenges cultivates a culture of continuous learning and improvement throughout the project lifecycle.
- **Phase-wise lessons learned**: The project manager should conduct regular "lessons learned" sessions after each project phase to actively capture new insights. The outcomes of these

sessions should be shared across the organization to embed the lessons into the organization’s memory. This enables potential reuse of knowledge in upcoming phases.

While this process might appear challenging to integrate within tight project schedules, adapting it to suit the project manager's convenience can promote repeated successes and prevent failures. A simplified depiction of this procedure is outlined in Figure 5.

Figure 5

Procedure for project managers to leverage past knowledge in new projects



5.4.2 Strengthen Communities of Practice

To reuse knowledge that already exists in the organization, a strategic approach is required to prioritize learning. This can be achieved by setting learning objectives that align with the organization’s larger strategic goals. Furthermore, fostering Communities of Practice (CoPs) within the organization, facilitates collaborative learning and knowledge exchange. Granting these CoPs the autonomy to collaborate across departments can break knowledge silos and make learning a more inclusive endeavour. This was practised by the Knowledge Groups of RHDHV.

The potential of CoPs to have measurable impact is a critical component of their effectiveness. The organization can monitor the progress and development of these groups by defining particular metrics or key performance indicators (Probst & Borzillo, 2008). These indicators must be closely related to the CoPs' goals to demonstrate how they contribute to overall organizational goals. This further strengthens their position within the organization and serves as a proof of concept for potential resource allocation. Furthermore, to maintain the excitement among CoP members, bringing in experts from outside organizations for open discussions can stimulate the sharing of experiences and promote natural dialogue.

5.4.3 Databases, awareness, and quality control

A centralized repository should be developed within the organizational data management system to ensure the seamless storage and retrieval of lessons learned. A structured process for regular evaluations or audits of stored knowledge should be followed. This involves establishing criteria to assess the relevance and applicability of the knowledge inputs, and ensuring outdated or irrelevant data is promptly removed or updated.

Dedicated individuals or teams should be assigned for managing the maintenance, evaluation, and continuous improvement of these knowledge systems, ensuring continuing effectiveness and relevance.

Chapter 6 Discussions

6.1 Comparing theory and results

This research draws significant parallels between the identified literature and the data analysis results, particularly in emphasizing the social learning approach. Both literature and this study underline the significance of social interactions and the learning derived from engaging with peers or within communities. The literature emphasizes the pivotal role of communities of practice (CoPs) in facilitating knowledge exchange (Probst & Borzillo, 2008). Similarly, the thesis findings shed light on the importance of personal networks, trust, and strong interpersonal relationships as foundational elements in both capturing and reusing knowledge within an organizational setting.

Moreover, the analysis of communication and collaboration resonates strongly across both the literature (Davenport & Prusak, 1998; Hendriks, 1999) and this research's outcomes. They converge in highlighting communication and collaboration as indispensable factors in facilitating effective knowledge transfer. Both sources emphasize the value of employing both formal and informal communication methods (Xu et al., 2017), stressing the necessity for ongoing and regular interactions among team members to foster knowledge exchange and reuse.

In addition, when addressing the barriers to knowledge reuse, both the literature and this thesis uncover several common issues. Both identify challenges such as lack of motivation, time constraints, and concerns regarding the reliability and transferability of knowledge as prevalent obstacles hindering the effective reuse of knowledge within organizational contexts. These identified barriers collectively pose significant challenges that limit the seamless reuse of knowledge in organizational settings, as highlighted across both the literature and the data analysis findings.

Nevertheless, one original research outcome in comparison to literature is – the impact of individual ownership on driving knowledge reuse in projects, which was uncovered in the interviews.

6.2 Learning: priority to value

Learning from past experiences within project-based organizations appears to be lacking a crucial level of emphasis. This might be attributed to the relatively lower stakes involved, especially when compared to high-stakes industries like safety and healthcare where human lives are directly affected. Consequently, there is a need to introduce a sense of urgency to initiate this necessary change.

One approach to achieving this transformation is to shift the focus from considering learning as merely a "high priority" to recognizing it as a matter of "high value." By making individuals firsthand witnesses of the tangible benefits that learning can bring, the urgency and commitment to this change can be effectively fostered.

While the principles discussed in the previous chapter have the potential to promote effective knowledge reuse in organizations, they can pose some risks. Although individual ownership of knowledge and learning journeys can improve capabilities, it can lead to individuals working in an isolated manner due to a possible belief that they can succeed in learning independently. This can be overcome by promoting the benefits of sharing experiences with colleagues. Organizations should encourage participation in group learning activities, and mentorship programs to balance independent learning with collaborative opportunities.

Organizations that are familiar with 'reactive learning' processes may show resistance to change towards 'proactive learning'. This change can be managed by providing training workshops that help individuals and teams identify learning opportunities. Furthermore, standardizing processes can also gain resistance from individuals who prefer freedom in organizing their projects. To combat this, organizations can leave room for customization in the templates and also invite feedback from the users to make them more user-friendly.

The interviews highlighted several drivers but the role of leadership in improving learning processes and harnessing knowledge for reuse has not been explored much. Nevertheless, extant literature places significant responsibility on leadership to coordinate learning efforts in the organization, particularly by fostering a trust-based culture (Vashdi et al., 2019).

This thesis is focused on knowledge reuse but several interview outcomes and literature findings are centred on learning. Nonetheless, this implies learning is a precursor to knowledge reuse i.e., individuals and organizations must learn from past experiences before reusing/applying that knowledge. Furthermore, as witnessed in the interview outcomes, continuous learning promotes the active reuse of knowledge. Therefore, organizations that prioritize learning are more likely to encourage individuals to seek, capture, and reuse knowledge.

Literature has shown a strong connection between collaboration and goal setting. An organization that champions individual learning and sharing experiences with colleagues is favourable to positive work outcomes, promoting collaboration, and shared goals. (Caniëls et al., 2019).

6.3 Theoretical implications

In the domain of knowledge management within project-based organizations, a significant gap continues regarding knowledge reusability. The case study, not only provides reusable knowledge assets but also explains the critical situations that prompt learning from past experiences.

This research contributes to the relatively limited body of knowledge about multi-level learning in project-based environments, i.e., the individual, project team, and organizational levels. The conceptual model of guiding principles developed in this study can be used for empirical testing by future researchers. Lastly, this study reinforces the crucial role of social interactions among individuals in enabling learning between projects, aligning with the existing literature in this domain.

6.4 Practical implications

While organizations invest their resources in creating extensive knowledge databases and repositories to improve learning across projects, this research reveals that true learning primarily occurs through social interactions. Consequently, this highlights a transition from "learning from repositories" to "learning through social means."

Furthermore, it underlines the significance of organizational culture, particularly one built on trust, in enhancing learning processes and promoting the reuse of knowledge. It also advocates for the development of personal networks, the establishment of communities of practice, and the creation of a blame-free organizational culture. These elements foster social environments conducive to capturing and reusing knowledge through continuous learning.

Lastly, through the guiding principles, this study places equal importance on both top-down and bottom-up approaches, to foster knowledge reuse at all levels of the organization.

6.5 Limitations

This section acknowledges the research limitations that influence the validity and relevance of this study.

This research, primarily focusing on project-based organizations, does not specify a particular industry. This could introduce potential inconsistencies in understanding the characteristics inherent to various industries. The findings of this study, derived from a single case study and a relatively limited sample set of interviews, may not be applicable to all organizations. Furthermore, the expert interview offers validity of the findings, but including more experts would undoubtedly enhance the credibility of the research.

Despite the effort to keep the interviews open-ended to limit response bias, some degree of inherent bias in the interview responses is inevitable. Additionally, the researcher's interpretation of the interview data may possess a certain amount of subjectivity, probably leading to different conclusions by other researchers.

The research does not discuss the extensive influence of technology and tools on knowledge reuse and learning, thereby overlooking an important aspect of present-day organizations. Furthermore, the applicability of the guiding principles to smaller organizations, with possible resource constraints and organizational structure, remains unaddressed.

The research offers a high-level overview of the interrelationships between the guiding principles without an in-depth exploration. This limitation may hinder the practical incorporation of the principles. While the guiding principles provide a theoretical foundation, their practical implementation may encounter challenges due to organizational culture, individual resistance, and other factors. This research does not elaborate on these potential hurdles.

Additionally, the long-term impact of the guiding principles on project performance remains unstated, which could cause readers to doubt whether they contribute to long-term improvements in knowledge reuse.

Chapter 7 Conclusion and Recommendations

This concluding chapter revisits the research questions and provides a summary of the research. The Master's thesis focuses on the subject of knowledge reuse within project-based organizations.

The initial phase of research involved conducting a literature review on knowledge management, with a particular emphasis on knowledge reuse in project backdrops. Subsequently, a case study was conducted within an engineering consultancy firm, Royal Haskoning DHV, with a specific focus on two projects within the Industry & Buildings business line. The case study was designed to investigate the existing processes for learning, knowledge capture, and knowledge reuse. Following that, semi-structured interviews were conducted with practitioners directly involved in these projects. These interviews played a crucial role in finding the main drivers and barriers that impact knowledge capture and reuse within the organization.

In the upcoming section 7.1, the research questions will be addressed, following which, in section 7.2, practical recommendations will be presented. Finally, in section 7.3, potential areas for future research are discussed, highlighting topics that call for further research.

7.1 Answering research questions

7.1.1 What is the current state of capturing and re-using knowledge in projects?

The current state of knowledge capture and reuse in organizations is characterized by both recognition of its importance and the challenges involved in achieving it. Organizational learning is seen as an important component, where knowledge generation and documentation play a central role. However, there is a notable "learning paradox" associated with projects. While projects serve as grounds for knowledge creation and innovation, their transient nature often inhibits the integration of this knowledge into the broader organizational context.

Two distinct approaches to knowledge sharing, codification, and personalization, have been identified in the literature. Codification involves the documentation of knowledge in repositories, whereas personalization relies on direct personal interactions. The choice between these approaches depends on the nature of the knowledge being shared, with tacit knowledge better suited for personalization and explicit or codified knowledge for documentation. However, maintaining an up-to-date knowledge database through codification can be resource-intensive. The interviews highlighted the necessity for standardized protocols during project closure and documentation of lessons learned. Codifying explicit project knowledge will significantly contribute to the organization's memory.

The interviews showed knowledge capture and reuse are observed in practice through collaboration, social interactions, and learning on the job. Collaboration is regarded as an effective means of reusing knowledge, with early stakeholder involvement and co-creation being emphasized. Knowledge sharing primarily occurs through interactions between

individuals, underlining the importance of personal networks and trust in identifying the right sources of knowledge. Learning on the job is a common practice, involving a cycle of trial, error, and improvement, with the organization's support being crucial for individual learning and development. Lessons learned sessions and post-project reviews remain popular mechanisms to capture knowledge. However, they are often conducted reactively after the project's completion, and hence, there is a call for a more structured and proactive approach to knowledge capture and sharing. Furthermore, the 'fit-for-purpose' application of lessons learned from one project, to another project remains unclear.

7.1.2 What are the key drivers and barriers to effectively reusing captured knowledge?

7.1.2.1 Drivers

Effective knowledge reuse relies on a combination of key drivers, including communication, willingness to share knowledge, individual ownership, project-specific collaboration, and a trust-based organizational culture. Communication, both formal and informal, plays a pivotal role in facilitating knowledge transfer. Formal methods like training sessions and lessons-learned forums foster regular interactions, member engagement, and better project performance, while informal interactions during coffee breaks strengthen team bonds and trust.

Willingness to share knowledge is another crucial driver influenced by personal and organizational factors. Personal attributes such as attitude and self-efficacy, coupled with organizational elements like trust and supervisor support, foster a culture of knowledge exchange. The interviews showed that individual ownership serves as a driving force for actively engaging in knowledge capture and sharing. Additionally, personal networks play a pivotal role in identifying the most suitable individuals within organizations from whom knowledge can be sought.

Project-specific collaboration is vital, with trust among team members creating an environment where knowledge sharing and learning flourish. Collaboration mechanisms, including regular meetings and project boards, not only facilitate knowledge capture but also enhance knowledge reuse capabilities. At the organizational level, a trust-based culture is a critical driver. Organizations that promote trust and mutual respect empower open communication and knowledge exchange. For instance, organizational leadership fostering a culture of trust encourages sharing mistakes and successes without fear of judgment.

7.1.2.2 Barriers

In the context of knowledge reuse, barriers can impede the smooth transfer of knowledge and experiences, falling into three distinct categories: individual, project-specific, and organizational. At the individual level, a significant barrier is the lack of motivation. Project managers and team members may prioritize their ongoing projects over knowledge capture, often because they fail to see the value in potential knowledge reuse. Resistance to change and a preference for individuality can exacerbate this issue.

Project-specific barriers include information overload, where it becomes challenging to sift through large amounts of data to identify critical knowledge. The transferability of knowledge presents another issue since what's relevant in one project context may not easily apply elsewhere. Time constraints also play a role, with project managers and team members often having to prioritize project execution over dedicated time for reflection and learning.

Organizational barriers involve a lack of awareness regarding the documentation of lessons learned, which restricts the utilization of valuable knowledge. The absence of clear learning goals impedes knowledge management efforts, due to lack of clear directives. Furthermore, a lack of standardization, in document storage and change management procedures, results in inconsistency in knowledge management practices.

To address these barriers effectively, project-based organizations must focus on fostering motivation, promoting openness to change, and encouraging standardized procedures. Additionally, creating an organizational culture that values learning and actively supports knowledge sharing is crucial in mitigating these barriers. Finally, aligning individual and project goals with broader organizational objectives can help overcome these obstacles, ensuring that knowledge capture and reuse become integral components of the project life cycle.

7.1.3 How can knowledge reuse be promoted in projects?

The principles highlighted—ownership, personal networks, collaborative undertakings, proactive learning, social learning approach, and a trust-based culture—collectively form a robust framework that significantly promotes knowledge reuse within projects. By instilling a sense of ownership, individuals are motivated to take charge of their learning journey, actively contributing their experiences to foster a culture of continuous improvement. The emphasis on personal networks encourages the development of diverse networks, fostering cross-disciplinary collaboration and providing access to a wealth of knowledge.

Moreover, recognizing learning as a collaborative effort underscores the importance of collective knowledge capture and sharing. Proactive learning promotes a shift from reactive approaches, encouraging the active identification and usage of opportunities for knowledge reuse. Embracing a social learning approach acknowledges that “learning is inherently social”, necessitating frequent interactions to share experiences and insights. Finally, a trust-based culture establishes an environment conducive to open communication and mutual respect, fostering empathy for each other's learning needs, thereby enhancing the collective capacity for knowledge reuse within project-based environments. Together, these principles form a comprehensive framework that not only encourages but actively compels the reuse of knowledge.

7.2 How can previously captured knowledge be reused in current and future projects?

Organizations are increasingly recognizing the need to replicate successful practices and learn from past project failures (Zhang, et al., 2021). In line with this need, the research outlines

critical mechanisms and driving factors to reuse previously captured knowledge in present and future projects. This study highlights collaboration, social interactions, and experiential learning (on the job) as fundamental components within the learning context.

The study emphasizes that early stakeholder involvement and co-creation play a fundamental role in enhancing the effectiveness of project-based initiatives. Stakeholders when seen as 'co-creators', actively participate in initiative development. Collaboration enables team members with varying levels of experience to share knowledge and learn from one another, characterized by mutual respect and a willingness to learn. Furthermore, this research highlights the reciprocal relationship between collaboration and learning. Ultimately, collaboration stands as a key driver for knowledge reuse in projects.

The research also indicates that knowledge is shared primarily through interpersonal interactions. Personal networks within the organization are crucial in identifying the right sources of knowledge. These networks provide platforms for exchanging knowledge and expertise among peers, facilitated by both face-to-face and online events. While databases have their place, their limitations in capturing project context make social interactions and events crucial for learning and knowledge sharing. Trust in the credibility of knowledge sources is important when seeking assistance and solving project-related issues. As such, social interactions serve as the foundation for effective learning within the organization.

Projects are acknowledged as sites for knowledge creation, offering abundant opportunities to learn on the job. This shows the importance of actively using knowledge to integrate knowledge effectively into individual and organizational systems. Balancing project-driven learning with organization-facilitated learning is essential for individual growth. The research notes that lessons-learned sessions tend to be conducted reactively when issues arise, suggesting the need for a more structured and proactive approach to capturing and sharing these lessons.

In conclusion, this research emphasizes the need to promote a culture of continuous learning to improve organizational performance. Furthermore, the role of leadership in cultivating a trust-based culture is of utmost importance. Prioritizing continuous learning and shared goals is essential in facilitating knowledge reuse, ultimately contributing to overall organizational success.

7.3 Recommendations for RHDHV

- An awareness campaign for project managers should be conducted, highlighting the existence and benefits of knowledge-capture tools. This can include creating easily accessible guides or tutorials on these systems.
- Comprehensive training programs should be developed for focusing on the functionalities and advantages of these systems. These programs should be mandatory for all employees involved in projects.
- Lessons learned captured from the Project Health Checks should be accounted for and returned to the owner in a usable form. This will encourage more individuals to contribute to these initiatives.

- Standardizing project close-out procedures, lessons learned sessions, and reviews, could provide individuals and project teams with a structured approach to organizing these efforts, thereby increasing their frequency. Furthermore, standardization can streamline information management, and enhance the reusability of captured knowledge.
- The current social learning system is quite well organised but it can be improved by setting some objectives for the Knowledge groups, in line with RHDHV's strategic goals.
- The case study findings emphasize the importance of early reflection within projects. Waiting until the end of a project for review or evaluation may be too late because experiences cannot be used to mitigate any issues (Chronéer & Backlund, 2015). Therefore, it is advisable for projects to initiate lessons learned reflections at the project's outset. In cases of long projects, it is recommended to schedule these reflection sessions regularly, such as on a monthly or bi-monthly basis.

7.4 Recommendations for practice

- Before starting a project, project managers are encouraged to seek advice from other experienced project managers who have handled similar projects. This tacit knowledge exchange, complemented by documented resources from internal repositories, provides project managers with a comprehensive perspective on what to anticipate.
- A centralized repository is essential to improve the accessibility of lessons learned gathered from various projects. Regular audits of this repository should be conducted to enhance its user-friendliness and remove outdated information, preventing information overload.
- To improve the applicability of lessons learned, they should be documented using common terminology. Categorizing these lessons by keywords, such as scope, area, business case, and other relevant topics, can further aid in their retrieval and use.
- Developing communities of practice (CoPs) and granting them the autonomy to collaborate with other teams and individuals will prevent knowledge silos from being formed.
- Lastly, organizations should highlight both success stories and failures. Fostering a culture that acknowledges positive outcomes, in addition to addressing negatives, can have a significant impact on motivation and team morale.

7.5 Future work

This research acknowledges several limitations, as previously discussed. However, it is worth noting that these limitations can also serve as a foundation for further research within this domain. Notably, there is limited literature on the reusability of knowledge, particularly concerning the specific aspects of captured knowledge that can be effectively reused within distinct contexts.

Additionally, future work could concentrate on understanding the influence of knowledge reuse on the management of cost and schedule overruns. By establishing measurable impacts of knowledge reuse, organizations can confidently invest in these initiatives.

The guiding principles derived from this study could be subjected to empirical validation through case studies or alternative research methods to assess their applicability in practical settings.

Furthermore, this research was conducted within the context of an engineering consultancy. So subsequent studies could extend their focus to other domains with diverse projects. For instance, the safety and healthcare sectors rely on standardized protocols and knowledge with high reuse value. Researchers can explore how learning mechanisms are achieved in these fields and compare them to the context of other sectors.

7.6 Personal reflection

This Master's thesis marks a significant milestone in my academic journey. Despite the initial uncertainty following the change from my original topic of interest, my supervisors offered invaluable support. While the topic did not resonate with me initially, I gradually realised that knowledge reuse as a topic holds relevance not just in project management but also in our daily lives.

This was the first time I positioned myself as a researcher so it was challenging to produce a consistent report at the end. During the data analysis phase, I slightly lost sense of the big picture and my report reflected this lack of cohesion. My supervisors rightfully pointed it out and I tried to integrate the literature, method, and results for better coherence.

My father's constant reminder "Ishtapadu, kashtapadaku" which loosely translates to "if you enjoy what you do, challenges won't seem that daunting", has been a guiding principle in this journey. Here are some lessons that I learned along the way –

Always have a plan B. No matter how carefully you design your timeline, unexpected disruptions often arise. I realized this when organizing semi-structured interviews without proper planning. Due to the summer vacation season in the Netherlands, I faced a four-week wait for the interviewees to return. This in turn, reduced the time available for analyzing the interview data.

Write first, edit later. My biggest challenge was articulating my thoughts into words. Writing the report was hard because it demands discipline over skill. I get caught up in details, which slowed me down. Before my greenlight meeting, I wrote every day for three weeks without constantly checking for mistakes. I only edited my work after finishing each chapter, and it turned out to be much more efficient that way.

Criticism of your work is not criticism of your worth. During my thesis, I received a lot of well-founded criticism and feedback. It can be overwhelming, but it is important to separate your self-worth from the assessment of your work. I made a conscious effort to maintain this perspective, allowing me to accept and act upon the feedback without it affecting my self-esteem.

Finally, this thesis journey was a rollercoaster ride with its fair share of ups and downs. Despite that, I am grateful for the opportunity to learn from some of the best minds in this field, and I am proud of the person I've become through the process.

References

Abdulkarim, S., Al-Eisa Furayyan, M., & Alhemoud, A. (2009). An empirical examination of the effects of self-efficacy, supervisor support and motivation to learn on transfer intention. *Management Decision, 47*(8), 1221-1244.

Ahmad, F., & Karim, M. (2019). Impacts of knowledge sharing : a review and directions for future research. *Workplace Learning, 31*(3), 207-230. doi:I10.1108/JWL-07-2018-0096

Alavi, M., Kayworth, T., & Leidner, D. (2006). An empirical examination of the influence of organizational culture on knowledge management practices. *Journal of Management Information Systems, 22*(3), 191-224.

Allen, T. J. (1984). *Managing the flow of technology: Technology transfer and the dissemination of technological information within the R&D organization.* MIT Press Books.

Argote, L. (2012). *Organizational learning: Creating, retaining and transferring knowledge.* Springer Science & Business Media.

Argyris, C., & Schön, D. A. (1978). *A theory of action perspective.* Reading, MA: Addison-Wesley Publishing Company.

Bakker, R. M., Cambré, B., Korlaar, L., & Raab, J. (2011). Managing the project learning paradox: A set-theoretic approach toward. *International Journal of Project Management, 29*, 494-503.

Bartlett, C. A., & Ghoshal, S. (2002). *Managing across borders: The transnational solution.* Boston: Harvard Business Press. Retrieved June 17, 2023

Bartsch, V., Ebers, M., & Maurer, I. (2013). Learning in project-based organizations: The role of project teams' social capital for overcoming barriers to learning. *International Journal of Project Management, 31*, 239-251. doi:10.1016/j.ijproman.2012.06.009

Bigliardi, B., Galati, F., & Petroni, A. (2014). How to effectively manage knowledge in the construction industry. *Measuring Business Excellence, 18*(3), 57-72.

Blackman, D. (2005). The role of mental models in the development of knowledge management systems. *International Journal of Organisational Behaviour, 10*(6), 757-769.

Bock, G., & Kim, Y. (2002). Breaking the myths of rewards: an exploratory study of attitudes about knowledge sharing. *Information Resources Management Journal, 15*(2), 14-21.

Boh, W. F. (2008). Reuse of knowledge assets from repositories: A mixed methods study. *Information & Management, 45*, 365–375.

Bradley, B. H., Postlethwaite, B. E., Klotz, A. C., Hamdani, M. R., & Brown, K. G. (2012). Reaping the benefits of task conflict in teams: The critical role of team psychological safety climate. *Journal of Applied Psychology, 97*(1), 151-158.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology. *Qualitative research in psychology, 3*(2), 77-101.

Bresnen, M., Edelman, L., Newell, S., Scarbrough, H., & Swan, J. (2003). Social practices and the management of knowledge in project environments. *International Journal of Project Management, 21*(3), 1535-1555.

Cabrera, A., & Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies, 23*(5), 687-710.

Caniëls, M. C., Chiocchio, F., & van Loon, N. P. (2019). Collaboration in project teams: The role of mastery and performance climates. *International Journal of Project Management, 37*(1), 1-13.

Carrillo, P., & Ruikar, K. F. (2013). When will we learn? Improving lessons learned practice in construction. *International Journal of Project Management, 31*(4), 567-578. doi:https://doi.org/10.1016/j.ijproman.2012.10.005

Chen, S., Chuang, Y., & Chen, P. (2012). Behavioral intention formation in knowledge sharing: Examining the roles of KMS quality, KMS self-efficacy, and organizational climate. *Knowledge-Based Systems, 31*, 106-118.

Chronéer, D., & Backlund, F. (2015). A holistic view on learning in project-based organisations. *Project Management Journal, 46*(3), 61-74. doi:10.1002/pmj.21503

Chua, A., & Lam, W. (2005). Why KM projects fail: a multi-case analysis. *Journal of knowledge management, 9*(3), 6-17.

Collins, C. J., & Smith, K. G. (2006). Knowledge exchange and combination: The role of human resource practices in the performance of high-technology firms. *Academy of Management Journal, 49*(3), 544-560.

Davenport, T., & Prusak, L. (1998). *Working Knowledge: How Organisations Manage What They Know.* Boston: HBS Press.

Desouza, K., & Awazu, Y. (2006). Knowledge management at SMEs: five peculiarities. *Journal of Knwoledge Management, 10*(1), 32-43.

Disterer, G. (2002). Management of project knowledge and experiences. *Journal of Knowledge Management, 6*(5), 512-520. doi:10.1108/ 13673270210450450

Dretske, F. (1981). *Knowledge and the Flow of Information.* Cambridge: MA: MIT Press/Bradford.

Easterby-Smith, M., Crossan, M., & Nicolini, D. (2000). ORGANIZATIONAL LEARNING: DEBATES PAST,PRESENT AND FUTURE. *Journal of Management Studies, 37*(6), 784-796.

Edmondson, A. (1999). The view through a different lens: Investigating organizational learning at the group level of analysis. *International Conference on Organizational Learning*, (pp. 299-323). Lancaster.

Eriksson, P. E., & Leiringer, R. (2015). Explorative and exploitative learning in project-based organizations: improving knowledge governance through a project management office? *Engineering Project Organization Journal, 5*(4), 160-179.

Foray, D., & Steinmueller, E. (2001). Replication of routine, the domestication of tacit knowledge and the economics of inscription technology: A Brave New World? *In*

conference in honor of Richard R. Nelson and Sidney Winter (pp. 12-15). Aalborg: Danish Research Unit in Industrial Dynamics (DRUID).

Formentini, M., & Romano, P. (2011). Using value analysis to support knowledge transfer in the multi-project setting. *International Journal of Production Economics, 131*(2), 545-560.

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational technology research and development, 29*(2), 75-91.

Hansen, M. T., Nohria, N., & Tierney, T. (2001). What's your strategy for managing knowledge. In J. A. Woods, & J. W. Cortada, *The knowledge management yearbook* (pp. 106-116). Woburn: Butterworth Heinemann.

Harmon, P. (2007). *A Guide for Business Managers and BPM and Six Sigma Professionals* (2nd ed.). Burlington: Morgan Kauffman Publishers. Retrieved June 12, 2023

Hartmann, A., & Dorée, A. (2015). Learning between projects: More than sending messages in bottles. *International Journal of Project Management, 33*(2), 341-351. doi:10.1016/j.ijproman.2014.07.006

Hauke, A. (2006). *Impact of Cultural Differences on knowledge Transfer in British, Hungarian, and Polish Enterprises.* The Poznana UNiversity of Economics, International Busness Department. Pozna: FEEM. Retrieved June 30, 2023

Hendriks, P. (1999). Why share knowledge? The influence of ICT on the motivation for knowledge sharing. *Knowledge and Process Management, 6*(2), 91-100.

Insight. (2023). Project Health Check. (T. Groen - Doppenberg, Ed.)

Iyer, N., Jayanti, S., Lou, K., Kalyanaraman, Y., & Ramani, K. (2005). Shape-based searching for product life cycle applications. *Computer Aided Design, 37*, 1435-46.

Javernick, W. A. (2011). Knowledge-sharing connections across geographical boundaries in global intra-firm networks. *Engineering Project Organisation Journal, 1*(4), 239-253.

Johnson, S. J., Blackman, D. A., & Buick, F. (2018). The 70: 20: 10 framework and the transfer of learning. *Human Resource Development Quarterly, 29*(4), 383-402.

Julian, J. (2008). How Project Management Office Leaders Facilitate Cross-Project Learning and Continuous Improvement. *Project Management, 39*(3), 43-58. doi:10.1002/pmj.20071

Kamara, J. M., Anumba, C. J., Carrillo, P. M., & Bouchlaghem, N. (2003). Conceptual framework for live capture and reuse of project knowledge. *CIB REPORT, 284*(178), 47-55.

Keegan, A., & Turner, J. R. (2001). Quantity versus Quality in Project-Based Learning Practices. *Management Learning, 32*(1), 77-98.

Koolwijk, J. S., van Oel, C. J., & Gaviria Moreno, J. C. (2020). No-blame culture and the effectiveness of project-based design teams in the construction industry: The mediating role of teamwork. *Journal of Management in Engineering, 36*(4).

Lam, A. (2000). Tacit Knowledge, Organizational Learning and Societal Institutions: An Integrated Framework. *Organization Studies, 21*(3), 487-513. doi:10.1177/0170840600213001

Levinthal, R., & March, J. (1993). The Myopia of Learning. *Strategic Management Journal, 14*, 95-112.

Lin, L., Geng, X., & Whinston, A. B. (2005, June). A Sender-Receiver Framework for Knowledge Transfer. *MIS Quarterly, 29*(2), pp. 197-219.

Liu, H., Chai, K. H., & & F. Nebus, J. (2013). Balancing codification and personalization for knowledge reuse: a Markov decision process approach. *Journal of Knowledge Management, 17*(5), 755-772.

Machlup, F. (1983). Semantic quirks in studies of information. In F. Machlup, *The study of information: Interdisciplinary messages* (pp. 641-671).

Mahr, D., Lievens, A., & Blazevic, V. (2014). The value of customer cocreated knowledge during the innovation process. *Journal of Product Innovation Management, 31*(3), 599-615.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization science, 2*(1), 71-87.

Markus, L. M. (2001). Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success. *Journal of management information systems, 18*(1), 57-93.

Minbaeva, D., Pedersen, T., Björkman, I., Fey, C. F., & Park, H. J. (2003). MNC knowledge transfer, subsidiary absorptive capacity, and HRM. *Journal of International Business Studies, 34*, 586-599.

Mukherji, S. (2005). Knowledge management strategy in software services organizations: Straddling codification and personalization. *IIMB Management Review, 17*(3), 33-39.

Müller, R. G. (2013). Project management knowledge flows in networks of project managers and project management offices: A case study in the pharmaceutical industry. *Project Management Journal, 44*(2), 4-19.

Nickols, F. (2000). The Knowledge in Knowledge Management. In J. W. Cortada, & J. A. Woods, *The Knowledge Management Yearbook* (pp. 12-22). Woburn, MA: Butterworth-Heinemann.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14-37.

Nonaka, I., & Takeuchi, H. (2007, July-August). The knowledge-creating company. *Harvard business review, 87*(7/8), pp. 162-171.

Paver, M., & Duffield, S. (2019). Project management lessons learned “the elephant in the room". *The Journal of Modern Project Management, 6*(3).

Poleacovschi, C., Javernick-Will, A., Tong, T., & Wanberg, J. (2019). Engineers seeking knowledge: Effect of control systems on accessibility of tacit and codified knowledge. *Journal of construction engineering and management, 145*(2).

Prencipe, A., & Tell, F. (2001). Inter-project learning: Processes and outcomes of knowledge codification in project-based firms. *Research Policy, 30*, 1373-1394.

Probst, G., & Borzillo, S. (2008). Why communities of practice succeed and why they fail. *European management journal, 26*(5), 335-347.

Project Management Institute. (2021). *A guide to the Project Management Body of Knowledge (PMBOK guide)* (7 ed.). Newtown Square: Project Management Institute.

Rezaei, G., Gholami, H., Shaharou, A. B., Zameri Mat Saman, M., Sadeghi, L., & Zakuan, N. (2017). hared knowledge mediated correlation between cultural excellence and organisational performance. *Total Quality Management & Business Excellence, 28*(3), 427-458.

Royal Haskoning DHV. (2023). *About us*. From Royal Haskoning DHV: https://www.royalhaskoningdhv.com/en/about-us

Royal Haskoning DHV. (2023). Masterclass to Business Process Mapping. Rotterdam, The Netherlands.

Royal Haskoning DHV. (2023). Project management I&B.

Scarbrough, H., Swan, J., Laurent, S., Bresnen, M., Edelman, L., & Newell, S. (2004). Project-Based Learning and the Role of Learning Boundaries. *Organization Studies, 25*(9), 1579–1600. doi:10.1177/0170840604048001

Schindler, M., & Eppler, M. J. (2003). Harvesting project knowledge : A review of project learning methods and success factors. *International Journal of Project Management, 21*, 219-228.

Schön, D. A. (1984). *The reflective practitioner: How professionals think in action* (Vol. 5126). New York: Basic Books.

Sergeeva, N., & Duryan, M. (2021). Reflecting on knowledge management as an enabler of innovation in project-based construction firms. *Construction Innovation, 21*(4), 934-950. doi:10.1108/CI-09-2020-0148

Sun, J., Ren, X., & Anumba, C. J. (2019). Analysis of knowledge-transfer mechanisms in construction project cooperation networks. *Journal of Management in Engineering, 35*(2).

Suresh, S., Olayinka, R., Chinyio, E., & Renukappa, S. (2016). Impact of knowledge management on construction projects. *ProceedingsoftheInstitutionofCivilEngineers, 170*(1), 27-43.

Szulanski, G. (1996). Exploring internal stickiness: Impediment to the transfer of best practice within the firm. *Strategic Management Journal, 17*(Winter Special Issue), 27-43.

Tan, H. C., Carrillo, P. M., Anumba, C. J., Bouchlaghem, N., Kamara, J. M., & Udeaja, C. E. (2007). Development of a methodology for live capture and reuse of project knowledge in construction. *Journal of management in engineering, 23*(1), 18-26.

Tonia, A. F., & Pessot, E. (2021). Investigating organisational learning to master project complexity: An embedded case study. *Journal of Business Research, 129*, 541-554. doi:10.1016/j.jbusres.2020.03.027

Turner, N., Maylor, H., Lee-Kelley, L., Brady, T., Kutsch, E., & Carver, S. (2014). Ambidexterity and knowledge strategy in major projects: A framework and illustrative case study. *Project Management Journal, 45*(5), 44-55.

Vaismoradi, M., Jones, J., Turunen, H., & Snelgrove, S. (2016). Theme development in qualitative content analysis and thematic analysis. *Journal of Nursing Education and Practice, 6*(5), 100-110.

Vashdi, D. R., Levitats, Z. S., & Grimland, S. (2019). Which transformational leadership behaviors relate to organizational learning processes? *The Learning Organization, 26*(2), 176-189.

Wang, Z., & Wang, N. (2012). Knowledge sharing, innovation and firm performance. *Expert systems with applications, 39*(10), 8899-8908.

Weber, R., Ahab, D., & Becerra-Fernandez, I. (2001). Intelligent lessons learned systems. *Expert Systems with Applications, 20*(1), 17-34. doi:https://doi.org/10.1016/S0957-4174(00)00046-4

Wenger, E., McDermott, R., & Snyder, W. M. (2002, March 25). Cultivating communities of practice: a guide to managing knowledge. *Harvard Business Press*, pp. 1-19.

Wiewiora, A., Chang, A., & Smidt, M. (2020). Individual, project and organizational learning flows within a global project-based organization: exploring what, how and who. *International journal of project management, 38*(4), 201-214.

Xu, R., Deng, X., & Liang, L. (2017). Knowledge transfer between projects within project-based organizations: the project nature perspective. *Journal of Knowledge Management, 22*(5), 1082-1103. doi:10.1108/JKM-05-2017-0184

Yang, Y., Brosch, G., Yang, B., & Cadden, T. (2020). Dissemination and communication of lessons learned for a project-based business with the application of information technology: a case study with Siemens. *Production Planning & Control - The Management of Operations, 31*(4), 273-286. doi:10.1080/09537287.2019.1630682

Yap, J. B., & Lock, A. (2017). Analysing the benefits, techniques, tools and challenges of knowledge management practices in the Malaysian construction SMEs. *Journal of Engineering, Design and Technology, 15*(6), 803-825.

Yap, J. B., Shavarebi, K., & Skitmore, M. (2021). Capturing and reusing knowledge: analysing the what, how and why for construction planning and control. *Production planning & control, 32*(11), 875-888.

Yin, R. K. (2009). *Case study research - Design and Methods* (Vol. 5). SAGE Publications.

Zhang, L., & Li, X. (2016). How to reduce the negative impacts of knowledge heterogeneity in engineering design team: Exploring the role of knowledge reuse. *International Journal of Project Management, 34*(7), 1138-1149.

Zhang, S., Duan, H., Z. X., Xia, B., Feng, Y., & Galvin, S. (2021). Learning on rework management of construction projects: A case study. *International journal of construction management, 21*(3), 246-260.

Zollo, M., & Winter, S. G. (2001). Deliberate Learning and the Evolution of Dynamic Capabilities. *Organisation Science, 13*(3), 339-351. doi:10.1287/orsc.13.3.339.2780

Appendix A: Interview protocol

Introduction

1. Name of the researcher – Pradeepthi Thimmapa
2. Qualification – MSc. Construction Management & Engineering
3. Research objective – Effective reuse of captured knowledge across projects within the organization
4. Purpose of the interview –
    a. To understand and evaluate the current mechanisms in the organization (across 3 levels – individual, project, organizational) to capture and reuse knowledge
    b. To identify barriers and drivers of knowledge reuse
    c. To investigate the preferred way of learning and reusing acquired knowledge
5. Provide informed consent/confidentiality

Questions

Opening questions

1. Describe your role and experience at the company briefly.
2. At what point do you need to use previous knowledge in a project?
3. Describe the mechanisms of knowledge capture and sharing across the organization.
4. How is the effectiveness of these mechanisms perceived (metrics, indicators, etc.)?
5. What are some of the drivers for knowledge capture and reuse?
6. What are some of the barriers to knowledge capture and reuse?

Learning processes

1. Is there an organization-wide database available for sharing and retrieving knowledge?
2. How often is the database audited? Are feedback sessions organized?
3. How would you perceive its user-friendliness?
4. Did you face any challenges in finding and accessing relevant knowledge when you need it?
5. When faced with a roadblock before starting a project or during its course, how do you acquire the knowledge to solve it?
6. Can you give an example where you used previously gained knowledge in other projects?
7. How do you like to learn?

Organizational culture

1. How do you feel about sharing successes and failures with your peers?
2. How motivated are you to share experiences?
3. How accessible are other professionals when you need information?

What do you want to stop, continue, and start with the way knowledge is captured and used in RHDHV?

Closing remarks

- Any final thoughts/reflections?
- Please provide feedback and suggestions to improve the interview process.

Appendix B: Interview summaries

Interviewee 1 (X1) – Project Manager of project P1

The interviewee, a senior project manager at RHDHV for almost two years, provided valuable insights into the knowledge capture and reuse practices within the organization. He emphasized that learning often occurs through firsthand experiences of encountering and resolving challenges, complemented by formal education on project management systems derived from past managerial experiences.

Within RHDHV, the interviewee highlighted the existing mechanisms for knowledge sharing, notably Insight, project management quality manuals, and individual sites curated by team members. However, he perceives these systems as limited, primarily fostering knowledge transfer at an individual level rather than a structured organizational approach. While acknowledging the necessity of a database, they stress the importance of its user-friendliness and active usage to ensure effective knowledge capture and retrieval.

Throughout the conversation, the interviewee identified various barriers and drivers to knowledge reuse within RHDHV. He pointed out the lack of standardized approaches among project managers and their resistance to adopting new methodologies as significant hurdles. Despite initiatives like business process mapping and template creation, not all mechanisms align with project managers' needs, hindering widespread adoption.

RHDHV's organizational culture, according to the interviewee, encourages knowledge sharing, yet the absence of standardization poses challenges for seamless collaboration among teams. He underscored the critical role of uniform terminology and understanding to facilitate effective knowledge reuse and collaboration across projects.

The discussion delved into the significance of lessons learned sessions, like those conducted for the project P1, in anticipating future discussions and decision-making. However, challenges persist in documenting and disseminating these insights effectively across the organization, raising uncertainty about the efficacy of knowledge transfer.

Looking ahead, the interviewee advocates for standardizing project approaches, leveraging past knowledge, and establishing a more structured project handling system, leading to the initiation of a Project Management Office (PMO). They suggest making tools user-friendly and emphasizing their benefits to drive adoption, while occasionally implementing mandatory usage to overcome resistance among project managers.

The interviewee's insights underscore the critical need for structured knowledge capture, standardized approaches, and user-friendly systems to enhance knowledge reuse across RHDHV's projects. His experiences highlight the importance of striking a balance between formal knowledge systems and person-to-person knowledge transfer for effective project management and continuous learning within the organization.

Interviewee 2 (X2) – Assistant Project Manager of project P1

The interviewee, a project manager at RHDHV, provided deep insights into knowledge capture and reuse within the organization. The interviewee worked on multiple projects, notably with P1, showcasing the significance of learning from past projects to inform current and future ones. He emphasized the critical role of knowledge collection for personal growth as a project manager and the organizational advantage gained from leveraging collective experiences.

He highlighted the varying approaches among project managers at RHDHV regarding knowledge capture, indicating a lack of standardized practices. The interviewee pointed out mechanisms for individual and project team knowledge sharing, citing the responsibility of individuals to actively seek information within the vast resources available. Despite available tools and senior management support, the lack of a structured approach and standardized systems hindered efficient knowledge sharing across the organization.

Regarding organizational culture, the interviewee described RHDHV as open and transparent, facilitating accessibility to experienced personnel. They emphasized the impact of this culture on individual and project levels, fostering communication but also noted challenges on an organizational scale due to the absence of a standardized working approach.

The interviewee advocated for a standardized approach, citing the need for a unified way of working to showcase alignment with clients and facilitate collective learning. They underlined the importance of consistent communication terminology but emphasized flexibility in adapting communication styles based on client preferences.

Reflecting on the P1 project, the interviewee highlighted the necessity of continuous review sessions during the project, particularly regarding cost estimation, to avoid substantial discrepancies. They stressed the importance of a structured weekly meeting format that allowed for efficient communication among disciplines, advocating for its continuation in future projects.

The lessons learned from the P1 project prompted the interviewee to push for more frequent intermediate lessons learned sessions to capture evolving project insights. He indicated that lessons learned should focus more on quality than quantity, aiming for actionable insights rather than an exhaustive list.

Lastly, the interviewee expressed anticipation about potential solutions for standardized knowledge capture, emphasizing the necessity of user-friendly tools based on shared industry challenges.

In summary, the interviewee's insights centred on the need for standardization, structured knowledge capture mechanisms, and a user-friendly approach to facilitate effective knowledge reuse across RHDHV's projects. He underscored the importance of a balance between formal systems and adaptable approaches within the organization's culture for enhanced project-based learning and continuous improvement.

Interviewee 3 (X3) – Architect of project P1

The interviewee, in this case, gave a thorough view of knowledge capture and reuse in their organization. There were a few standout points. Firstly, there's a recognition that the company's foundation plays a pivotal role in enabling individuals to operate freely and achieve project success. He believe that while the company provides basic resources and systems, the onus of knowledge acquisition and utilization largely lies with individuals and their interactions within teams.

When it comes to capturing knowledge, the interviewee acknowledged the existence of an organizational archive, but highlighted the challenge of its practical use. He expressed scepticism about the effectiveness of a centralized database due to the unique nature of each project, making a one-size-fits-all knowledge repository less useful. This opinion was supported by the belief that learning and reusing knowledge often happen through interactions with colleagues and personal networks rather than relying solely on organizational archives.

The interviewee emphasized that the organization's culture fosters a desire among employees to share knowledge and ideas. However, they noted that despite this cultural inclination, there are significant barriers to effective knowledge sharing and capture. Among these barriers are the difficulty in determining what information is essential for future projects, the impracticality of a copy-and-paste approach due to project variability, and the challenges of maintaining and organizing vast amounts of information.

In projects like the P1 project, where multiple disciplines collaborated, the interviewee highlighted issues related to alignment and communication between teams. They believed that while lessons learned sessions are valuable, large-scale projects often face unexpected challenges, making it difficult to predict and prepare for all eventualities.

Ultimately, the interviewee's perspective highlights the complexity of knowledge reuse in project settings, emphasizing the importance of individual contributions, effective communication, and a culture that encourages knowledge sharing.

Interviewee 4 (X4) – Project Manager of project P2

The interviewee observed a substantial demographic gap within the organization, acknowledging the challenge of transferring knowledge from seasoned professionals to newer recruits. The interviewee highlighted the importance of bridging this gap to effectively leverage the wealth of experience within the company.

Regarding current practices in capturing and reusing knowledge, the interviewee mentioned a reliance on personal networks and face-to-face interactions rather than a centralized knowledge repository. The organization seemed to lack a structured system for documenting and accessing accumulated knowledge, hindering its effective reuse across projects. Despite initiatives like periodic sharing sessions, challenges persist in maintaining engagement and evolving these efforts into sustained knowledge-sharing mechanisms.

Barriers and drivers to knowledge reuse became apparent during the conversation. Silos within teams and departments were identified as a significant obstacle, limiting the cross-sharing of information and services. The interviewee highlighted the challenges in discovering available resources due to the organization's dependency on individual expertise rather than institutionalized knowledge.

Regarding the role of organizational culture in promoting knowledge reuse, the interviewee observed a blend of resistance to change, particularly among senior members, and a reliance on personal networks for knowledge exchange. While efforts such as periodic sharing sessions and recent enhancements to the internal search system for expertise demonstrate steps toward a more systematic approach, sustaining engagement remains a challenge.

The interviewee detailed her extensive involvement as a project manager for the toucan project, an extension of a brownfield brewery. Her experience spans from the project's initial feasibility stage in Rotterdam to managing design stages both in the Netherlands and Vietnam, and finally, supporting construction management. She emphasized the significance of personal relationships built during her travels, acknowledging their pivotal role in effective communication and knowledge transfer between the teams in different locations.

The cultural differences between teams in various geographical locations impacted communication and knowledge sharing. The team in Vietnam, due to their closely knit office environment, exhibited a stronger sense of unity and communication despite the physical distance. She acknowledged the challenges in effectively managing a project where different teams had varying levels of expertise and emphasized the reliance on the expertise of the team in Vietnam for detailed design stages.

Regarding lessons learned, she highlighted a workshop held for capturing and sharing lessons, primarily focusing on brewery projects. Although lessons were documented, the practical application of these insights across projects remained limited. She reflected on the need for a more structured approach to knowledge-sharing mechanisms beyond mere documentation, particularly involving different departments and levels within the organization.

She expressed the importance of standardizing processes and communication across projects for a consistent quality of deliverables to clients like Heineken. Regular meetings among project managers were established, but their infrequency limited the depth of discussion and knowledge exchange. She advocated for more frequent discussions and workshops to foster a culture of open sharing and learning among project managers.

She believes that efforts must be made to enhance the accessibility and usability of the existing database, establish comprehensive onboarding processes, foster a culture of knowledge sharing through consistent initiatives, and incentivize collaborative learning across departments and experience levels.

Lastly, she underlined the necessity of a centralized and accessible knowledge repository that could transcend individual projects and departments. She proposed the integration of lessons learned into the project closure process and the incorporation of regular health checks, advocating for a mandatory project close-out procedure for effective knowledge capture and sharing.

Interviewee 5 (X5) – Design Manager of project P2

The interviewee provided valuable insights into knowledge sharing and reuse within Royal Haskoning. They highlighted several themes, including current practices of capturing and reusing knowledge, barriers and drivers to knowledge reuse, the role of organizational culture in promoting knowledge sharing and learning, and other significant takeaways.

The interviewee emphasized learning through job experiences and interactions with colleagues globally, utilizing various channels such as online training, documentation repositories like Insight, and regular sharing sessions with project managers. However, time constraints limited comprehensive utilization of available knowledge resources.

He highlighted a case-by-case problem-solving approach involving internal teams, technical experts, and managers as needed. The interviewee stressed transparency with clients when issues could impact project outcomes.

The culture at RHDHV encouraged open exploration of problems rather than concealing mistakes. Though past concerns existed about potential blame for errors, the organization encouraged openly addressing and resolving issues.

Communication across global teams posed challenges despite multiple channels like MS Teams, emails, and documents stored in Insight and Box. He highlighted the need for improved communication methods facilitating quicker exchanges and better information flow across projects. Translating tacit knowledge into documented formats posed challenges due to the experiential nature of certain aspects, such as local standards and client-specific requirements.

He experience with the P2 project, involving teams from multiple countries, revealed successful coordination despite time zone differences. Regular updates and coordination meetings helped align efforts across locations, mitigating potential challenges posed by geographic diversity.

The interviewee highlighted positive experiences with knowledge-sharing sessions such as intervision meetings and knowledge-sharing initiatives. He stressed the need for better accessibility to sessions held in different time zones and language proficiency for effective communication and learning.

He expressed satisfaction with existing knowledge-sharing processes but suggested improvements in scheduling sessions in more accessible time zones and enhancing English proficiency for better comprehension during international discussions. Additionally, they emphasized replicating the benefits of face-to-face presentations in virtual settings.

Overall, the interviewee underscored the significance of continuing knowledge-sharing practices while seeking better feedback mechanisms to improve future sessions. They advocated for increased attention to communication strategies bridging cultural and linguistic barriers, emphasizing the importance of understanding participants' engagement during virtual meetings for effective knowledge exchange.

Interviewee 6 (X6) – Director, PM&C AG

The Director of an advisory group at RHDHV offered insights into knowledge reuse within the organization, overseeing a team involved in projects for multinationals across diverse sectors. While a database for lessons learned exists, it's not universally embraced by project teams post-closure. However, for larger projects, there's a push for post-project reviews that may include client involvement.

She highlighted individual preferences and work culture as influencers on using the knowledge database. Some prefer direct communication over database navigation when faced with roadblocks, indicating that while a centralized resource is beneficial, personal interactions offer nuanced details.

Initiatives like PM inter-vision meetings, knowledge groups, and sessions facilitate knowledge exchange. Retention of expertise amid potential employee turnover remains a concern, emphasizing reusable knowledge assets such as process approaches, templates, and how projects are organized. Leadership's role involves supporting knowledge-sharing initiatives and ensuring active participation. They anticipate leveraging outcomes from business process mapping to enhance standardization and knowledge reuse. Balancing a sharing culture while structuring it effectively and fostering an open environment for discussing challenges remains a priority. Efforts to standardize processes through manuals and templates exist while acknowledging the organization's adaptability. Utilization of platforms like SharePoint, Asite, and Microsoft Teams aids communication, yet challenges persist in disseminating knowledge across the organization. However, ongoing efforts aim to consolidate knowledge through various channels, sessions, and lessons learned documentation.

The focus extends to easing knowledge access for new team members by linking them to relevant networks and channels. RHDHV acknowledges the significance of knowledge reuse, emphasizing the need to balance standardization with adaptability.

The interviewee also acknowledges the impact of diverse working cultures on information sharing, stressing the need for increased cultural awareness to accommodate different perspectives in a multinational setting. This awareness would foster more effective knowledge sharing and collaboration across varied backgrounds and preferences.

Interviewee 7 (X7) – Associate Director, PM&C AG

Exploring the landscape of knowledge capture and reuse at RHDHV, the interviewee shed light on the paramount importance of this practice alongside the obstacles encountered within the organization. The interviewee, a significant advocate for leveraging knowledge for continuous improvement, highlighted the challenge of practical implementation due to disparate approaches across teams and initiatives.

At RHDHV, multiple endeavours exist to capture knowledge, including a dedicated knowledge group in project management and the use of internal standards for training purposes. However, these efforts operate independently, lacking a cohesive structure for unified standards in project execution. The interviewee's endeavour to unify these practices emphasizes the necessity for a more integrated approach to knowledge management.

Resistance to standardization emerges from concerns about potentially stifling creativity and autonomy in decision-making processes. Some team members fear that adhering to standardized practices might limit their ability to innovate or tailor solutions to specific project needs. Nonetheless, the interviewee advocates for a balanced approach, endorsing standardized practices while preserving space for creativity during problem-solving phases.

The organization's culture exhibits a spectrum, with the interviewee expressing comfort in admitting mistakes and seeking help. However, this comfort level isn't uniformly shared across the company. Feedback mechanisms and the incorporation of lessons learned lack consistency, leading to missed opportunities for organizational learning and improvement.

Despite ongoing initiatives such as the rollout of business process mapping (BPM) to streamline project execution, a structured knowledge management approach is imperative. Centralized platforms for storing and sharing lessons learned could significantly benefit the organization if made accessible and actively used across teams.

One notable challenge lies in the absence of clear KPIs or indicators to measure the effectiveness of knowledge-sharing mechanisms. Establishing these metrics could provide tangible evidence of the value derived from knowledge reuse initiatives and validate resource allocation for these activities.

The interviewee provided comprehensive insights into various aspects of knowledge capture and reuse at RHDHV, shedding light on diverse themes within the organization's dynamics. Examining current practices to capture and reuse knowledge, the interviewee acknowledged dissatisfaction with communication channels, pointing out the overwhelming array of options. While recognizing the value of varied communication for creativity, the dispersion of information across multiple platforms poses challenges in staying updated.

Motivation to share experiences emerged as a significant driver for knowledge sharing, with the interviewee expressing a high level of motivation to pass on knowledge, emphasizing its importance in fostering connections and aiding newcomers. The interviewee's perception aligns with the organization's acknowledgment of the risk associated with employee turnover, proposing structured coaching programs and mentor-mentee initiatives to mitigate this risk.

Regarding the transfer of project ownership, the interviewee outlined the handover from one team to another, emphasizing the need for clarity and understanding of project phases and deliverables. The challenges encountered involved familiarity with the previous team's work and aligning terminologies and expectations with the client.

The interviewee suggested a proactive approach to integrating lessons learned into projects by mandating the incorporation of relevant previous project lessons during initiation. This structured approach ensures the application of pertinent knowledge and experiences, aiming to avoid repetition of past mistakes.

Moreover, the interviewee advocated for structured project close-out sessions as a regular mandated practice to facilitate reflective learning at the end of each project. While emphasizing the need for continued cross-collaboration between advisory groups, the interviewee highlighted the necessity to curb emotional investment during knowledge exchange sessions, aiming to mitigate unprofessional behaviour and create a more open and receptive environment for feedback and improvement.

Interviewee 8 (X8) – Associate Director, PM&C AG

The interviewee highlighted knowledge as the company's primary asset, emphasizing a shift toward a data-centric approach in capturing domain-specific knowledge. They discussed formal structures like knowledge groups and coordinators and outlined both formal and informal knowledge-sharing initiatives such as lunch meetings, intervision sessions, and specialized training like the MEP Academy. Despite these efforts, challenges persist in accessing centralized knowledge repositories, calling for a more structured system.

He noted past measurement of knowledge mechanisms tied to formal project KPIs and outlined ongoing initiatives in business process mapping across global leading markets, anticipating resistance in implementing new processes and emphasizing the importance of change management.

Future strategies involve appointing discipline-specific owners within the business process map to maintain and enhance processes continuously through feedback loops from stakeholders.

Regarding organizational culture, they discussed time constraints and resource justification challenges in a project-centric setting, emphasizing the need to instil enthusiasm and engagement among busy but knowledgeable individuals for knowledge capture. They also stressed leveraging standardization and data-driven processes to boost creativity without automating everything entirely.

Improving communication channels for easier access to information and incentivizing knowledge sharing were highlighted. Encouraging domain-specific knowledge capture and partnerships between experienced and newer employees were suggested solutions to mitigate knowledge loss due to senior professionals leaving.

The interviewee emphasized the need for structured knowledge-sharing systems beyond project-specific meetings, promoting continuous improvement and active learning during project execution. Overall, he advocated for a more data-driven, connected, and user-centric approach while highlighting the pivotal role of leadership in fostering a culture of continuous learning and knowledge sharing within the organization. Key takeaways include the company's transition to data-centric knowledge management, structured knowledge development, challenges in accessing and organizing knowledge, ongoing initiatives in business process mapping, and the need for effective change management during process implementation.

Interviewee 9 (X9) – Corporate QHSE Manager, RHDHV

The interviewee, discussed various challenges within the company's knowledge management systems. She highlighted a lack of awareness among employees, particularly project managers, about the available knowledge tools and their location, hindering their effective use. The integration issues between different knowledge systems result in fragmented information storage, complicating data retrieval. The interviewee noted the presence of lessons learned databases within the management system but faced challenges in their accessibility and proper utilization.

She emphasized the importance of recording lessons learned at a corporate level, although it was not consistently implemented across projects due to practical challenges. The interview revealed a disconnect between storing information in Power BI and accessing it, leading to difficulties for employees in finding relevant data. The interviewee acknowledged the absence of audits for obsolete knowledge and emphasized the need for better utilization and evaluation of captured insights.

The interviewee shared her preferred method of learning, citing conversations and interactions with a wide range of colleagues as her primary source of acquiring knowledge. She stressed the importance of an inclusive and informal communication approach within the company.

In conclusion, the interviewee expressed the need for better communication and support from higher management to encourage more consistent use of corporate forms and knowledge-sharing platforms. She highlighted the diverse preferences among individuals regarding learning methods, emphasizing the challenge in accommodating these differences within the organization's knowledge management approach.