SUCCESSFUL IMPLEMENTATION OF LESSONS LEARNED

Case study of business unit A in Corporation X

Lappeenranta–Lahti University of Technology LUT

Global Management of Innovation and Technology, Master's Thesis

2025

Chen Li

Examiner(s): Professor Leonid Chechurin

Zahra Honarmand Shahzileh M.Sc. (Tech.)

ABSTRACT

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Chen Li

Successful implementation of lessons learned: case study of business unit A in Corporation X

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Lessons Learned (LL) is vital for project led companies, as effective project learning enhances project outcomes, internal organizational learning, and decision-making. However, implementing LL and facilitating learning activities pose significant challenges. This master's thesis investigates the development history and business processes related to LL implementation within organizations, using the business unit A in global Corporation X as a case study. The focus is on identifying implementation challenges and areas for improvement. The study begins with a comprehensive literature review, outlining strategies for LL implementation and analysing case studies to identify best practices. It provides an overview of current LL practices, detailing the history, processes, and tools developed in the company.

Quantitative and qualitative methods are employed in this study. Initially, an analysis of data from 2,438 existing LL records at the case company reveals significant variations in compliance and data integrity across business units. This highlights the need for standardized training and process reinforcement. Based on the results, participants for the survey were selected. The survey conducted as part of this study gathers insights from 26 key participants. The survey identifies challenges such as lack of structured process, inadequate training, lack of team awareness, no visibility on outcomes, poor documentation, and lack of management enforcement. Finally, the root cause analysis was conducted through 8 workshops involving key roles related to LL, identifying the underlying issues behind these challenges.

The findings suggest a new way to simplify the LL creation process. Enhancing training programs and assigning dedicated resources can significantly improve the LL

implementation. The study concludes with suggestions aimed at fostering a robust organizational learning culture, ultimately leading to better knowledge retention and improved project outcomes.

ABBREVIATIONS

AI	Artificial Intelligence
CD	Customer Delivery
INPO	Institute of Nuclear Power Operations
KM	Knowledge Management
KPIs	Key Performance Indicators
LL	Lessons Learned
NASA	Aeronautics and Space Administration
PMBOK	Project Management Book of Knowledge
PMWIS	Project Management Wisdom
PPM	Project and Portfolio Management
QEHS	Quality, Environmental, Health and Safety management
RCA	Root cause analysis
SMEs	Subject Matter Experts
UI	User Interface
UX	User experience

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1 Introduction

This chapter begins with a brief overview of Lessons Learned (LL) implementation in large corporations, highlighting its importance in knowledge management. The chapter then narrows its focus to describe the current challenges related to LL implementation within a specific business unit A, where enthusiasm and participation in LL practices have declined. Following this, the research questions are presented, aiming to identify implementation challenges and explore strategies for successful long-term LL adoption. The research method, which combines quantitative analysis of LL records with qualitative surveys and workshops, is then outlined. The chapter concludes with a detailed structure of the thesis.

1.1 Background

LL has been a significant focus within many large corporations for several years, often implemented across various organizational levels including several business units. Typically, each business unit designates its own LL process owner responsible for driving the implementation and ensuring the effectiveness. The corporation entity provides a basic template, allowing business units the authority to modify the process to better fit their specific operational needs. This approach balances standardization with flexibility, enabling tailored LL practices across diverse organizational contexts.

LL is considered a crucial component of knowledge management. In the post-pandemic era, with the prevalence of remote work, facilitating knowledge flow throughout the organization has become increasingly challenging. The importance of LL cannot be overstated, as it can bring numerous benefits to projects, portfolios, and the organization as a whole. Effective use of LL can improve project outcomes, enhance organizational learning, and refine decision-making processes. These benefits are particularly critical in dynamic business environments where rapid adaptation and continuous improvement are essential for maintaining competitive advantage.

However, despite its recognized importance, many organizations struggle with successful LL implementation. This study takes the case of a specific business unit A in a global Corporation X, where the LL process was introduced early in the company's inception.

Recent observations have shown a gradual decline in enthusiasm and participation in LL practices, leading to an unsatisfactory situation that highlights the urgent need for improvement. This decline is not uncommon in organizational settings and often stems from various factors such as lack of perceived value, time constraints, or inadequate support structures.

To address these challenges, this master's thesis aims to conduct a thorough review of the existing LL process within unit A. The primary objectives are to identify the root causes of the current implementation problems and develop workable recommendations for enhancing LL practices. This study is particularly timely given the increasing importance of knowledge management in today's rapidly evolving business landscape. By examining the specific context of unit A, this study aims to contribute insights that may be applicable to broader organizational contexts and advance the understanding of effective LL implementation strategies.

1.2 Research questions and objectives

The implementation of LL processes within business units often faces significant challenges, which can result in ineffective knowledge sharing and process improvement. This situation can undermine the potential benefits of LL. To address these familiar challenges, this study aims to answer the following two research questions:

1. What are the implementation challenges contributing to the unsatisfactory practice of LL?
2. How can LL be successfully implemented and maintained as a long-term work habit?

The first research question seeks to uncover the fundamental issues contributing to the current inefficacies in the LL process. Identifying these root causes is essential for developing targeted and effective solutions. The second research question focuses on establishing strategies and practices that can ensure the successful and sustainable implementation of LL, making it an integral part of the organizational culture.

The objective of this study is to perform a comprehensive Root Cause Analysis (RCA) of the current LL state within the case business unit. Based on this analysis, the study proposes improvement suggestions and develop a detailed plan for enhancing the LL process,

including process strategies and tool User Experience (UX) developments. These recommendations can be implemented within the organizations to address the identified issues.

It is important to note that the goal of implementing LL for unit A extends beyond merely increasing the number of registered lessons or creating sophisticated reporting interfaces. Instead, the study aims to facilitate effective knowledge transfer across different business units, projects with similarities over time, and among Subject Matter Experts (SMEs) in various forms. This approach seeks to cultivate a culture of continuous learning and improvement, which is vital for the long-term success of the global corporation.

By addressing these research questions and objectives, this study contributes to the broader understanding of LL implementation challenges and strategies in large corporations. The findings and recommendations from this study may have implications beyond the case organization, potentially offering insights applicable to other businesses facing similar challenges in knowledge management and organizational learning.

1.3 Research method

The implementation and impact of LL in organizations are often examined through qualitative research methods. Previous studies have employed various approaches, including surveys (Carrillo, et al., 2013), case studies (Hartmann & Dorée, 2015), interviews (McClory & Read, 2017), and focus groups (Carrillo, et al., 2013). The predominance of qualitative methods in this field is primarily due to the inherent difficulty in quantifying the effects of knowledge dissemination. For instance, the success of LL implementation cannot be measured solely based on the number of lessons registered in a system, and quantifying whether lessons are actually learned and applied in new projects presents a significant challenge. Despite these difficulties, there is a growing desire within organizations to increase transparency in this area and to establish key performance indicators (KPIs) for LL implementation.

This study adopts a mixed-methods approach, combining both quantitative and qualitative research methods to provide a comprehensive analysis of the LL process within the case organization. As a novel contribution to the field, this study incorporates quantitative

research methods as a foundation for the subsequent qualitative analysis. Specifically, quantitative analysis is applied to 2,438 LL records saved in the organization's database. This quantitative component serves several purposes. The results of the quantitative analysis help make the survey design more scientific and reasonable. For example, the main target group for the survey is determined by the frequency of names appearing in the LL records. Additionally, the usage rates of different fields in the LL records are considered when drafting survey questions, ensuring that the most relevant and frequently used aspects of the LL process are addressed. Furthermore, the quantitative data is applied in the analysis of the survey results. Building upon the quantitative foundation, the study then employs qualitative methods to provide depth and context to the findings. These methods include surveys to gather insights from a broad range of employees involved in the LL process, workshops to delve deeper into specific issues and experiences identified through the survey and generate ideas for improvement. The qualitative phase allows for a more nuanced understanding of the challenges and opportunities in LL implementation, providing rich, contextual data to complement the quantitative analysis.

1.4 Structure of the thesis

The thesis is structured in a logical and comprehensive manner. Chapter 2 presents a literature review, which forms the theoretical foundation of the study. This chapter includes the review strategy, an examination of LL implementation practices, relevant case studies, and a summary of key findings from existing research. Chapter 3 offers an overview of current practices within Corporation X. It provides detailed information about Corporation X's structure, including its sector Y and sector Z. The chapter also describes the existing reporting mechanisms and delves into the specific processes and tools used in the sector Z across various stages. Chapter 4 focuses on the analysis of existing lessons. This chapter covers the data collection process, pre-processing methods, analysis techniques, and results. This quantitative analysis forms the foundation for the subsequent qualitative investigation. Chapter 5 presents a Root Cause Analysis (RCA) of the LL process and offers improvement suggestions. This chapter incorporates the results from surveys and workshops, highlighting key implementation challenges. These challenges include the lack of a structured process, inadequate training, lack of team awareness, no visibility on outcomes, poor documentation, and lack of management enforcement. By identifying these root causes, the chapter sets the

stage for targeted improvements. Chapter 6 provides detailed implementation suggestions for both the LL process and associated tools. These recommendations are based on the findings from the previous chapters and are designed to address the identified challenges and improve the overall effectiveness of the LL system. Finally, Chapter 7 concludes the thesis, summarizing the key findings, discussing their implications, and suggesting areas for future research.

2 Literature review

This chapter examines the existing literature on the field of LL worldwide, emphasizing its significance and application in various fields. Best practices in the field of LL are summarised by reviewing previous studies and case studies, best methods and best practices. The literature review strategy used is introduced firstly, then findings from the LL implementation is described, which is followed by several case studies and summary in the end.

2.1 Literature review strategy

Scopus is primarily utilized for literature review searches, the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flow diagram (Page, et al., 2021) for the literature review is used in this study.

In the identification stage, the keywords “Lessons learned” AND “Company” OR “Organization” AND “Development” OR “Strategy” OR “Improvement” AND “Process” AND “Assessment” OR “Analysis” were used to search the literature. Since only Scopus was used, there were no duplicate or ineligible records. Subsequently, records were filtered by two criteria: references from 2005 to 2025 and English-language documents. References with fewer than 10 citations were excluded to enhance the reliability of the literature review. The abstracts of the remaining literature were reviewed, and those with irrelevant topics were removed.

In the second stage, studies were sourced from websites, organizational compass page, and newly discovered references found while reading the selected literature. Only a selected number of studies were listed here, as it was challenging to determine the exact number of sources reviewed. Ultimately, all relevant literatures were referenced and cited. The flow chart illustrating this process can be seen in Figure 1.

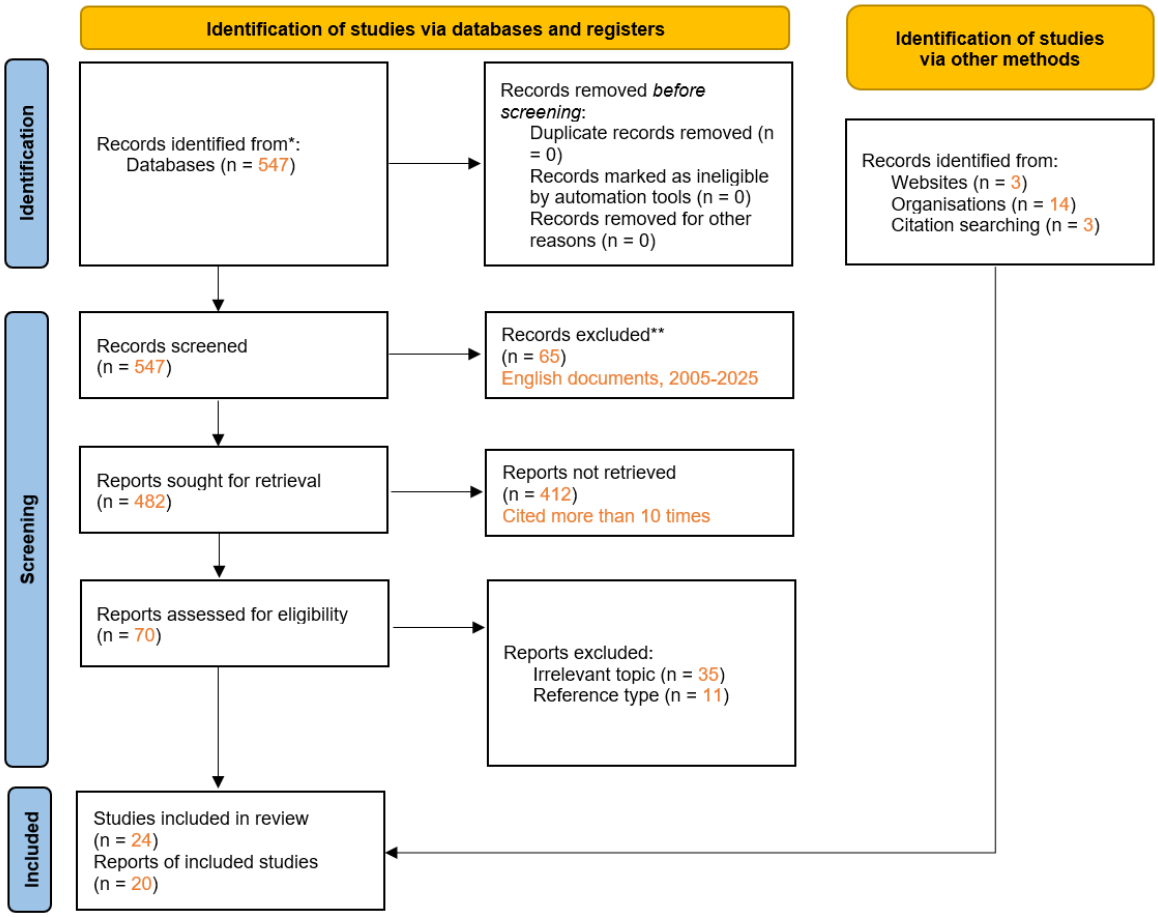


Figure 1. PRISMA flow diagram

2.2 Lessons Learned implementation

Many companies use LL for Knowledge Management (KM), especially in product development, to gain a competitive edge. However, capturing and sharing these lessons remains challenging. Competitive advantage relies on creating, transferring, utilizing, developing, and protecting organizational knowledge. Projects should foster learning through LL, but organizations often fail to apply these lessons. Capturing, verifying, storing, and sharing LL is crucial for reducing costs, and increasing effectiveness. Brent (2008) introduces an enhanced software-based process, including peer reviews, electronic communities of practice, targeted dissemination, and implementation records, all within a measurable environment. Love (2016) mentioned that program alliance that improved safety and quality by adopting continuous LL, shifting from single to double loop learning, and

provides implementation examples. Chirumalla (2016) assesses the organizational environment to identify key factors and dependencies that support effective learning and KM, proposing a video-based approach using social media technologies to improve this process, supported by a case study in the aerospace industry.

2.2.1 Lessons Learned

In project management, the term LL refers to project learning (Thomas, et al., 2018). The learning may stem from failures or successes, negative or positive cases, but the project learning is always positive because of its merits and significance (Thomas, et al., 2018), which in the short or long term provides organisations with competitive advantages (Duffield & Whitty, 2015). LL is one of the knowledge-intensive processes, because it requires project team's expertise to capture and learn from knowledge (Bernd, et al., 2022), which process is different from manufacturing process that can be fully standardized (Tang, et al., 2023)

LL is a concept first put forward and applied in high-risk organization. These industries, such as the US National Aeronautics and Space Administration (NASA), Institute of Nuclear Power Operations (INPO), need LL process to help organisations better learn from every single experience, which avoids the potential accidents (Carroll, 2004) and ensures the next attempt is safer and more trustworthy. NASA has long been a pioneer in implementing laboratory processes. For example, after the Challenger disaster in 1986, NASA conducted an extensive investigation and made numerous changes to its procedures and safety protocols (NASA, 1986). This tragic event emphasised the importance of learning from failures, leading to the establishment of more rigorous testing and validation processes. Similarly, LL from the 2003 Columbia disaster led NASA to strengthen its risk assessment and management strategies, which greatly improved the safety and reliability of subsequent missions (NASA, 2003). The INPO was established in response to the Three Mile Island accident to promote safety and reliability in the nuclear power industry. Jones, et al. (2006) presents findings from the LearnSafe project at reactor sites in Finland, Sweden, and the UK, highlighting key facilitators and barriers to organizational learning in the nuclear power sector. It discussed insights from senior and functional managers and proposes strategies to overcome barriers to enhance learning. Nuclear power industry as a highly regulated and monitored field of operation, there was long traditions of LL. Two Finnish nuclear

organisations used workshops, surveys and interviews to address learning from operational and minor adverse events. Insights for improving learning from adverse events were presented by Puro, et al. (2021). There were also quite many papers discuss about LL based on the Fukushima event (Sciences, et al., 2016; Kim, 2014).

The Swiss cheese model (Reason, 2016) proposed the concept that a system is made of many slices of cheese. Holes in each slice of cheese are considered as weaknesses while conversely the absence of holes represents a defended area. When the holes in the different slices of cheese are aligned, the system flaw exists, since the accident would have a chance to take place and cause potential losses to organization. unit A also attaches significant importance to the safety of the projects and products, specifically high quality, safety and reliability are one of the biggest competences. Compared to the competitors, so far, unit A has not had a single fire caused by spontaneous battery combustion worldwide. Therefore, LL is crucial for unit A to maintain this competitive edge.

The positive benefits of LL and KM tend to be greater and more significant for organisations that rely heavily on past project experience, project member experience and historical data. Such organisations often lack systematic ways of working and methodologies (Maqsood, et al., 2006). With reference to the actual situation, in unit A, there are project-tailored systematic ways of working, such as process management, gate and milestone structures, and so on. So, compared to companies that significantly rely on experience, unit A sees LL as a continuous improvement effort that is nice to have rather than a necessity, which is one of the reasons that LL has not been prioritized.

2.2.2 Implementation approaches

The approaches of the LL implementation can be organised according to two of the most important phases, which are the documentation and learning of lessons.

In the phase of documentation, there are a total of two approaches to gathering experience, one process-based and another document-based. The process-based approach is always dependent on other organisational processes or planned activities. (Maqsood, et al., 2006) Specifically in the process-based approach, lessons are always recorded at a specific point in time, and this behaviour needs to be triggered by another activity. On the contrary, the

document-based approach, which is also encouraged by unit A, records LL as soon as they are identified throughout the project cycle.

In the phase of learning, the organisers of LL need to design the process and activities with learning theories and approaches to enhance the applications of project learning. For example, the adult learning theory (Muneja, 2015) is worth considering since project members are always adults. Unlike children, project members come with a certain amount of experience prior to learning and appropriate group work needs to be integrated throughout the learning. (Speck, 1996) The sender-receiver approach (Lin, et al., 2005) is based on the senders' ability to capture, express, and share; the receivers' ability to absorb, and the establishment of knowledge transfer channels between both parties. This peer-to-peer approach is suitable for inter-project learning, and relatively small group of people. The social learning approach, as a supplement to sender-receiver approach, stresses the importance of connecting knowledge with practices (Nicolini, 2011), and interacting between project teams, which significantly enhance the performance of cross-project learning (Hartmann & Dorée, 2015).

Documentation often makes little distinction between levels, but to understand the various levels of project learning and their impact on knowledge dissemination, it is essential to distinguish between single-loop, double-loop, and triple-loop project learning approaches. Single-loop project learning creates the experience for project managers, and the knowledge created stays at the individual level. Both double-loop and triple-loop project learning start after a lesson has been recorded, see Figure 2 below. Compared to the single-loop project learning, double and triple-loop ones provide knowledge to project and organizational level. While double-loop project learning focus on revised process and opinions stakeholders' input, the triple-loop extends the scope to developing and implementing action plan of learning for new projects. (McClory & Read, 2017)

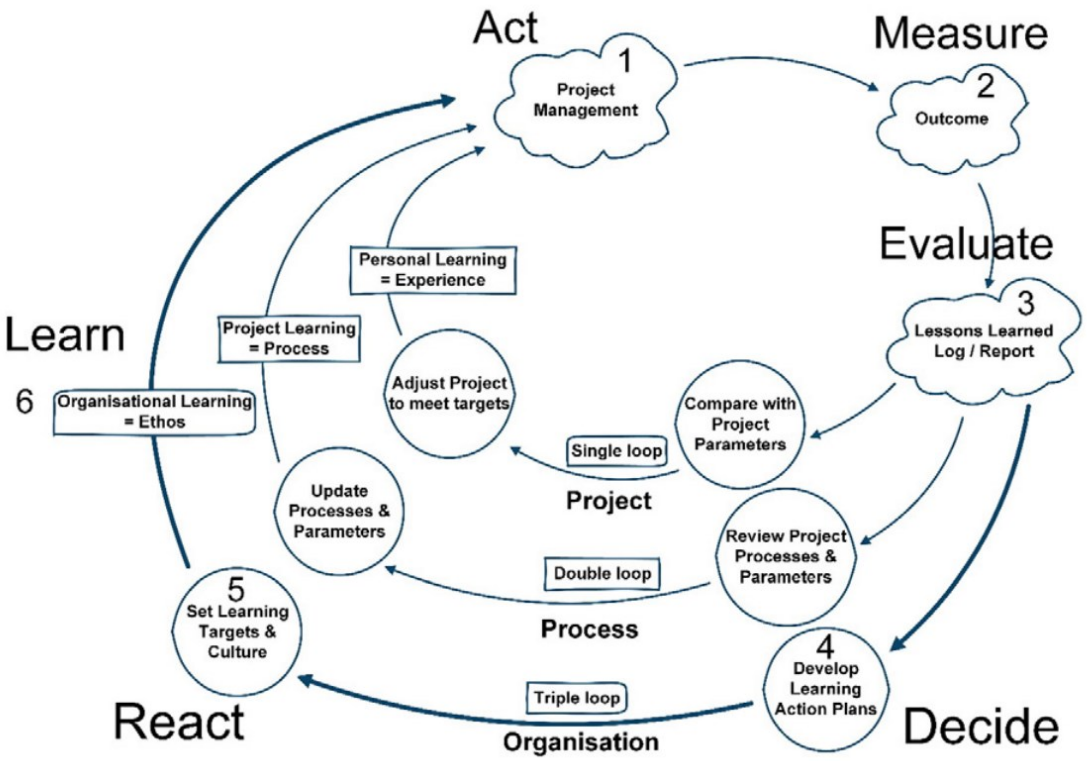


Figure 2. Single, double, and triple-loop project learning (McClory & Read, 2017)

The current practice of unit A is somewhere between single and double-loop project learning. It would be beneficial to include additional loops in future development phases. In particular, the learning process should be revised and updated following a review of the existing data, including registered lessons, suggestions from project managers, case studies from other business units. Subsequently, when a new lesson is record, action plans associated with roles, for example, LL process owner, initiator, and assessors, should be considered.

2.2.3 Implementation challenges

From a systemic point of view, from making mistakes or successes, to documenting lessons, to disseminating it and finally generating applications, the human factor is the more essential component compared to the technology factors (McClory & Read, 2017). Specifically, an individual's behaviour can lead to mistakes or successes in a project. It is then up to the individual to figure out how to use technology to document the LL and, more importantly, disseminate them. In this way, individual knowledge turns into organizational knowledge

(Duffield & Whitty, 2015), and the benefit from LL is not only limited to other individuals, but also the whole organisation.

In addition to being more essential, the human factor is the most difficult to predictable and control part of the process compared to the technology part. This complicates the implementation of LL in organizations, especially in a large global organization. Whether the cognitive styles of team members are compatible can affect the efficiency of knowledge transfer (Sense, 2007). For example, when a pragmatic team member shares LL, people with similar cognitive styles can quickly identify and conjure up application scenarios, while a reticent audience can ponder the significance and the development roadmap of this lesson.

Technological factors, which are less sophisticated than human factors, such as software, web pages or information systems, are approaches of making the implementation of LL easier and more flexible. From the perspective of collecting and documenting lessons, technology has significantly reduced the reliance on paper-based records and archiving. More stable and secure repositories have been created, and lessons are thus well documented and stored (Duffield & Whitty, 2015). From the perspective of disseminating and applying lessons, there are still many pending developments in the technology factors. The projects in organizations are considered as siloed islands if channel for information flow among different projects is not established (Carrillo, et al., 2013). For example, if a completed project wants to interact with a project that has not yet started, the lessons need to await in the repository and release to target projects, which process is highly dependent on the support of information technology. After dissemination, new projects are supposed to create value for themselves from applying these lessons. This is a part that is often missing in organisations (Duffield & Whitty, 2015). In other words, the use of technology to enhance the input of lessons is widely used, but the output volume and application is insufficient (Williams, 2008). To summarise, the existing technology factors are often viewed as a repository for the LL implementation process, which underestimates the positive impact that technology factors can bring to the process.

2.3 Case studies

Engaging leadership and ensuring their integration into the LL process is critical for continuous improvement (Klein, 2022). Regularly reviewing and developing LL processes

based on feedback can enhance their effectiveness. Using structured frameworks and standardized templates ensures consistency across different organizational levels (Cheah, et al., 2011). Many companies use LL practices for competitive advantage in product development but struggle with capturing and sharing them. Chirumalla (2012) proposes a video-based approach using social media technologies to improve this process, demonstrated through a case study in the aerospace industry, which presents a conceptual video-based sharing portal.

LL is also crucial for emergency management and organizational agility, enhancing resilience and adaptiveness. A robust process informs decisions, guides plans and strengthens strategies. The Canadian Safety and Security Program (Friesen, et al., 2017) developed a comprehensive framework for sharing best practices and prioritizing recommendations, involving literature reviews, surveys, taxonomy development, and standardized tools. To avoid similar mistakes in the future, a new approach using a source-impact-action (SIA) triple (Cheah, et al., 2011) to improve capturing LL in electronic product design projects was described. Traditional methods led to unstructured documentation, but a case study (Ferrada, et al., 2013) at Motorola Penang Design Centre successfully demonstrated the template's effectiveness in enhancing knowledge retrieval and reuse. While many companies used LL practices for future benefits, little research existed on manufacturing firms offering product-service combinations. Chirumalla (2016) conducted three case studies in two large manufacturing companies, identifying ten requirements in content, process, and technology, and developed a method for representing LL in product-service innovation, concluding that LL are most valuable when part of a continuous learning process, documented, communicated, and archived throughout a project to maximize absorptive capacity.

2.4 Summary of literature review

In summary of literature review, LL is crucial for competitive advantage, particularly in high-risk industries, where learning from past failures has significantly enhanced safety and reliability. The implementation of LL involves documentation and learning phases, with documentation being either process-based or document-based, and learning incorporating theories such as adult learning and social learning to improve knowledge transfer.

Challenges include human factors, which are unpredictable, and technological factors, which facilitate documentation but often lack in dissemination and application. Case studies highlight the importance of leadership engagement, structured frameworks, and standardized templates for effective LL processes. Innovative approaches, such as video-based sharing and structured templates, shows success in various industries, emphasizing the need for continuous learning and systematic documentation to maximize organizational benefits.

3 Overview of current practices of Lessons Learned

This chapter provides an overview of the current practices of LL within the case corporation x, including corporation, sector and business unit level. It begins with a historical development of these practices, detailing the evolution of the reporting mechanisms. The next section describes the specific processes and tools employed in the sector Z, outlining the creation, assessment, evaluation, resolution, and closing stages. Finally, the chapter reviews the effectiveness and challenges of the current practices, offering insights into areas for potential improvement and enhancement in capturing and utilizing LL.

3.1 Development history

At Corporation X, the implementation of the LL process is a multi-dimensional approach spanning the corporation, sector Y and sector Z, as shown in Figure 3. By integrating LL practices into day-to-day operations, Corporation X aims to enhance organisational learning, streamline project execution and ensure that valuable insights are captured and utilised effectively. There are some differences in how each business unit operates, but the lesson captured is ultimately consolidated into a report that everyone has access to. This section provides insights into the specific processes and tools used by Corporation X to foster a culture of continuous improvement and knowledge sharing. The following subsections look at the different approaches and resources used in Corporation X and sector Y, sector Z and unit A, as well as the integrated reporting mechanisms that support these efforts.

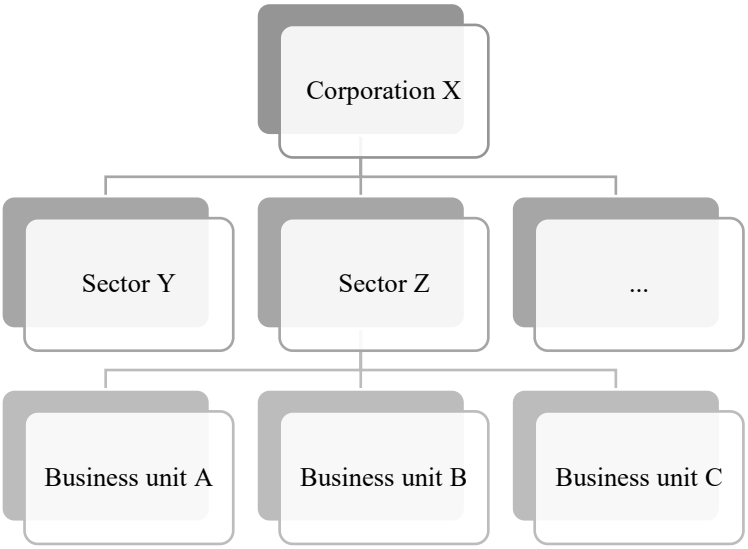


Figure 3. Corporation X chart

3.1.1 Corporation X and sector Y

The development at the corporation level emphasizes the importance of fostering a culture of openness and transparency. The CEO of Corporation X has emphasized the need to embed LL's culture into day-to-day operations, encouraging employees to share insights and experiences freely. To facilitate quick learning, revision, and memorization, cards were introduced as an effective tool. These cards served as a practical resource for capturing and disseminating valuable lessons, ensuring that knowledge could be retained and easily accessible for future reference.

At the sector Y level, the development of LL is supported through courses, which offer in-depth, comprehensive, and structured learning experiences. The training modules are designed to cater to different roles within the organization, with specific recommendations on who should complete each module. The core module, which takes approximately 1 hour and 10 minutes to complete, is designed for everyone. Additional modules are tailored for line managers, management teams, and colleagues in project execution roles, each requiring around 20 to 30 minutes. These modules ensure that all employees, from general staff to management, are well-versed in the LL processes. To explore the existing lessons, sector Y employees can refer to the Summary App, which uses artificial intelligence to search and generate concise summaries of LL cases.

3.1.2 Sector Z

From 2021 onwards, the unit B sides have introduced a combined role of process owner and tool developer for LL. This individual has been instrumental in relaunching the LL training for the entire sector Z.

From the SharePoint page, an integrated platform called Project Management Wisdom (PMWIS), users can access quality management area and various LL training materials. The training materials consist of four presentation slides and corresponding recordings. The first presentation is a governance model and information session, which is conducted prior to the actual training. This session sets the stage for the subsequent training by providing an overview of the LL process and its importance. The second presentation offers LL evaluation guidance, detailing the process, roles, and examples in the PPM software. This guidance helps participants understand how to evaluate LL effectively. The third presentation is a user guide that focuses on where to find old LL, which can be used as input when planning new projects. It also explains how to record LL from current projects. The fourth presentation continues with a user guide on how the LL process works after a new lesson has been recorded in the PPM software, and how user can follow the progress in the PPM software. Additionally, there are two Word tutorial documents named "Quick Guide," which cover both the assessment and resolution stages of the LL process. These guides provide step-by-step instructions and detailed descriptions for each option in every field. This ensures that users understand the meaning of each option, thereby reducing the likelihood of leaving fields blank.

Since 2018, when unit A was acquired by Corporation X, it has followed the governance model inherited from the sector Z. The training and guidance was provided to all sector Z users by unit B’s LL process owner. Until September 2024, unit A appointed its own LL process owner, who is from the Quality, Environmental, Health and Safety Management (QEHS) department. This new process owner took the initiative to relaunch the LL process by making significant modifications to improve its effectiveness.

3.1.3 Reporting mechanisms

The reporting and visualization of existing lessons are managed through a set of Power BI pages, which is publicly available to all Corporation X employees and serves as a comprehensive LL library. This library comprises seven pages, each equipped with specific filters to facilitate the search for LL.

The landing page integrates lessons from both SAP and PPM software, providing an introduction and directing users to the appropriate sections. Following the landing page, there are three pages dedicated to the distinct project categories: customer delivery, operational development, and product and solution development. Additionally, the PPM software process follow-up page tracks the status of LLs, indicating how many are in draft, released for assessment, released for evaluation, evaluated, resolved, and closed, along with a time perspective. A separate process follow-up page is also available for lessons originating from SAP. Finally, a comprehensive search page encompassing all sources is designed to streamline the retrieval of LL.

3.2 Process and tool in sector Z

The LL process, as recorded in the PPM software and followed by the entire sector Z, is structured into five main stages: creation, assessment, evaluation, resolution, and closing. This process was followed by unit A from 2018 until September 2024.This process involves seven distinct roles: creator, contact person, accessor, evaluator, resolution owner, interested stakeholders, and those recommended to. The roles and stages are integral to the User Interface (UI) of the PPM software.

The PPM software (Project and Portfolio Management) is a solution developed back to early 2000s. It is designed to help organizations manage their project portfolios, resources, and financials. Over the years, the PPM software has undergone numerous new releases and iterations. For example, in December 2024, unit A started undergoing a version upgrade to the version 16.2.1.

The PPM software's classic UI had been widely used for many years until 2018 when the modern UI was introduced. The Classic UI is known for its detailed and comprehensive

functionality but is often criticised for being complex and less user-friendly. Within Corporation X, some colleagues jokingly claimed that the classic UI looked like Windows 90S and no longer met the expectations of modern technology. Therefore, an internal operational development project has been launched from 2023, in order to migrate functions from the classic UI to the modern UI, where features a minimalist design and offers more customization options for the users (Broadcom, 2024).

The entire sector Z was using the PPM software Classic UI for LL. In September 2024, unit B's process owner released LL training in modern UI. This meant that unit B users would henceforth use a cleaner and simpler page for LL activities. The comparation between LL module in classic UI and modern UI can be seen in Figure 4 below.

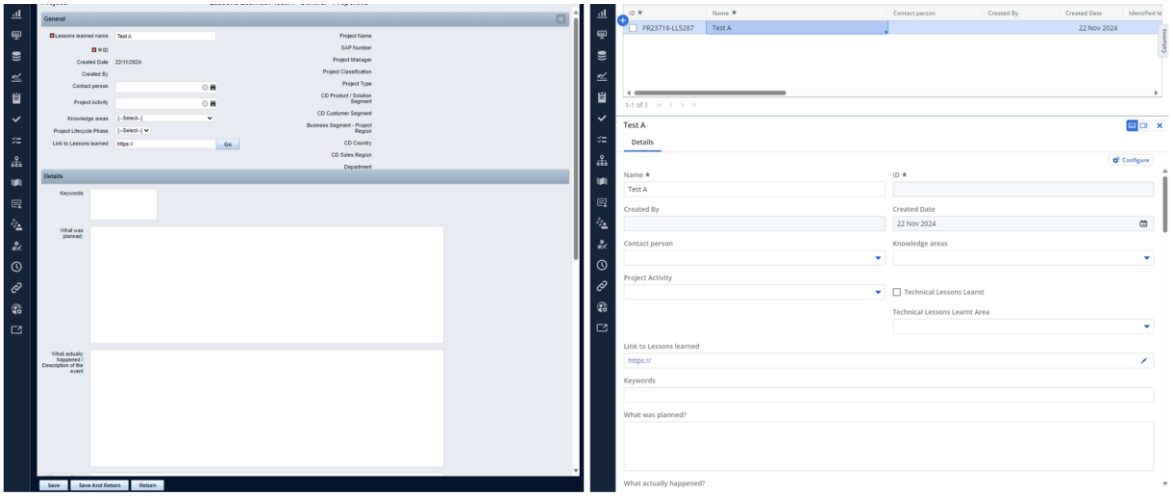


Figure 4. LL module in classic UI (left) and modern UI (right)

Meanwhile, unit A and unit C users are still staying with the classic UI. The evolution of the LL module from classic to modern did not come from the vendor's development, nor a version upgrade. It came from unit B's LL process owners spontaneously communicating and developing with software engineers in the Corporation X information management department for the customised functions. In other words, the LL module in the PPM software modern UI is limited to Corporation X internal use. The processes have not changed in this software-related evolution. The following sub-sections describe the 5 phases of the current process and the fields that are designed into each phase.

3.2.1 Creation stage

The process begins with any project team member opening the PPM software LL module within their project and clicking on the ‘new’ button. This is the first stage, creation, where the creator fills out the information into 2 major sections: general and details. The general section captures basic information about the lesson, which includes 1 compulsory field and 7 optional fields for the creator to fill out, as shown in Table 1. The details section in the creation stage provides a more comprehensive description of the lesson, including 7 optional fields, as shown in Table 2.

Table 1. Fields in creation stage - general section

Field No.	**Field Name**	**Field Type**
1.1	Lessons Learned name *	Text/String
1.2	Contact person	Dropdown
1.3	Link to Lessons Learned	URL
1.4	Knowledge areas	Dropdown
1.5	Project activities	Dropdown
1.6	Project lifecycle phase	Dropdown
1.7	Technical Lessons Learned	Checkbox
1.8	Technical Lessons Learned area	Dropdown

Table 2. Fields in creation stage - details section

Field No.	**Field Name**	**Field Type**
1.9	Keywords	Text/String
1.10	What was planned	Text/String
1.11	What actually happened / Description of the event	Text/String
1.12	Why were there differences / What was the root cause	Text/String
1.13	Identified Lessons Learned & Recommendations	Text/String
1.14	Additional description	Text/String
1.15	Released for assessment	Checkbox

It is important to note that only two fields are mandatory throughout the entire LL process: the LL name and the ID, both marked with an asterisk (*), which are required at the creation

stage. The ID is a unique string automatically generated by the PPM software, making the LL name the only required input from the creator. The contact person, who owns the best knowledge of this lesson, can be added in the general section. If no contact person is specified, the creator automatically undertakes the role of the contact person. The creator can click 'save and return' at any time for potential further modification. Once the content is finalized, the creator is expected to check the 'released for assessment' box, which forwards the lesson to the assessor, typically the line manager of the contact person. Once this box is checked, the date of release and the name of the person who released it automatically appear for future reference. Then, based on a scripted process, the PPM software automatically sends an email notification to the assessor.

3.2.2 Assessment stage

The assessment stage begins when the assessor reads this email notification. In which, the evaluator can see basic information about the lesson, as well as a link that can be clicked to reach the evaluation page for that lesson. The assessor's responsibilities include making sure the LL cases are accurate, and the action plans are clearly described within an appropriate timeframe. There are 7 optional fields that the assessor is supposed to fill out at this stage, as shown in Table 3 below.

Table 3. Fields in assessment stage

Field No.	**Field Name**	**Field Type**
2.1	Urgency	Dropdown
2.2	Repeatable	Dropdown
2.3	Lessons Learned type	Dropdown
2.4	Link for additional info	URL
2.5	Assessor name	Dropdown
2.6	Assessment comment	Text/String
2.7	Released for evaluation	Checkbox

The assessment process can be streamlined under certain conditions. Specifically, the assessor can proceed directly to the resolution stage if a clear knowledge area owner is

identified. Additionally, the assessor has the discretion to skip to the final stage and close the LL if no further investigation is required. However, if the required actions are unclear or disputed by stakeholders or colleagues, the assessor should escalate the LL case to the unit B's LL Evaluation Forum for further evaluation. Once the 'Released for evaluation' box is checked, the assessment date and the name of the person who update the LL automatically appear for future reference.

3.2.3 Evaluation stage

The evaluation stage is initiated only when the 'Released for evaluation' box is checked by the assessor. At this point, the unit B's LL Evaluation Forum takes over the entire process. Within the unit B, this forum consists of a dedicated facilitator and business experts from various functional departments, who convene for a 1.5-hour meeting every third week. Their responsibilities include initiating corrective actions, assigning resolution owners, and monitoring the progress of resolutions if resolution stage is needed. Otherwise, the forum closes the LL and determine the appropriate methods for communicating corrective actions and best practices to the business unit. During this stage, the evaluation forum is also responsible for filling out 5 optional fields, as shown in Table 4 below.

Table 4. Fields in evaluation stage

Field No.	**Field Name**	**Field Type**
3.1	Evaluated	Checkbox
3.2	Evaluator's comments	Text/String
3.3	Assigned person (for resolution stage)	Dropdown
3.4	Interested stakeholders	Dropdown (Multi)
3.5	Action proposed for resolution	Text/String

Once the evaluated box is checked, the evaluated date and the name of the evaluator automatically appear for future reference. Overall, not every case needs be discussed in the evaluation meetings. However, having this stage in place greatly improves the overall effectiveness of the LL process.

3.2.4 Resolution stage

The resolution stage begins when a resolution owner is appointed by either the assessor or the evaluation forum. Typically, the resolution owner is the knowledge area owner or a subject matter expert. The resolution owner is accountable for and takes ownership of the defined actions, including planning, execution, follow-up, and ensuring that the actions are completed within the specified timeframe. However, the resolution owner does not necessarily need to execute all the actions personally to mark the resolved flag. A detailed action plan with a specified timeframe is considered sufficient. There are 7 optional fields that the resolution owner is supposed to fill out at this stage, as shown in Table 5 below.

Table 5. Fields in resolution stage

Field No.	**Field Name**	**Field Type**
4.1	Resolved (Flag)	Checkbox
4.2	Resolution owner's comments	Text/String
4.3	Corrective actions	Text/String
4.4	Feedback for project cost calculation	Text/String
4.5	URL to additional info	URL
4.6	Recommended for later development action	Checkbox
4.7	Recommended to	Dropdown

Once the resolved box is checked, the resolved date and the name of the resolution owner automatically appear for future reference.

3.2.5 Closing stage

The final stage is the LL closure. As previously mentioned, only the assessor or the evaluation forum has the authority to close the LL by checking the closed box. No other individuals have this right. There are two optional fields to fill out, as shown in Table 6.

Table 6. Fields in closing stage

Field No.	Field Name	Field Type
5.1	Closed (Flag)	Checkbox
5.2	Closer's comments	Text/String

Once the closed box is checked, the closed date and the name of the person who closed it automatically appear for future reference.

3.3 Review of current practices

From an overall process perspective, there supposed to have stages designed and followed for knowledge sharing and project learning. The implementation of LL should encompass at least two main phases: documentation and learning. Most existing stages focus heavily on documentation, ensuring that lessons are reviewed by several experts to verify their accuracy and usefulness. However, the learning aspect is often overlooked and not integrated as a vital part of the process. Or in fact Corporation X is eager to facilitate project learning, but the available tools do not support the development of learning behaviours, resulting in documentation primarily serving to record successes or failures. Databases have been created to allow users to browse through the information voluntarily and spontaneously, similar to how one might explore books in a library.

From unit A perspective, there are several obvious problems. Firstly, the implementation of the LL process, which was inherited from unit B, is inadequate. unit A does not fully utilize the training materials and user guides provided by the sector Z. For example, only the creation stage, as mentioned in the previous section, was relatively strict followed, while the completion of the other steps was significantly low. Secondly, there is no dedicated facilitator or process owner, resulting in no tailor-made process for Customer Delivery (CD) projects. Not to mention the fact that the types of CD projects for unit B and unit A are inherently different and should have had tailored processes. Currently it is hard to squeeze in processes and steps that are appropriate for unit B, resulting in poorly defined phases. Questions arise as whether five stages are too many, making a simple process overly

complex, and whether the learning aspect is being neglected. Could some stages be eliminated to make the process more flexible? Which phases should be retained, and which should be removed? Thirdly, there is no audit trail for the entire LL process in the PPM software or any other system, leading to a lack of a comprehensive overview. Over time, people forget the purpose and lose enthusiasm for LL, knowing only where and how to record a new lesson in the PPM software, but not the big picture of it. This makes it challenging for unit A users to understand how to effectively utilize the existing knowledge.

4 Analysis and discussion on the existing lessons

Having a well-documented LL database is invaluable, not only for project learning, but also for having credible data at any point in time when there is a need to audit or reflect on the current implementation. The PPM software is the LL database for entire sector Z. In this chapter, the existing 2438 LL records are exported from the PPM software and analysed with Microsoft Excel and Power BI. In total, 3 reporting pages are created

The purpose of analysing the existing LL data is to gain a comprehensive understanding of its scope and effectiveness. This analysis aims to determine the total number of lessons recorded in the system and their distribution across different business units under sector Z. In addition, it explores trends in the amount of LL from inception to date, from 2010 to September 2024, noting any significant increases or decreases and pointing out key milestones. Users' adherence to existing processes is also assessed to understand the level of compliance and effectiveness. Furthermore, the main users of the unit A LL are identified, who are selected as the target participants of survey in the next step to gather their insights and feedback.

4.1 Data collection

The data collection process for this analysis begins with sourcing all the existing LL records from the PPM software LL portlet. This portlet serves as a centralized repository, capturing lessons from various projects across different business units under sector Z, including unit B, unit A, and ES. The portlet was configured several years ago to provide a comprehensive portfolio-level view, ensuring that all relevant lessons from different business units are searchable. This portlet was also primarily used for reporting purposes until Power BI was set up as LL repository.

To facilitate detailed analysis, additional fields were added to the portlet's search result template. These fields were selected based on their relevance to the study's objectives, such as ‘What was planned’ ‘What actually happened / Description of the event’ and other text string fields, which were included in the current processes and stages mentioned in Section 3.2 . Once the configuration was complete, filters were applied to refine the dataset,

exporting all the existing LL from entire sector Z. LL records from outside of sector Z were considered as irrelevant and excluded from this study.

The filtered data was then exported to Microsoft Excel, which served as the primary tool for organizing and managing the dataset. Excel was chosen to be the data collection tool because the PPM software's portlet itself contained the option to export as a csv or xlsx file, and because the functionality of excel allowed efficient handling of large amounts of data. There were a total of 2,438 LL records exported, consisting of 51 columns.

4.2 Data pre-processing

In addition to collecting the data, Excel was used to perform initial data cleaning and preprocessing tasks. This included checking for missing values and verifying the completeness of each field. By addressing these issues early in the process, the quality of the data was significantly improved, laying a reliable foundation for subsequent analysis.

In the data cleaning phase, non-project related LLs were excluded from the dataset by applying a filter where the 'SAP Number' is neither blank nor equal to 'xx007', the latter being an informal SAP number used for testing purposes. This filtering process resulted in the removal of 31 non-project related records, leaving 2407 records that were all associated with specific customer delivery projects spanning from 2010 to 2024.

Upon further examination, it was observed that the datasheet comprises 51 columns. However, many of these columns exhibited low completion rates, indicating that users did not consistently populate these fields in the PPM software, leading to numerous blank values. To quantify this, a 'Field Usage' index was established. The index, expressed as a percentage, represents the proportion of non-blank cells to the total number of records in the database. The 'Field Usage' index was calculated for each column, with values ranging from 1.44% to 100%. In addition to providing a reference to which fields users find more useful and which are less useful, the index served as an indicator of the reliability of the columns, guiding the selection of columns for subsequent analysis.

4.3 Data analysis

Excel was utilized to create pivot tables for conducting preliminary tests in preparation for subsequent data analysis in Power BI. The combination of Excel and Power BI ensured a robust and efficient data analysis process with the aim of thoroughly examining the 2,407 pieces of LL data existing in the PPM software.

Firstly, pivot tables were created to provide an overview of the trend in the amount of LL and their creators within the context of a longitudinal study. If the pivot tables proved to be effective and meaningful, the data would then be transferred to Power BI for the creation of more visually engaging data analysis reports. The first pivot table was designed with 'Business Unit' as the column, 'Created Date' as the row, and the count of 'Lesson Learned ID' as the values. This configuration allowed for the generation of a line chart, as illustrated in Figure 5. The orange line shows the trend for unit A, the green for unit B, and the blue for unit C. The chart clearly indicates that the trend is worth further investigation, as it may reveal significant findings. The second pivot table was configured with 'Business Unit = unit A' as a filter, 'Created Date' as the column, 'Created By' as the row, and the count of 'Lesson Learned ID' as the values. This setup produced a table, as shown in Table 7 below. The table provides a clear overview of the individuals who have created the most LLs each year and highlights the unit A colleagues who consistently contribute to the creation of LLs.

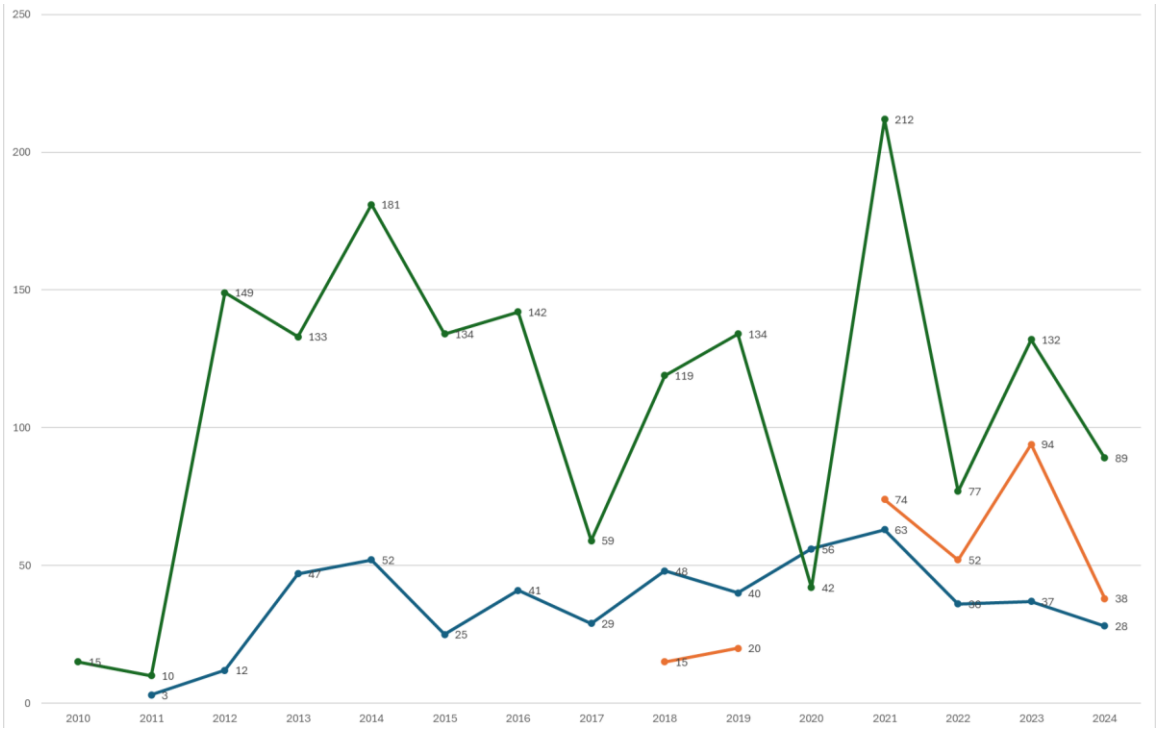


Figure 5. Amount of LL trend by year and business units

Table 7. Amount of LL by creator and year

Creator	2018	2019	2021	2022	2023	2024	Grand Total
People 1			2	7			9
People 2					23		23
People 3		10					10
People 4					7		7
People 5			6	1			7
People 6					1		1
People 7				7			7
People 8				2	3		5
People 9					1	6	7
People 10		7					7
People 11					3	7	10
People 12				2	3		5
People 13					2		2
People 14					10	2	12
People 15					4		4
People 16				1			1
People 17					1		1
People 18				8	8		16
People 19			28			3	31
People 20	1	1					2
People 21				3			3
People 22					2		2
People 23			26				26

People 24			3				3
People 25				1			1
People 26			1				1
People 27				1	11		12
People 28		2					2
People 29			1				1
People 30			6		4		10
People 31					1	1	2
People 32				3	2		5
People 33	14						14
People 34			1	1	1		3
People 35					3	1	4
People 36				15	4	1	20
People 37						3	3
Grand Total	**15**	**20**	**74**	**52**	**94**	**24**	**279**

Secondly, the cleaned and organized data was transferred into Microsoft Power BI for formal data analysis. The transition to Power BI further enhanced the visualization and interpretation of the data, making it more accessible and actionable for stakeholders.

In Power BI, the data analysis process began by importing data from Excel and transforming it as needed. The platform automatically corrected the data types for each column; for instance, the 'Creation date' was recognized as a 'Date' type, and 'Resolved (Y/N)' is identified as a 'True/False' type. To ensure accuracy, potential errors were checked to confirm that each column has the appropriate data type. Rows were filtered to exclude entries meant for testing purposes by using the expression '= Table.SelectRows(#"Changed Type", each ([SAP Number] <> "" and [SAP Number] <> "xx007"))'. Irrelevant columns, such as those containing URLs that are difficult to analyse or have low field usage value, like 'Project classification' and 'Link to LL', were removed. Once the data was cleaned, it was applied, and the process of building reports could commence.

4.4 Analysis and discussion

This section describes 3 Power BI report pages, which contain data that is current up to September 11th, 2024.

4.4.1 Report page 1: overview

Report page 1 provides an overview of the pre-processed data, as shown in Figure 6. Consequently, the figures for 2024 show a declining trend compared to 2023.

Firstly, Among the three business units, unit B has the highest number of registered LL. The lowest point in recent years was in 2020, due to the reduced project activity during the pandemic. However, 2021 saw a historical peak, coinciding with the year when the unit B LL process owner conducted refresher training for the sector Z, applicable to all three business units. Data for unit A starts from 2018, with no lessons recorded in 2020. In contrast, unit C shows the smallest variation in the number of LL registrations.

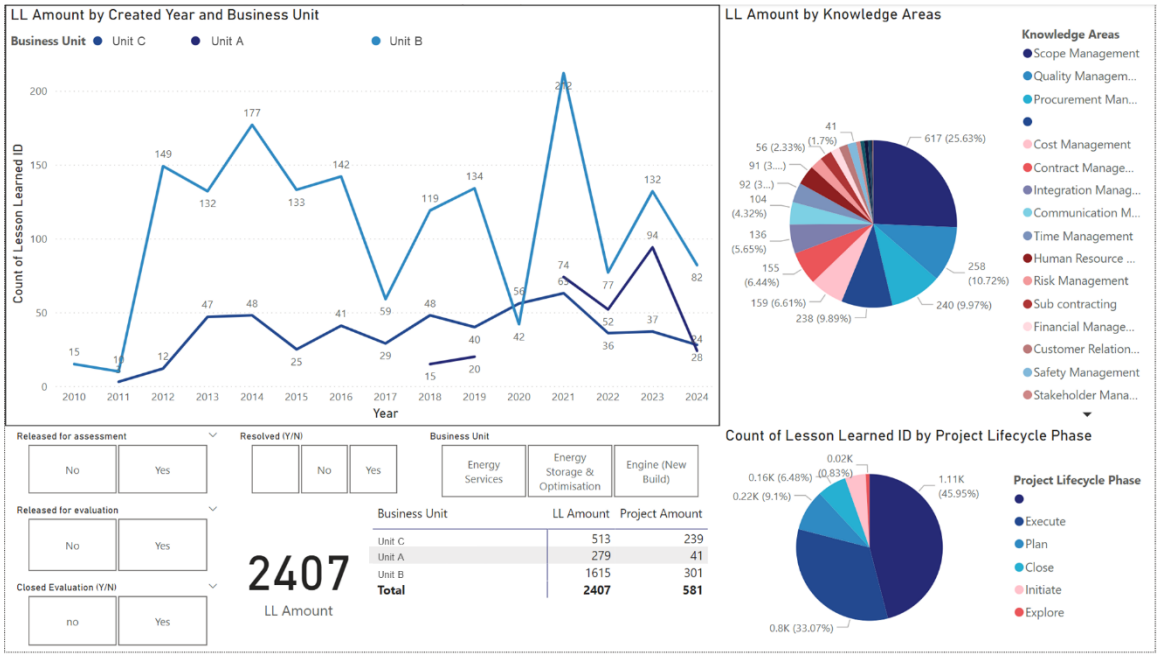


Figure 6. Power BI report page 1: Overview

Secondly, all flags included in the database are designed into slices. These flags assess whether LL participants followed the process and adhered to compliance. Unit B has the highest compliance among the three business units, see Table 8. For example, the 'resolved' flag shows that unit B has 1328 out of 1615 resolved cases, while unit A has only 44 out of 279, and unit C has 31 out of 513. This indicator effectively reflects whether the resolution stage was followed.

Table 8. Completion rate of LL flags

	Released for assessment	**Released for evaluation**	**Closed Evaluation**	**Resolved**	**Total**
Unit C	423 (82.5%)	36 (7.0%)	2 (0.4%)	31 (6.0%)	513 (100%)
Unit A	189 (67.7%)	111 (39.8%)	44 (15.8%)	44 (15.8%)	279 (100%)
Unit B	1517 (93.9%)	400 (24.8%)	1315 (81.4%)	1328 (82.2%)	1615 (100%)
Total	2129 (88.5%)	547 (22.7%)	1361 (56.5%)	1403 (58.3%)	2407 (100%)

Lastly, the concept of knowledge area, as proposed by Project Management Book of Knowledge (PMBOK), shows a blank rate of 9.76%. The top two categories are scope management at 25.94% and quality management at 11.05%. The blank rate for the project lifecycle phase is as high as 46.61%, followed by the execution phase. This is because the project execution team uses the PPM software for LL activities, while the Sales team uses a different software. There is no automation between the two platforms, resulting in fewer lessons for the initiate and explore phases. Although these fields are not mandatory, their purpose is to facilitate future users in finding relevant content more easily through filters.

4.4.2 Report page 2: fields in creation stage

Report page 2 contains a more detailed analysis, which is specific to unit A, as the focus of the case study is to identify what has gone wrong on the unit A side. This page serves a similar function to counting each column's field usage, as mentioned in Section 4.3 , but it uses a stacked bar chart with ribbons to show the trend of which of the seven text/string fields in the detail section of the creation stage are most important to users in each year, as shown in Figure 7.

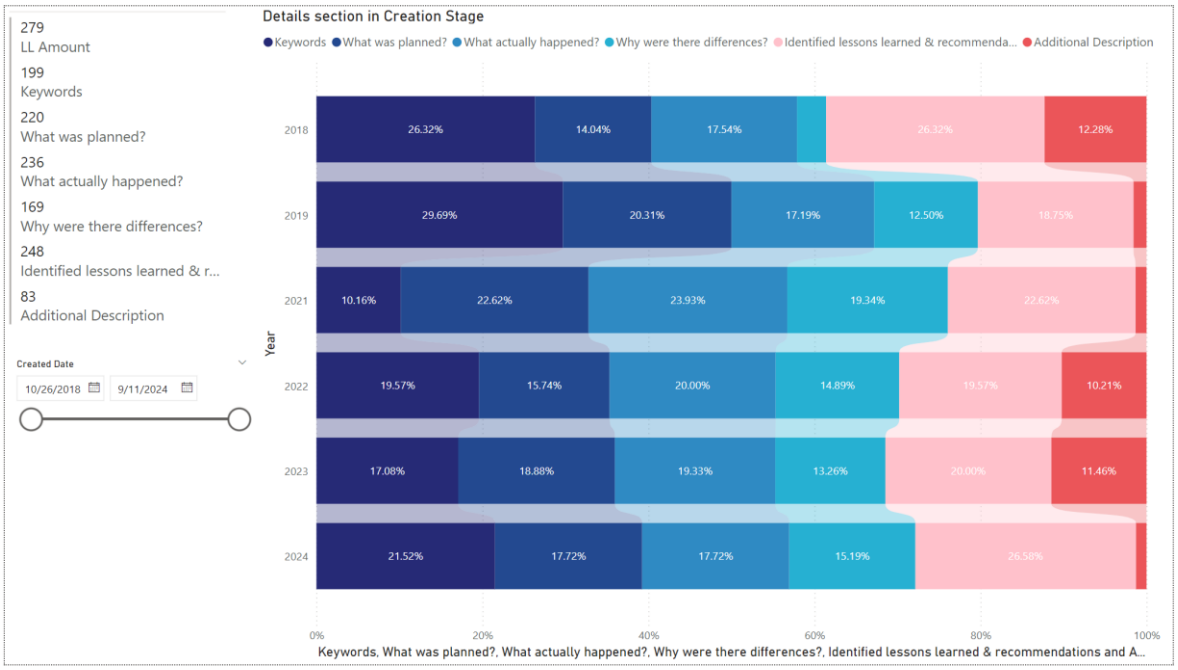


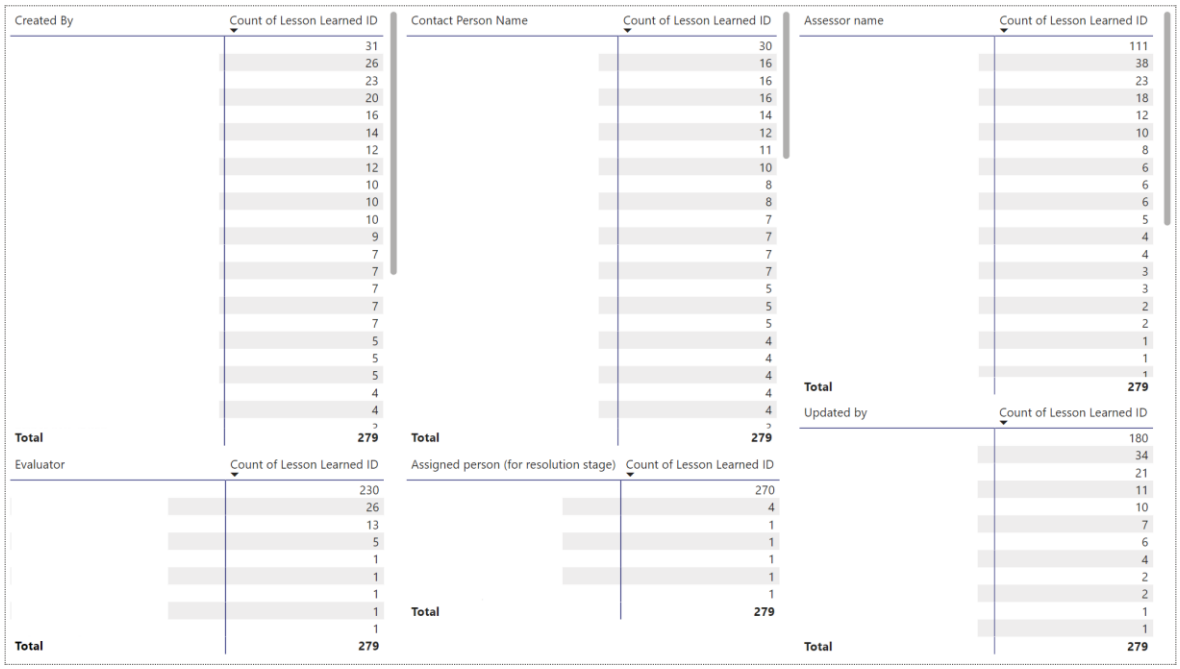
Figure 7. Power BI report page 2: Fields in creation stage

Regardless of the year, 'additional description' is consistently the least useful field, followed by 'why were there differences'. When considering the years, it can be observed that from 2021 to 2024, the importance users place on the 'what actually happened' field gradually declined, meaning that the completion rates for other fields have increased. Specifically, the fields 'Keywords' and 'Identified LL & recommendations' see higher completion rates. Overall, the fields present in the creation stage are intended to guide the LL creator's thinking process. However, creators typically do not open the LL registration page without a reason; they usually do so after a meeting or when instructed by someone else, meaning they already have an idea of what lessons are worth recording. While the existing fields aim to encourage systematic thinking, the numerous steps involved can be discouraging. Therefore, it may be worth considering reducing or combining some of the fields to streamline the process.

4.4.3 Report page 3: key participants

Report page 3 provides a comprehensive understanding of the key participants involved in the LL process, as shown in Figure 8. This page includes six tables that contain the roles, and the count of LLs associated with individual: creator, contact person, assessor, evaluator,

resolution owner, and updated by. For privacy reasons, the names of individuals were anonymized.



Created By	Count of Lesson Learned ID
	31
	26
	23
	20
	16
	14
	12
	12
	10
	10
	10
	9
	7
	7
	7
	7
	5
	5
	4
	4
Total	279

Contact Person Name	Count of Lesson Learned ID
	30
	16
	16
	16
	14
	12
	11
	10
	8
	8
	7
	7
	7
	5
	5
	5
	4
	4
	4
	4
	4
Total	279

Assessor name	Count of Lesson Learned ID
	111
	38
	23
	18
	12
	10
	8
	6
	6
	6
	5
	4
	4
	3
	3
	2
	2
	1
	1
	1
Total	279

Updated by	Count of Lesson Learned ID
	180
	34
	21
	11
	10
	7
	6
	4
	2
	2
	1
	1
Total	279

Evaluator	Count of Lesson Learned ID
	230
	26
	13
	5
	1
	1
	1
	1
	1
Total	279

Assigned person (for resolution stage)	Count of Lesson Learned ID
	270
	4
	1
	1
	1
	1
Total	279

Figure 8. Power BI report page 3: Key participants of LL in unit A

The first table identifies the creators of LLs. Notably, the top five creators each generated over 15 LL records in the PPM software, with the highest being 31 and 26 LLs. Three of these individuals function as project controllers, while the other two left the corporation. This indicates that project controllers play a significant role in the creation stage.

The second table lists the contact persons, who are expected to have the best knowledge of the LLs. Historically, the contact person field was often left blank by the creators. However, a process automation in the PPM software assigns the creator as the contact person if the field is not filled. Consequently, only 14 LLs have no contact person. Among the top five contact persons, the first two are project managers responsible for 30 and 16 LLs respectively, followed by a system engineer. These three individuals are all based in Vaasa, Finland, and focus on European projects. The fourth contact person left the corporation, and the fifth entry is blank.

The third table highlights the most frequent assessors. When an LL is released for evaluation, the assessor is automatically assigned as the line manager of the contact person. The first record shows that 111 LLs lack a proper assessor, indicating they were not released for evaluation by the creators. The second most frequent assessor is the general manager of project management, followed by the director of QEHS, a former project controller in the sector Z, and the commissioning manager.

The fourth table shows who were the evaluators. The evaluation process was largely neglected in unit A due to the absence of a dedicated resource. Consequently, 230 LLs have no evaluator. The second most frequent evaluator is the LL process owner in unit B, who had evaluated 26 LLs for unit A. The third evaluator left the corporation, and the fourth is a quality manager. Other evaluators have only one related LL.

The fifth table addresses the resolution stage, identifying the resolution owners. Similar to the evaluation stage, this was overlooked in unit A, with 270 LLs lacking a resolution owner. The director of product management was responsible for resolving 4 LLs, while others have only one related LL.

The sixth table captures the individuals who made the last changes to the LLs. This field was designed to capture who made the last changes in the assessment stage. A total of 180 LLs do not have an "updated by" entry, indicating that either they were not released for evaluation by the creators, or the assessors have not logged into the PPM software to make any assessment. The second, third, and fourth most frequent entries in this table show similar outcomes to the third table for assessors.

The results from these tables are instrumental in selecting participants for the survey in the next part of this study, as they possess more knowledge of LLs compared to their colleagues. By learning from their experiences, a valuable insight can be gained into past events and improve future processes.

5 Root cause analysis of implementation challenges

The chapter begins with a survey designed to gather comprehensive insights into the current LL practices and perceptions within the organization. It details the survey design, participant selection, and the results obtained. Following the survey, this chapter describes the design and execution of workshops aimed at conducting a thorough RCA. The findings from these workshops were analysed to identify the root causes of 6 major categories of challenges.

5.1 Survey

To gain a comprehensive understanding of the current LL practices and perceptions within the organization, a survey was conducted. This survey aimed to gather overall reviews of these practices, identify the challenges faced, and uncover the success factors as well as suggestions for improvement.

5.1.1 Survey design

The aim of this survey was to gain a comprehensive understanding of the current LL practices and perceptions within the organization. Specifically, the survey tried to gather overall reviews of these practices, identify the challenges faced, and uncover the success factors as well as suggestions for improvement.

Based on the information provided in (Krosnick, 2018), the survey questions were meticulously designed to follow a structured format, consisting of 20-30 questions divided into six distinct sections, which were demographic information, activity perspective, process perspective, tool perspective in the current LL practices, the PPM software create and assess experience, and review and outlook. The survey design is shown in Figure 9 below.

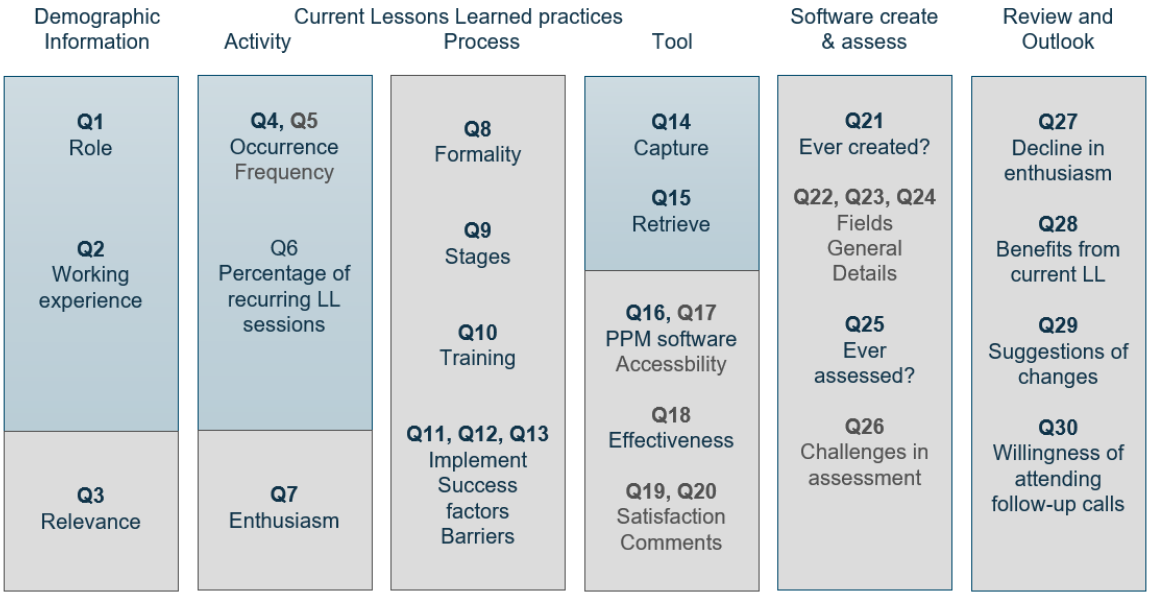


Figure 9. The survey design

5.1.2 Survey participants

The target participants for the survey was identified based on data analyses of existing LL records to ensure that respondents were well-informed and relevant to the study. In total, 49 respondents were carefully selected based on the criteria of individuals being listed as evaluators, contacts, creators, assessors, resolution owners, or updaters. Of these respondents, the most frequently occurring name was recorded 72 times, followed by another name appearing 40 times and a third name appearing 34 times. This method ensured that the respondents were experienced, but without considering whether they had enough time to answer the survey, as a high number of occurrences of a name indicated that he or she could be a high-level manager.

Before distributing the survey formally, a pilot test was conducted with three colleagues from November 5th to 7th, 2024. Their feedback was valuable in modifying the survey questions and format. Based on their opinions, necessary changes were made, such as adding ‘I don't know’ and ‘I don't remember’ options instead of ‘Neutral’, thus ensuring that the survey was clear and relevant. The pilot test helped to improve the overall data quality and effectiveness of the survey.

The formal distribution of the survey began with an initial email, triggered by Microsoft Form, sent to the 49 selected respondents. This first approach, conducted from November 11th to 17th, resulted in 9 replies. To increase the response rate, a second approach was used on November 18th, which involved sending an auto-reminder email to those who had not yet responded. This effort brought in 6 more replies over the next four days. Finally, on November 22nd, a more personalized third approach was used by sending individual Microsoft Team messages. These messages included greetings, an explanation of the survey's purpose, and the reason for selecting them based on their role in the existing LL record. This approach proved effective, bringing in 8 more responses by November 25th. In summary, 26 colleagues responded to the survey over a period of 20 days.

5.2 Survey result

This section provides a comprehensive understanding of the survey results from 3 perspectives and concludes with a review and outlook.

5.2.1 Demographic information

Out of the 26 respondents, half have one to three years of experience working in unit A. Additionally, nine respondents (34.6%) have three to five years of experience, and other four respondents (15.4%) have more than five years of experience. None of the respondents have less than one year of experience. The most common roles are Project Manager, with five respondents holding this position, followed by System Engineer, represented by four respondents. In addition, three respondents identify as Project Controllers, and two as General Managers. When asking about the relevance of the LL to their job roles, over 80% of respondents rate it as relevant, consisting of 11 who find it very relevant and 10 who find it relevant. neutral stance is taken five individuals, while no one find it irrelevant to their job roles.

5.2.2 Current LL practice

The vast majority of respondents (76.9%) confirm that LL sessions are organized in the projects in which they were involved. These meetings are scheduled according to different rules. Only 23.1% indicate that there are recurring sessions included in the project, for example weekly, monthly, quarterly, or planned according to the project lifecycle. The rest of the respondents indicate that non-scheduled LL sessions are usually held at the time of project handover or after a major incident, or when necessary or needed. However, if their schedule allows, over 80% of respondents are willing to participate in the organized LL sessions, consisting of 14 very likely and 10 likely. Despite a lack of regular participation, the high willingness indicates that the value of learning sessions are recognized among respondents and among unit A.

It is worth noting and reflecting on the fact that only three respondents (11.5%) believe that unit A has an established and well-structured formal process for LL. In contrast, 57.7% of the respondents do not think so. And the rest have other opinions, such as the existing process are not functioning as they should and need to be improved. As noted by the respondents, the current LL process encompasses several stages: creation (84.6%, 22 respondents), assessment (50%, 13 respondents), evaluation (46.2%, 12 respondents), and application (42.3%, 11 respondents). However, respondents appeared to be less clear about other key stages, which are resolution, analysis, and retrieval. This ambiguity suggests a potential gap in the communication and implementation of the LL process. In addition, only two respondents (7.7%) reported receiving adequate training on LL, while a significant portion either had not received training or were unaware of it. This lack of training is reflected in the overall poor ratings of the current LL implementation, 80.8% rating it as neutral, bad, or very bad. Key success factors identified for effective LL implementation include strong leadership support, regular follow-up and review, and a well-defined process. However, significant barriers such as lack of time or resources, inadequate management support, and a deficient learning culture hinder the process. Addressing these barriers and enhancing training and awareness are essential for improving the LL process in unit A.

The tools used for capturing and retrieving LL show a strong reliance on PPM software, with 84.6% of respondents using it for capturing and 73.1% for retrieving lessons. It is encouraging that the majority are aware that PPM software is the official tool for recording

LL. However, it is notable that many respondents do not recognize that the Power BI page is the recommended tool for retrieving LLs, with only 23.1% using it for this purpose. Instead, respondents are using a variety of other tools for retrieval, including personal notebooks, offline or shared Microsoft files, and Microsoft Teams. This indicates a potential gap in communication or training regarding the recommended tools. Despite the widespread use and acceptance of PPM software, with more than half of the respondents endorsing ease of use, a large proportion were still unable to judge the effectiveness of the PPM software for enhancing LL process.

5.2.3 Creation and assessment in the PPM software

The process of creating and assessing LL entries in the PPM software reveals several challenges and areas for improvement. In the PPM software, 60% of respondents actively created LL entries, but many find the process complex due to the numerous fields required. The most useful fields in the General section are ‘Contact person’, ‘Project activity’, and ‘Knowledge area’, while in the Details section, ‘What actually happened?’, ‘What was planned’, and ‘Identified LL & recommendations’ are valued most. Only 28% of respondents have assessed LL entries, indicating a gap in the assessment stage. Assessors find this stage overly complicated and struggle to assign LL to the correct resources.

Generally, respondents' comments highlight several key areas for improvement the PPM software:

1. UX improvements: Many suggest updating and simplifying the PPM software UI by removing unnecessary data fields to enhance usability. Transitioning to a modern UI could make the PPM software more user-friendly and encourage consistent use.
2. Integration and functionality: Respondents highlight the need for better integration with other tools like Salesforce, the ability to assign topics to responsible individuals, and comprehensive reporting capabilities. Ongoing training is also necessary to ensure effective use of the tool.
3. Additional features: Suggestions include increasing the space for information entry and adding features like drag-and-drop for easier file uploads.

5.2.4 Review and outlook

The analysis of responses regarding enthusiasm for LL activities over time reveals a mix of perspectives, with notable concerns impacting engagement. Several respondents have experienced a decline in enthusiasm due to a lack of transparency and feedback on the outcomes of LL entries, which reduces the perceived value of their efforts. The absence of dedicated resources and structured processes for handling LLs further contributes to slower actions and lower participation. Additionally, the failure to assess and act on reported lessons demotivates project teams, resulting in a feeling that documenting LLs is pointless.

In contrast, some respondents maintain or even increase their enthusiasm, recognizing the importance of LL in understanding causes, designing action plans, and promoting continuous improvement. They find satisfaction in the potential for LL to enhance project efficiency, reduce mistakes, and contribute to organizational knowledge. In conclusion, the overall result suggests that without visible outcomes and proper integration of processes, enthusiasm for LL activities is likely to decline. To enhance the effectiveness and usability of LL activities, it is recommended to implement process improvements, provide more training on the processes, and define clear follow-up items.

5.3 Workshops

Following the distribution and analysis of the survey, which was designed to gain a comprehensive understanding of the current LL practices and perceptions within unit A, it became evident that the implementation of LL has not been satisfactory. To address this issue in greater depth, follow-up workshops were deemed necessary.

5.3.1 Workshop design

The primary aim of these workshops was to conduct a thorough RCA to understand why this problem occurred and why it escaped the standard procedures in place. The workshops were conducted as 30-minute online Teams meetings, with cameras turned on to facilitate engagement and transcription enabled to ensure accurate records of the discussions.

The workshop was structured into three stages: general experiences, specific instances, and RCA for each participant, see Figure 10. Each stage was allocated approximately 10 minutes to ensure a focused and efficient discussion.

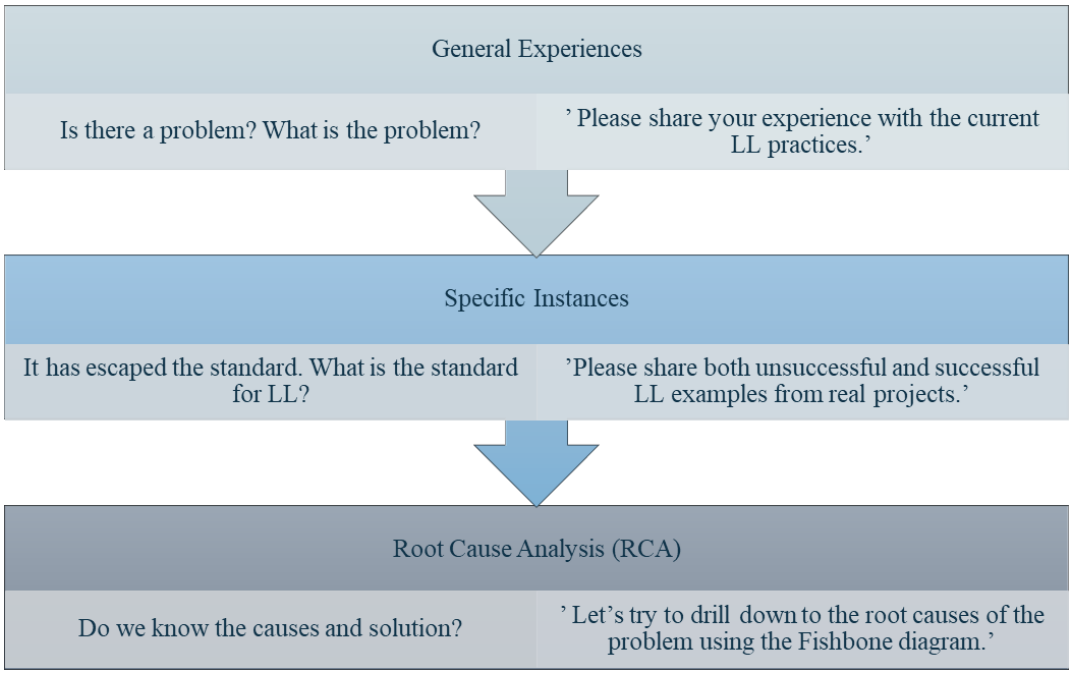


Figure 10. The workshop design

In the general experiences stage, the goal is to engage participants in identifying whether there is a problem and, if so, what the problem is. The purpose of this stage is to determine whether the current status is perceived as normal or if there is an underlying issue that needs to be addressed. To facilitate this discussion, the opening prompt is designed as, "Please share your experience with current LL practices." This helps set the stage for understanding the participants' perspectives on the existing practices.

Once a problem is identified, the next step is to verify that something has deviated from the standard. The aim here is to identify the standard for LL implementation. This is a relatively new concept for many colleagues, as LL implementation involves intensive knowledge processes that are difficult to standardize, unlike manufacturing processes where quantification is straightforward. By asking participants to "Please share both successful and unsuccessful LL examples from real projects," they begin to reflect on an abstract standard

in their minds. This reflection helps them distinguish between successful and unsuccessful instances, indicating that they have an implicit understanding of the standard.

After identifying the problem and the standard, the focus shifts to uncovering the causes and potential solutions. The aim is to determine whether the causes are known or if they remain unidentified. RCA is one of the thematic analysis approaches. The root cause possesses the capability to activate or deactivate the mechanism, thereby preventing the recurrence of the same issue in the future. (Dalgobind & Anjani, 2008) Therefore, this stage involves conducting the RCA using the Miro board, an online mind mapping tool. A fishbone diagram is utilized to categorize the most frequent causes based on survey responses. Participants are asked to find root causes for these categories, contributing the top three categories from their survey responses. At the end of each workshop, the participants' inputs are summarized into the main fishbone diagram for further analysis. By following these stages, the workshop aims to systematically identify problems, understand standards, and uncover root causes, ultimately leading to actionable solutions.

5.3.2 Workshop participants

The selection of workshop participants was based on the responses to the survey. In detail, this study filtered those who expressed a willingness to participate in follow-up workshops and sorted them by their years of experience working in unit A. From the 27 survey responses, 8 participants were chosen based on their current roles within the organization, as shown in Table 9, ensuring a diverse and representative sample. The selected roles included 2 project controllers, 2 project managers, 2 general managers of project management, 1 system engineer, and 1 supply quality manager. These roles were identified as particularly important for project learning within the unit A, compared to other roles.

Table 9. Workshop participants

No.	Current role (Code)	Workshop time
1	Project controller A	10th Jan 2025
2	Project controller B	17th Jan 2025
3	Project manager A	17th Jan 2025

4	Project manager B	20th Jan 2025
5	General manager of project management A	21st Jan 2025
6	General manager of project management B	28th Jan 2025
7	System engineer	10th Jan 2025
8	Supply quality manager	10th Jan 2025

5.4 Workshop result

Reaching a consensus on the major categories in the fishbone chart, can be challenging. Text correlation aids in identifying potential root causes of a problem (Francesca, et al., 2022). Therefore, after a systematic review of the survey results, 6 major categories were summarized, which are lack of structured process, inadequate training, lack of team awareness, no visibility on outcomes, poor documentation, and lack of management enforcement, as shown in Figure 11, with no participants expressing disagreement with any of them. The lack of structured processes and inadequate training reveals the insufficiency of LL implementation. The LL process includes documentation and learning phases, as mentioned in Section 2.2.2. Lack of team awareness and poor documentation are implementation challenges highlighted in Section 2.2.3, representing human factors that are difficult to predict and control.

Figure 11. Fish bone chart

There are 2 new challenges not included in previous studies: no visibility of outcomes and lack of management enforcement. These findings enrich the implementation approaches by demonstrating that human factors can be both challenges and enablers. Every project team member deserves to know the outcomes of the LL processes, which convinces them that value is created for the organization and that their time is not wasted on LL activities. Furthermore, enforcement from the management team can drive implementation and formalize the entire process. These insights suggest that addressing human factors can not only mitigate challenges but also boost the effectiveness of LL implementation.

5.4.1 Lack of structured process

The term ‘lack of structured process’ refers to the absence of a well-defined, organized, and systematic LL approach to conducting tasks or activities. In the context of the workshop discussions, it means that there is no clear, documented, and consistently followed procedure for implementing LL. This can lead to several issues, such as inconsistency, inefficiency, and lack of accountability. Without a structured process, different team members may follow different methods, leading to inconsistent results, wasted time and difficulties in assigning responsibility. During the workshop, participants agreed that the lack of structured processes was a major problem. Specifically, participants identified the following root causes:

1. Lack of team awareness: Team members are not sufficiently aware of the existing processes, leading to ineffective implementation. This lack of awareness results in inconsistent application of procedures and hinders the overall effectiveness of the process. Many participants noted that the process is not well understood by the team, which contributes to its poor execution.
2. Lack of time and resources: Participants pointed out that team members feel too tired after daily work to follow the process. The exhaustion and resource limitations prevent the team from dedicating the necessary effort to properly follow and maintain the structured process. It was highlighted that after a full day of work, team members often lack the mental capacity to adhere to additional processes.
3. Outdated process: The process may be outdated and not aligned with current needs and changes. An outdated process fails to address the evolving requirements of the

project, leading to its underutilization and ineffectiveness. Participants mentioned that the existing process might not be followed because it is perceived as outdated and irrelevant to current project demands.

4. Lack of process owner: There is no clear process owner, leading to a lack of management and updates. Without a designated individual responsible for overseeing the process, it becomes challenging to enforce adherence and make necessary improvements. The absence of a process owner results in a lack of accountability and continuous improvement.
5. Process description is not easily accessible: The process description is not easily accessible and is not well communicated to team members. This lack of accessibility and communication results in confusion and inconsistency in following the process. Participants noted that even if a process description exists, it is not effectively communicated to the relevant stakeholders, making it difficult for them to follow the process.

5.4.2 Inadequate training

The term ‘inadequate training’ refers to insufficient and ineffective training provided to team members on the processes and tools needed to implement LL. This inadequacy was demonstrated in several ways, resulting in a lack of understanding and proper implementation of the processes. The following root causes were identified:

1. Not enough refresher sessions: Training sessions are not conducted frequently enough to reinforce the knowledge and skills required. When new employees join the corporation, they often struggle to find opportunities to meet trainers either face-to-face or in online sessions. Typically, if they are fortunate enough to identify the contact person for certain processes, they are provided with presentation slides and training recordings that last for about an hour. This method reduces the willingness to focus and follow the training, as it lacks interactive and engaging elements. Regular reminders and refresher sessions are essential to keep the team updated and motivated to adhere to the processes.

2. Lack of structured process: The absence of a structured process for training further worsen the issue. Without a clear and organized training program, new employees and existing team members do not receive consistent and comprehensive training. This leads to gaps in knowledge and understanding, making it difficult for team members to effectively implement the processes.
3. Lack of strategy or objectives: Training sessions often focus solely on the mechanisms of how to perform tasks without explaining the underlying strategy or aim. This lack of context makes it challenging for team members to understand the importance and purpose of the processes. When the rationale behind the processes is not communicated, it reduces the motivation to follow them. Effective training should include not only the how but also the why do we need LL in unit A.
4. Lack of time and resources: Similar to the category of lacking the structured processes, the lack of time and resources also affects the adequacy of training. Team members are often too busy with their daily tasks to dedicate sufficient time to training. Additionally, limited resources, such as trainers and training materials, further hinder the ability to provide comprehensive and effective training.

5.4.3 Lack of team awareness

The term ‘lack of team awareness’ refers to the insufficient understanding and engagement of project team members in the LL activities. This lack of awareness leads to repeated mistakes and missed opportunities for improvement. The following root causes were identified:

1. No visibility on outcomes: Team members often feel that the information they provide is not utilized effectively, leading to a perception that their efforts are wasted. This sentiment was expressed as feeling like "filling all the information and throwing it into a volcano." Without clear visibility on the outcomes and impact of their contributions, team members are less likely to engage in the process of documenting and implementing LL.
2. Lack of motivation: Many team members lack the motivation and willingness to participate in the LL process because they do not perceive its value. They do not see

the bigger picture, nor can they understand how their contributions can lead to organizational improvements. This lack of perceived value diminishes their engagement and commitment to the process.

3. Failing to see value beyond the individual level: In some cases, the value of LL is not recognized by users at all. And in some cases, the current value is only at an individual level. For example, project managers or project controllers may acquire LL from previous projects for their own use, but this knowledge is not extended to the project level or organizational level. This means that future projects do not benefit from the collective experiences of past projects unless keeping the experienced personnel, limiting the overall impact of LL.
4. LL is not prioritized: The LL process is often not prioritized among other activities. There are many competing priorities, and LL may be seen as less important, resulting that team members do not allocate sufficient time and effort to documenting and learning from lessons.
5. Teams rushed to deliver projects: There is a tendency for the team to rush through the delivery phase of a project and move on to the next one. Lessons are typically recorded when the project is about to be delivered, although it is encouraged to record them at any time during the project phase. This hurried approach results in incomplete or superficial documentation of LL, reducing their effectiveness

5.4.4 No visibility on outcomes

The term ‘No visibility on outcomes’ refers to lack of transparency and feedback regarding the results and impacts of the recorded LL. This lack of visibility discourages team members from engaging in the process, as they do not see the tangible benefits of their contributions. The following root causes were identified:

1. Tool user-friendliness is low: The tools used for documenting and viewing LL are not user-friendly and lack transparency in audit trail. The complexity and lack of intuitive design reduce the likelihood of team members engaging with the tools, thereby limiting the visibility of outcomes.

2. Lack of knowledge sharing process: There is an absence of a clear and structured knowledge sharing process both literally and practically. The sharing and learning mechanisms have not been introduced clearly, and no regular sessions have been scheduled to facilitate this process. Without a formalized approach to knowledge sharing, team members are unaware of how to access and benefit from LL.
3. Lack of guidelines for assessors: When assessors receive email notifications about LL, they often lack the necessary training or experience to handle the assessment effectively. The absence of clear guidelines embedded in the tool makes it challenging for assessors to evaluate and act. This results in a bottleneck, where LL are not accurately assessed and implemented, further reducing visibility on outcomes.
4. Limited awareness of the tool: Many team members are still unaware that tools for viewing LL are available, for example the portlet in the PPM software and Power BI. This lack of awareness means that even if lessons are documented, they are not accessed or utilized by the broader team. The limited visibility of the tool and its capabilities hinders the dissemination and application of LL across the organization.

5.4.5 Poor documentation

The term ‘Poor documentation’ can be understood from two different perspectives: the quality of the documentation itself and the process of documenting LL. Both perspectives suggest that the quality of documentation is substandard, and the documentation does not support operations as it should. The following root causes were identified:

1. Lack of resources, especially unit A LL process owner: The absence of a dedicated LL process owner for the unit A has been a long-standing issue. Without a responsible individual to oversee and manage the documentation process, there is a lack of coordination and consistency in capturing LLs.
2. Lack of unit A-specific clear instructions: The instructions provided for documenting LL are often not tailored to the specific needs. Instead, they rely on generic EB processes, some of the stages and fields are not applicable to unit A. This lack of

clear, division-specific instructions leads to confusion and inconsistency in how lessons are documented, further degrading the quality of the documentation.

3. Bad accessibility of the PPM software classic UI: The classic UI, which has been used for documenting LL for 14 years, has poor accessibility. The cumbersome interface and challenges in navigating to evaluation subpage discourage users from engaging with the tool, resulting in incomplete or poorly documented lessons.
4. LL are not captured in an easily understandable way: The way LL are documented often lacks clarity and comprehensibility. Team members may use technical terminologies, and sometimes fail to provide sufficient context, making it difficult for readers to understand. This issue is compounded by the lack of standardized templates or guidelines for documenting lessons in a clear and concise manner.
5. Lack of reviewing process: There is no formal process for reviewing the quality of the documented LL. As a result, the creators of these documents are not aware of the quality of their material. Without a review mechanism, errors and inconsistencies go unchecked, further diminishing the usefulness of the documentation.
6. People are not really using the PPM software: Many team members have preferred software for quickly jotting down notes for themselves, as it is faster and requires less detail than the PPM software. This preference for OneNote over the PPM software means that LL are not being captured in a centralized, accessible format. The fragmented documentation across different tools reduces the ability to share knowledge effectively.

5.4.6 Lack of management enforcement

The term has been commented on by general managers and renamed from ‘lack of management support’ to ‘lack of management enforcement’. It refers to the insufficient enforcement and prioritization of the LL implementation by the board of management in unit A. The following root causes were identified:

1. Process is not strict enough: The LL has not been enforced as a strict or mandatory requirement within the organization. It was not explicitly written into job responsibilities or job descriptions, which means that team members do not feel

obligated to follow it. Without clear mandates and expectations, the process is often overlooked or deprioritized, leading to inconsistent documentation and implementation of LL.

2. Siloed organizational structure: The problem of unsatisfactory LL implementation is not solely tool-related but also stem from the siloed organizational structure and lack of cross-functional communication. The current organizational setup hinders the flow of information and collaboration between different departments and teams. The shift to teleworking has been exacerbated by the impact of the COVID-19 pandemic. This makes knowledge sharing more difficult as employees are used to working from their home offices. Management teams need to take a more integrated approach to transform these silos into a cohesive and collaborative environment.

6 Implementation and development suggestions

This chapter provides tailored suggestions for implementing and developing the LL process and enhancing the PPM software. It is divided into two main sections: the LL process implementation strategy and the LL tool UX development strategy. The implementation strategy focuses on streamlining process stages, defining roles and responsibilities, and integrating LL into the governance model. The development strategy aims to improve the usability and effectiveness of the PPM software through UI redesign and field optimization.

6.1 LL process implementation strategy

Enhancing the LL process involves streamlining its stages, clearly defining roles and responsibilities, and integrating LL into the governance model. Addressing these areas ensures a more effective, coordinated, and continuously improving process.

6.1.1 Process improvement

To enhance the effectiveness of the LL process, it is essential to streamline and clarify the stages involved. If certain stages are not clear to users or are perceived as redundant, such as the assessment and resolution stages, they should be reconsidered or removed. It is observed that while a process may exist, adherence is often lacking due to its outdated nature and the absence of a clearly defined owner. The current process contains outdated stages, and the identity of the process owner is not well-known among users.

The next item to consider in the process improvement is to include necessary elements that users find valuable. For instance, learning and sharing are highly valued by users and should be integrated into the process. There exists a culture of informal learning where issues are discussed casually among colleagues, indicating a need for more structured and formalized learning and sharing sessions. For example, structured learning sessions, such as townhalls, can facilitate the sharing of occurrences and LL. These sessions can serve as a platform for disseminating valuable information and ensuring that all stakeholders are informed and aligned.

Another important improvement aspect is the visibility and accessibility of the process. The process should be made more user-friendly and interactive to ensure better understanding and adherence. Users often find it challenging to identify the process and its owner, which impedes the ability to implement necessary changes.

Finally, a clear relationship needs to be established between risks, issues, and LL. As one experienced project controller mentioned, documenting an item first as a risk, then as an issue, and finally as an LL can create a cohesive feedback loop. Currently, there is a lack of feedback on the outcomes of risks and issues, which needs to be addressed to ensure continuous improvement.

6.1.2 Role, responsibilities in the process

Compared to the sector Z, unit A has a more agile structure. This agility can be leveraged by appointing a dedicated LL process owner. The process owner’s role would include overseeing the LL process, ensuring that it is followed correctly, and providing support to

LL activities as needed. In addition, the scope of responsibilities can be extended to include a ‘missionary’ role, whereby one person moves between project teams, sharing and collecting LL and ensuring that knowledge is transferred effectively between projects. This approach helps bridge the gap between different teams and promotes a culture of continuous learning and improvement.

With the facilitation of unit A LL process owner, it is crucial to define and document clearer roles and responsibilities. Implementing a RACI (Responsible, Accountable, Consultative, and Informed) matrix helps to delineate who is responsible for each stage, including creators, discipline owners and SMEs. LL process owner should first agree among these roles to ensure effective communication and coordination. This is because clear role definitions help avoid confusion and ensure that each stage of the process is managed effectively (Kettenbohrer, et al., 2015). Once the roles are clearly defined, then appropriate targeted training is convened.

Specifically, each team member should be responsible for recording LL, with the project manager acting as the leader and the project controller serving as a facilitator in the creation stage. This distributed responsibility ensures that LL are captured from various perspectives, enriching the overall knowledge base. Furthermore, in the assessment stage, the assessor should no longer be equated with the line manager of the contact person. This change is based on the belief in the capabilities of every colleague in unit A, eliminating the need for a second-time supervision. In some cases, it may not be reasonable for the line manager to conduct the review. For example, the line manager may not have the bandwidth or specific expertise required to assess certain technical aspects of the LL, making it more practical for discipline owners to take on this role. The discipline owners and the unit A LL core team should take responsibility together for rewriting or restructuring the text to make it more understandable, which ensures that the documented lessons are clear and actionable for future teams to make use of.

When talking about the closing and learning stage afterwards, it is essential for the team to foster a collaborative environment where insights and experiences are shared, leading to continuous improvement. Regular team meetings or workshops focused on LL can provide a structured forum for these discussions, ensuring that they are an integral part of the project lifecycle. By allocating time to these activities and prioritize LL, teams can ensure that LL are not only recorded but also thoroughly analysed and integrated into future projects.

6.1.3 Governance model and monitoring plan

To enhance the governance model and monitoring plan, it is essential to integrate LL into the business process as a key monitoring point. LL should be included in gates and milestones, ensuring that they are consistently reviewed and addressed throughout the project lifecycle. By incorporating LL into monitoring points, similar to how cost is monitored by comparing the sales budget with the actual budget, organizations can ensure that valuable insights are systematically captured and utilized.

A more stringent process, enforced by the management team, is necessary to ensure compliance and effectiveness. Management support is crucial in driving the importance of LL and ensuring that the process is followed rigorously. By enforcing a strict process, management can ensure that LL are not only recorded but also analysed and applied to future projects.

Another critical aspect of the governance model is feeding project execution knowledge back to the sales team. This feedback loop ensures that the sales team is aware of past mistakes and can take preventive measures when exploring new opportunities. For example, knowledge gained from previous projects can inform the sales team about potential pitfalls in contract signing, helping them avoid similar issues in the future.

Re-occurring training sessions are important for reinforcing the significance of LL and ensuring all team members are well-versed in the process. These sessions can provide continuous education and updates on best practices, fostering a culture of continuous improvement. Additionally, incorporating LL training into the onboarding process can ensure that new employees are immediately introduced to the importance of LL. This training can be structured in the format of a checklist, providing a clear and concise guide for new hires to follow.

6.2 LL tool user experience development strategy

This section outlines the strategy for developing and enhancing the UX of the LL tool within PPM software. It includes plans for usability improvements, UI redesign, and field optimization. The strategy addresses current challenges, streamlines processes, and ensures

transparency. A validation plan is proposed to review and test the new interface, gather user feedback, and ensure continuous improvement.

6.2.1 Development

To support the development of the LL process, several enhancements can be implemented to improve usability and effectiveness. Adding a table that outlines development requirements and how improvements have been implemented can provide transparency and accountability. Table 10 details specific the aims, current way of working, and action plan, which documents the creation of useful fields, the removal of unnecessary fields, the configuration in portfolio portlet and so on. By documenting these development actions, stakeholders can see how their feedback has been addressed and the impact of these changes.

Table 10. LL development requirements

No.	Aims	Current way of working	Action plan
1	For users: easy access LL through email notifications	The email notification contains the link, leading to classic UI.	1. Check how many email notifications contains Link 2. Change the link address from classic UI to modern UI
2	For users: see clearly the LL is last updated by whom and the date	The view does not include these columns	Add two columns ‘Last Updated By’ and ‘Last Updated Date’ in landing page
3	For users: simplify the stages	Creation, Assessment, Evaluation, Resolution, Closing	1. Map out the process in Miro board 2. Evaluate and remove redundant stages and fields
4	For users: easy upload related documents	The users only have options to add URL.	Create a new field for users to upload the attachment(s)
5	For LL core team: track assessors, sub-assessors (SMEs), and the LL allocation date	There is no field for tracking sub-assessors and LL allocation date. The portfolio portlet does not include the filter of assessor.	1. Create new field: Sub-assessors (SMEs), which allows multiple entries. 2. Create new field: Assessor’s allocation date, which captures the date when the Assessor is appointed.

			3. Configure ‘Assessor Name’ and ‘Sub-assessor (SMEs)’ in the portfolio portlet
6	For LL core team: ensure that each lesson has been adequately assessed before closing.	The ‘Closed (Flag)’ checkbox can be checked by anyone.	Secure the ‘Closed (Flag)’ checkbox for LL core team.
7	For LL admin: ensure users have view and edit rights to the LL module in the PPM software modern UI.	There is no documentation of who has access rights to which field.	1. Add LL-related rights to user group ‘unit A people’. 2. Document the fields and access rights to the PPM software data reference table.

Once these development actions are finalised, creating two short video tutorials of around three minutes in length for users can provide quick and easy reference points, allowing them to revisit essential instructions whenever needed. These tutorials can help users navigate the system more efficiently and understand key functionalities.

As one of the next steps in the development plan, actions taken after viewing a lesson need to be recorded. The PPM software as a tool should develop this functionality to track the application of learning materials. For example, how many hits and how many thumbs up each course gets. Users can also log actions taken through the comments section. Such a feature increases the visibility of outcomes and can ensure that LL is not only recorded but also acted upon, leading to continuous improvement.

Incorporating an Artificial Intelligence (AI) tool to summarize knowledge using filters, such as 'UK' or 'EEQ', can further enhance the development process. The AI function can help users quickly find relevant information and insights, making the LL process more efficient and effective. In addition, the inclusion of flowcharts in the PPM software provides a visual representation of the process and helps users understand the current stage where LL is located. This visual aid helps users understand processes more quickly.

6.2.2 User interface redesign and field optimization

Transitioning from a classic to a modern UI design enhances UX and efficiency, see Figure 4. The primary goal of this transition is to present the most valuable information at first

glance on the landing page, ensuring that users can quickly and easily access critical data. A modern interface prioritizes clarity and usability, significantly improving the overall effectiveness of the LL process, see Figure 12. The 'unit A' view is saved and set as the default suggestion for all unit A users.

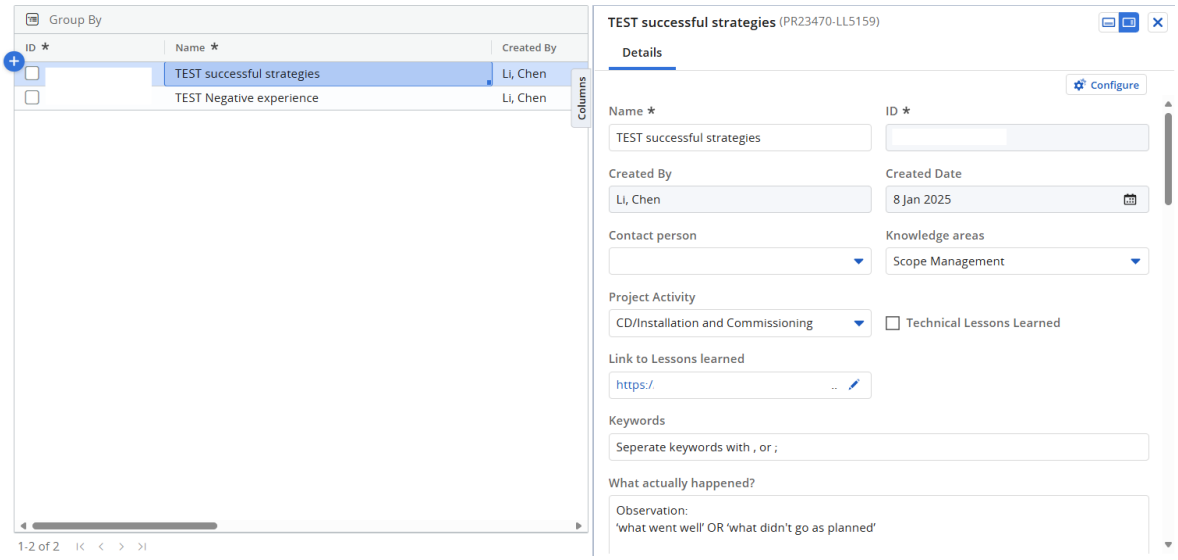


Figure 12. LL module in the PPM software modern user interface

To achieve an optimal user experience, it is essential to eliminate fields that may distract users from key information. This streamlined design reduces cognitive load and ensures that users can concentrate on the most relevant aspects of the LL process. In contrast to the previous iteration, which incorporated 5 flags, the current design is refined to include only 3. These flags are strategically repositioned to follow the final field in each respective stage, thereby demarcating the conclusion of each phase. Additionally, two monitoring fields are appended after each flag, serving to record the identity of the user who activates the flag and the corresponding timestamp.

In the first stage, namely the creation stage, 4 fields are identified for removal. The first field, 'Project Lifecycle Phase,' is deemed unnecessary because the PPM software, is dedicated to the order-to-delivery process, which exclusively records LL related to the execution phase. Consequently, it is redundant for users to select the project lifecycle phases. As demonstrated in Section 4.4.1 , 44.95% of LL records have a blank value, while 33.07% indicate that the

LL pertains to the execution phase. The second field, ‘Technical Lessons Learned area’ is removed, because all unit A LLs are directed to select the ‘unit A’ option and the other options are designed for unit B operations. It does not make sense to state that the LL belongs to unit A when the LL has project information, and the project has a defined business unit. The third field, ‘Why were there differences / What was the root cause’, is eliminated due to its high correlation with the 'Identified Lessons Learned & Recommendations' field. It is impractical to separate this content into two distinct text boxes, as users typically consider them as a unified whole. The fourth field, ‘Additional description’, is identified as the most redundant, as indicated in Section 4.4.2 . Given that the creation stage already includes three text fields, an additional text field for supplementary descriptions is unnecessary and can be integrated into the existing fields.

Furthermore, the order of the fields is adjusted to enhance user-friendliness. For instance, ‘Link to Lessons Learned’ now follows 'Technical Lessons Learned,' as this link typically includes technical drawings. Additionally, the sequence of ‘What was planned’ and ‘What actually happened / Description of the event’ is reversed, reflecting the logical progression from the current stage observation to the reflection on the original plan. In summary, the LL creation stage now comprises 10 fields requiring information input from creator, as shown in Table 11.

Table 11. Fields in creation stage (new)

New Field No.	**Field Name**	**Field Type**
1.1	Lessons Learned name *	Text/String
1.2	Contact person	Dropdown
1.3	Knowledge areas	Dropdown
1.4	Project activities	Dropdown
1.5	Technical Lessons Learned	Checkbox
1.6	Link to Lessons Learned	URL
1.7	Keywords	Text/String
1.8	What actually happened / Description of the event	Text/String
1.9	What was planned	Text/String
1.10	Identified Lessons Learned & Recommendations	Text/String
Flag 1	Released for assessment	Checkbox

As before, the LL ID remains a unique identifier generated by the PPM software system upon creation of a new LL record. Two new monitoring fields, 'Released for business evaluation by' and 'Date of release,' are added. These fields are populated when Flag 1 'Released for assessment' is checked, recording the name of the person who checked the flag and the release date. Their placement after Flag 1 indicates the completion of the creation stage and the transfer of responsibility from the creator to the LL core team for review.

In the second stage, namely the assessment stage, 1 field is removed, 1 field name is changed, and 3 fields are added. The 'Urgency' field is eliminated, as LL differs from risk assessment in terms of impact variation. 'Repeatable' is renamed 'Recurrence' to better reflect the assessor's evaluation of the lesson's frequency. To address the absence of an expert forum (unit B LL forum) in the unit A business for the evaluation stage, three new fields are introduced to integrate evaluation and resolution functions while maintaining user-friendliness. The first, 'Sub-Assessor (SMEs)', accommodates the unit A-specific LL process, allowing for the appointment of one or multiple subject matter experts (SMEs) when the primary assessor lacks sufficient capacity. This role is analogous to the resolution owner in the previous process. The second, 'Corrective actions', is transferred from the previous resolution stage, enabling SMEs or discipline owners to document action plans derived from the lessons. The third, 'Attachment', resolves the limitation of only being able to add URLs to LL records, thereby increasing documentation flexibility. The field layout is optimized, with names displayed in the left half and corresponding comment boxes in the right half, enhancing visual clarity and user experience. In summary, the LL assessment stage now comprises 8 fields requiring information input from assessor and sub-assessors, as shown in Table 12.

Table 12. Fields in assessment stage (new)

New Field No.	**Field Name**	**Field Type**
2.1	Assessor name	Dropdown
2.2	Assessment comment	Text/String
2.3	Sub-Assessor (SMEs)	Dropdown (Multi)
2.4	Lessons learned type	Dropdown
2.5	Recurrence	Dropdown
2.6	Corrective actions	Text/String

2.7	Link for additional info	URL
2.8	Attachment	Blob
Flag 2	Released for evaluation	Checkbox

There are 3 monitoring fields incorporated into the assessment stage. 'Assessor's allocation date' records the initial appointment date of the assessor by the LL core team and updates if reassignment occurs. 'Updated by' and 'Assessment date' are populated upon activation of Flag 2 'Released for evaluation,' indicating the completion of the assessment stage and the transfer of responsibility back to the LL core team for closure approval.

In the third stage, namely the closing stage, 2 new fields are added without removing any existing ones. The first field, ‘Closing category’, provides options for the LL core team to efficiently categorize the LL, for example, no action required, for future considerations, best practice, change initiated, or shared for information. The second field, ‘Change impact level’, indicates whether changes resulting from the lesson affect the function, project, or global level. In summary, the LL closing stage now comprises 3 fields requiring information input from LL core team, as shown in Table 13.

Table 13. Fields in closing stage (new)

New Field No.	**Field Name**	**Field Type**
3.1	Closing category	Dropdown
3.2	Change impace level	Text/String
3.3	Closer’s comment	Text/String
Flag 3	Closed	Checkbox

There are 2 monitoring fields in this stage, which are ‘Closed by’ and ‘Closed date’. These are populated when Flag 3 'Closed' is activated, signifying the completion of the LL's journey in the PPM software and its readiness for archival in the reference library.

6.2.3 Validation plan

The redesign of the UI and fields optimization was firstly reviewed by the unit A LL core team to ensure it meets the necessary standards and requirements. This review process helped identify any potential issues and areas for improvement before the design is rolled out to all users.

Following the initial review, a User Acceptance Testing (UAT) phase was implemented. A diverse group of end-users from various roles within unit A was selected to participate in this testing. Specific test scenarios and tasks were defined to simulate real-world usage of the new interface. The UAT participants provided detailed feedback on the usability, functionality, and overall UX of the modern LL system. This feedback was carefully analysed and used to make any necessary adjustments before the full rollout.

In addition to the UAT, three global training sessions, hereafter referred to as roll-out sessions, are scheduled in Week 8 of 2025. These sessions are strategically timed to accommodate the global time zones. These sessions were a joint effort with the unit A LL process owner and included a Q&A segment to address any questions or concerns from the users. The training provided users with a thorough understanding of the new interface and its functionalities, ensuring they were well-prepared to use the modern LL system effectively.

After users have the opportunity to use the modern LL system, their feedback are collected and analysed. This feedback are invaluable in identifying any further improvements that can be made to enhance the UX. A formal post-implementation review is scheduled 1-2 months after full implementation. This review is to assess system performance, user adoption rates, and the overall impact on LL processes within unit A.

To ensure continuous improvement, a mechanism for ongoing user feedback collection is established. Regular review cycles is set up to prioritize and implement future enhancements based on user input and evolving business needs. This approach allows the LL system to remain responsive to user needs and continue to improve over time.

7 Conclusions

This study explores the implementation of LL processes within organizations, using the unit A in Corporation X as a case study. The study aims to identify key challenges and propose actionable recommendations for improving LL practices. By employing a mixed-methods approach, combining quantitative analysis of existing LL records with qualitative surveys and workshops, the study provides a comprehensive understanding of the current state of LL practices and the underlying issues affecting their effectiveness.

7.1 Lessons Learned implementation

The study aims to answer two critical research questions: What are the implementation challenges contributing to the unsatisfactory practice of LL? And how can LL be successfully implemented and maintained as a long-term work habit?

The first research question aims to reveal the underlying issues contributing to the inefficacies in the LL process. The study identifies several critical challenges in the current LL implementation at unit A, which are likely representative of challenges faced by many organizations. These include a lack of structured processes, inadequate training, insufficient team awareness, poor documentation, no visibility of outcomes, and lack of management enforcement. The study finds that the lack of structured processes leads to inconsistencies and inefficiencies, while inadequate training prevents team members from effectively participating in the LL process. Additionally, limited awareness and understanding of the LL process among team members hinder its successful implementation. Inadequate documentation practices result in incomplete or inaccessible LL records, and the lack of feedback on the outcomes of LL activities reduces motivation and perceived value. Furthermore, insufficient support and enforcement from management undermine the formalization and adherence to the LL process.

The second research question focuses on establishing strategies and practices that can ensure the successful and sustainable implementation of LL, making it an integral part of the organizational culture. The study suggests that developing and implementing a clear, well-documented LL process that is consistently followed across all business units is essential.

Enhancing training programs to ensure all team members are adequately prepared to participate in the LL process is also crucial. Increasing awareness and understanding of the LL process among team members through regular communication and engagement can further support successful implementation. Improving the quality and accessibility of documentation ensures that lessons are accurately recorded and easily retrievable. Ensuring that the outcomes of LL activities are visible to all team members demonstrates the value created for the organization and reinforces the importance of LL practices. Strengthening management support and enforcement can drive the implementation and formalization of the LL process.

7.2 Implications for global companies

The findings of this study have significant implications for global companies and other large organizations seeking to improve their LL implementation. In the short term, it is essential to provide sufficient refresher sessions and training on the business process to ensure that all team members are well-versed in the LL procedures. These sessions can help reinforce the importance of the LL process and ensure consistent application across the organization.

In the long term, the focus should shift to leveraging advanced technologies, such as AI tools, to enhance project learning. For instance, AI-powered summary tools can automatically generate concise summaries of project documents, aiding in the quick dissemination of key information. Additionally, AI tools that employ semantic distance to detect relevant content can further enhance the LL process by marking flags or warnings for critical information, helping to identify patterns and highlight key lessons. By integrating such AI tools into the LL process, organizations can improve the efficiency and effectiveness of knowledge capture and dissemination. This approach can lead to a more robust and intelligent LL system that supports continuous improvement and innovation. The use of advanced technologies can also help organizations stay competitive in a rapidly evolving business environment by ensuring that valuable lessons are learned and applied effectively across all levels of the organization.

Overall, the implications of this study suggest that a combination of targeted training, advanced technological integration, improved documentation practices, increased team awareness, outcome visibility, and strong management support can significantly enhance the

LL process. These strategies can lead to better project outcomes, improved organizational learning, and more informed decision-making. By fostering a culture of continuous learning and improvement, global companies and other large organizations can achieve long-term success and sustainability in a rapidly evolving business environment.

7.3 Limitations and future studies

This study has several limitations that should be acknowledged. Firstly, in the literature review, the latest literatures were filtered due to concerns about reliability. However, there might be valuable novel literatures with fewer than 10 citations that were excluded. Additionally, content analysis and related tools, such as term frequency analysis, keyword extraction, and text mining, were not utilized. The absence of these analytical methods may have limited the depth and breadth of insights that could are derived from the data.

The study's data collection was limited to 26 survey responses and workshop inputs from 8 participants, who were the most important stakeholders. While their insights are valuable, the small sample size may not fully represent the broader organizational perspective. As the survey responses could be influenced by personal perceptions or organizational culture, future research should consider incorporating advanced content analysis tools, expanding the sample size, and including diverse organizational contexts to address these limitations and provide a more robust analysis.

Furthermore, LL in this study primarily refers to project learning, focusing on the order-to-delivery process. It does not encompass the sales-to-order or post-delivery lifecycle teams. This means that during the process development and tool creation, the opinions and needs of other teams were not considered. Consequently, the findings and tools developed are tailored specifically for the project execution team and may not be applicable to the entire organization. However, this can be viewed as a pilot initiative; if the implementation is successful, the scope could be expanded to cover the entire operation functions.

This study was conducted within a single business unit of a specific organization, which might limit the generalizability of the findings. Consequently, the findings and recommendations may be specific to this context and might not be directly applicable to other organizations or business units within or outside of Corporation X. The scope of the

study may be constrained by the limited time available for conducting thorough research, analysis, and implementation. This limitation could impact the depth of the RCA and the comprehensiveness of the improvement suggestions. Assessing the long-term impact and sustainability of the implemented improvements is beyond the timeframe of the thesis. Continuous monitoring and evaluation are necessary to determine the lasting effects of the changes.

Additionally, the development and implementation of tools and UX improvements depend on the existing technological infrastructure. If the software tool itself does not have the required features, the capabilities that can be developed or customized are extremely limited. Even if there is software on the market that better meets the organization's expectations, it is difficult to abandon the existing system and introduce completely new software just for the need of implementing LL. This is because organizations prefer to have distinct functions integrated into a single platform to achieve efficient data management while also saving on the costs of multiple software licenses.

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