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Recommendations for an Improved Information Exchange Approach in a Case Company

Metropolia University of Applied Sciences

Master of Engineering

Degree Programme in Industrial Management

Master's Thesis

10 May 2024

Preface

Few years back when I was working as an Engineer, I started to develop profound interest towards management. When I was exploring for the better master's studies, I found this programme which matched my interest, so I applied and got study right at Metropolia IM programme. It has been wonderful, challenging, and rewarding journey altogether. The thesis gate model helped me develop personally as well as professionally.

I would like to thank my case company for helping me throughout different stages of this thesis. Although, I was not working at the case company during this thesis, I am very grateful for all the time, and support that I was provided during multiple interviews, and phone calls.

I would like to extend my deepest gratitude to my thesis instructor and Principal Lecturer Dr James Collins for the continuous guidance, encouragement, and motivation that he has provided me throughout the study. The research would not have been possible without the supervision from M.A., Senior Lecturer Sonja Holappa regarding my professional language and writing. I am also greatly thankful to Dr Thomas Rohweder and Dr Sami Sainio for their invaluable insights and feedback during the presentation. I would also like to thank everyone related to IM department, including all the lecturers and my fellow classmates studying together.

Finally, a special thanks to my lovely wife, Monika for her unconditional love and support since start to end of the study. Your insights, advice, and critical feedback have had significant impact on the completion of my study. Lastly, I can't thank enough my late beloved mother for teaching me consistence and resilience through hardships in life.

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Helsinki

May 10, 2024

Abstract

Author:	Prashant Pradhan
Title:	Recommendations for an Improved Information Exchange Approach in a Case Company
Number of Pages:	72 pages + 4 appendices
Date:	10 May 2024
Degree:	Master of Engineering
Degree Programme:	Industrial Management
Specialization option:	Data Specialization
Instructor(s):	Dr. James Collins, Principal Lecturer M.A. Sonja Holappa, Senior Lecturer

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This study was carried out considering a case organization which is a Finnish construction consulting and planning company. The case company experiences involvement of multiple stakeholders as well as flow of large volume of data in their operations which has resulted in inefficient information exchange. This has directly and indirectly impacted on the day-to-day operations of the case company by obstructing the smooth flow of communication and data management. The objective of this study was to recommend improvement ideas for the information exchange approach of the case company.

The author has followed ‘applied action research’ and utilized qualitative methods such as semi-structured interviews, open-ended questionnaire, and workshop for data collection. The study was conducted under four phases. The first phase is current state analysis where strengths and weaknesses of the case company’s current information exchange approach were identified. The second phase includes literature study based on the selected weaknesses to explore relevant ideas and best practices to overcome the weaknesses. The third phase includes co-creation of initial recommendations with the case company’s stakeholders based on the outcomes of the previous phases. The fourth phase includes validation of the initial recommendations by senior management of the company to create final recommendations.

For the in-depth study of the business challenges, the case company’s information exchange approach has been categorized into communication channels (in-person communication and communication through use of system) and data management system (web-based data management system and folder structure). Thus, the final proposal constitutes recommendations to remove barriers in the communication channel and those to improve the data management system of the company.

Keywords: Information exchange, Communication, Communication model, Data management system, Common data environment, Folder structure, Project bank

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1 Introduction

Most often, when a question is raised about what the important resources of any company are, the first and most common answers are finance, human resources, and other tangible assets of the company. The significance of these resources and their management is indeed undeniable. However, in today's tech-savvy global village, where the most desired 'I-phone' gets manufactured and assembled in multiple countries, where people need not be in a same place to perform a joint task, and where corporate employees are adapting to a remote-work culture, the volume, significance, and management of information that gets exchanged every second is increasing.

Among several projects that require substantial flow of information, one is 'Construction' project. This is because of the fact that a construction project comprises of numerous stakeholders. The design process is carried out with the information exchange between the owner, designer, contractor, and subcontractors depending on the project delivery method. Having many stakeholders in a project, the volume of information circulating is very high which generates differences and losses in the workflow (Becerik-Gerber, 2012). This has been the major challenge faced in a construction project.

This thesis aims to direct the challenges and problems of information exchange experienced by the case company and develop recommendations for an improved information exchange among its stakeholders in a project for smooth flow of the project.

1.1 Description of the case company

The case company is a Finnish planning and consulting company. It was merged in 2017 from two different construction consulting companies. It is located in different cities of Finland and Sweden working in three different business areas. They are Real Estate and buildings, Infrastructure and skill

structures and Digital Solutions. The company has more than 2200 employees and has an annual net sales growth of 14% in 2022.

The case company provides design and consulting expertise driven by sustainability. This study is primarily focused on project coordination among the different internal and external stakeholders of Real Estate and buildings unit.

1.2 Business Challenges, Objective and Outcome of the thesis

The case company works on three different business areas of real estate and buildings, infrastructure and skill structures and digital solutions. All the business areas work as a design consultant in a core construction project. This study is focused on information exchange of a team working in a real estate and building project with all the stakeholders.

A construction project consists of many stakeholders (internal and external) including the client themselves, for example Architects, Electrical designer, MEP designer, Element designer, Structural designer, among others. Some of the stakeholders might be from the same company but usually most of them are from different companies. The project related data including design drawings, specifications, contracts, schedules, budgets, etc. are stored in a data management system. This data is accessed by both the stakeholders working on a project in addition to different bodies associated with the project. The project faces challenges as a result of communication issues and data management issues among the stakeholders. This needs careful analysis and a practical solution.

The objective of this thesis is to propose recommendations for an improved information exchange among the stakeholders. The challenges faced during a project could risk the present and future of the project’s budget and timeline. The improvement guidelines would benefit the stakeholders in many ways. There can be clarity in the information exchange. The project would be

completed in the desired timeframe. Due to clarity in the communication flow, there can be smooth coordination among the stakeholders.

Similarly, the outcome of this study is the recommendations to improve information exchange among the stakeholders.

1.3 Scope and Outline of the study

The scope of this thesis includes establishment of recommendations for the information exchange among the project stakeholders of 'Real Estate and Buildings unit' of the case company. However, Infrastructure and Digital solution are outside the area of this study because the project flow and stakeholders' presence in these two units are different compared to Real estate and buildings.

The study is conducted in seven sections. The first section is the introduction of the thesis followed by the general description of the case company in the first subsection. Then, the next subsection describes the challenges faced by the case company. Similarly, determining the objective of the study will guide for solution to overcome the challenges.

The second section provides the project plan of this thesis. Research approach in the project plan allows the researcher to select among two research approaches. Research design provides an overview of the whole project. Similarly, data plan is the planning of three different data stages in the project. It is a tabulated explanation of how the project was conducted.

The third section describes the current state analysis of information exchange among the construction stakeholders in the case company. This will then help to understand the situation of the challenges of the existing information exchange approach and guide the selection of literature to research.

The fourth section is the literature study for ideas on improving the information exchange approach. At this stage, the analysis of the available literature will

provide guidance to overcome challenges in the existing information exchange approach and its underlying weaknesses. It will ultimately help in determining the tools to design an improved information exchange approach.

The fifth section focuses on building the proposed recommendations for information exchange and the outcome is the initial proposal for the improved approach.

The sixth section is the feedback section for the initial proposal. This results in preparing the final proposal for the improved approach after seeking improvement ideas from the senior management of the company.

The seventh and the last section is the conclusion. This section reflects on the findings, practical next-step recommendations to the case company, self-evaluation, and feedback.

2 Project Plan

This section of the thesis focuses on planning the study, selecting the research approach, designing the research, and preparing the data plan. The research approach guides the selection of the right approach for the study. Then, the research design outlines a process map to conduct the study in phases. Similarly, the data plan tabulates the phases in order of contents, sources, and timing to have a clear perspective of work. Finally, this section finishes by briefly describing the next step in the study which is Current State Analysis.

The research approach is explained below in addition to an explanation of the selected research approach for this study.

2.1 Research Approach

Research has two approaches to perform the study: Basic/Fundamental/Pure Research and Applied Research.

According to Saunders et al. (2012:8), basic research is focused on generating new or improved theory. This research is conducted to understand the theoretical processes. It is mainly utilized in traditional universities and the key consumer is the academic community. In contrast, applied research concerns problems which are important and are presented in an understandable way. This research is of direct importance to managers.

According to (Kothari, 2004:3), Applied Research is focused on solving an immediate problem a company is experiencing.

Applied research can be performed in different ways. For example, case studies and action research. According to (Kananen, 2013), action research is a process that follows each other during the operations of the business. It has continuous iterations, so it does not suit well for this study. Hence, only a few principles of “Action Research” are undertaken such as working with directly

involved individuals and dealing with company issues. This research is labelled as “Applied Action Research”.

2.2 Research Design

The research has been designed to accomplish the objective of the study. It shows four phases with three stages of data collection with their planned outcomes. The Literature study is not data; thus, it is not mentioned in the data stage. Figure 1 below shows the Research Design to create recommendations for improved approach of information exchange among the stakeholders.

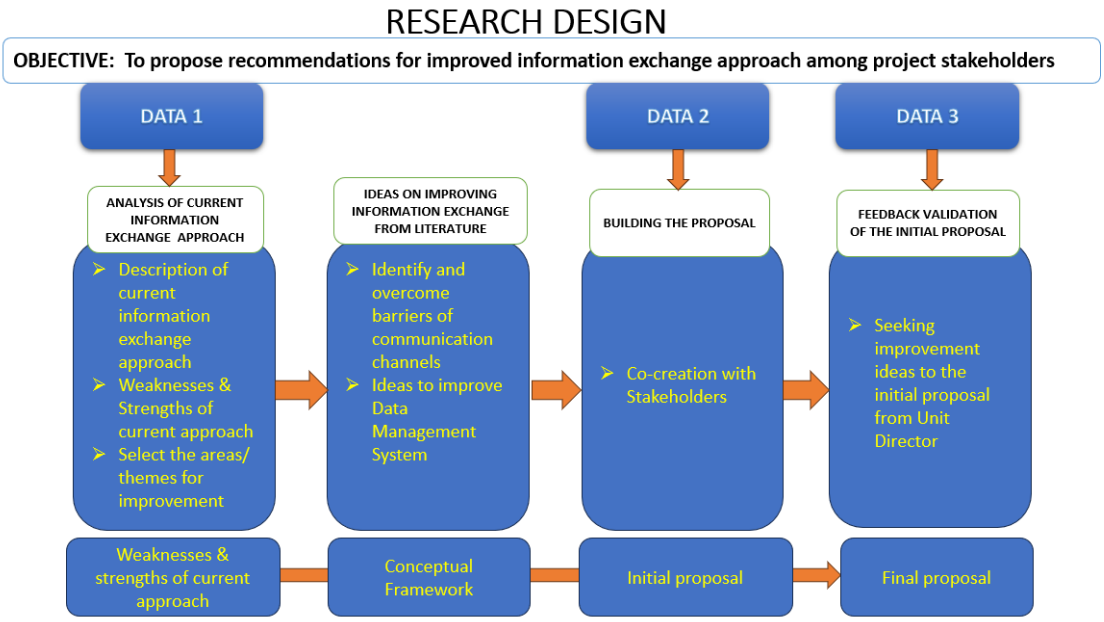

Figure 1. Research Design of this study

As presented in Figure 1, this study strives to achieve its objective by performing a current state analysis of the information exchange approach of the case company first, followed by literature study.

For this thesis, the first phase is the current state analysis of the information exchange approach. The strengths and weaknesses of the current information exchange approach were analyzed.

The second phase is the literature review. It is an important tool in this study to create a conceptual framework for overcoming the weaknesses revealed by the current state analysis. The literature study allows the author to perform a detailed study from previous research, journals, and articles about the information exchange challenges in a construction design project globally. Different ideas from relevant literature are used to create a conceptual framework.

The third phase is building the initial recommendations to improve the information exchange approach. After the successful completion of the current state analysis and conceptual framework, a clear vision is created to develop the initial recommendations. This phase requires co-creation with the stakeholders. It then generates the initial proposal for an improved approach.

The fourth phase is the feedback validation of the initial proposal. It requires seeking improvement ideas to the initial proposal from the unit director. The final proposal was prepared after validation was done for the initial proposal by the Unit Director.

2.3 Data Plan

The research design is the mind map of the whole project allowing a researcher to follow the data stages and complete the work smoothly. Similarly, the data plan is the tabulated form of research design in addition to source, informants and timing of the data stages. Table 1 below describes the data plan of this study.

Table 1. Data Plan

DATA PLAN

	CONTENT	SOURCE	INFORMANT	TIMING	OUTCOME
DATA 1 ANALYSIS OF CURRENT APPROACH FOR INFORMATION EXCHANGE	➢ Description of current information exchange approach ➢ Weaknesses and strengths of current approach ➢ Select the areas and themes for improvement	➢ Stakeholder Interview ➢ Open ended Questionaires	➢ Structural Designer (Internal) ➢ Project Engineer (Internal) ➢ Element Designer (Internal) ➢ HVAC (External) ➢ Project Manager (Internal)	January-February	- **Weaknesses and Strengths of current approach**
DATA 2 BUILDING THE PROPOSAL	➢ Co-creation with the stakeholders	➢ Workshop among Stakeholder ➢ Interview with Stakeholders absent during the workshop	➢ Project Manager ➢ Structural Designer (Internal) ➢ Project Engineer (Internal) ➢ Element Designer (Internal)	March	- **Initial proposal for improved approach**
DATA 3 FEEDBACK VALIDATION OF PROPOSAL	➢ Seeking Improvement ideas to initial proposal from the Unit Director	➢ Interview with Unit Director ➢ Open ended Questionnaire	➢ Unit Director ➢ Head of Department	March-April	- **Final proposal for improved approach**

As illustrated in Table 1 above, there are three stages of data each with desired sources, informants, and timing. Planning helps to utilize the time properly and obtain the desired outcome.

Data 1 was gathered through semi-structured interviews with the stakeholders. Internal and external stakeholders, Structural designer (internal), Architects (external) and Electrical designer (internal/external) are the informants involved in performing the analysis of the current information exchange approach in the project. The weaknesses and strengths were categorized in accordance with their importance. This was scheduled and carried out during January.

The second stage of the data plan is building the initial recommendations during February after the conceptual framework has been prepared. This stage requires more participation of stakeholders and Project Manager. Thus, an interview and workshop were carried out to develop recommendation ideas to

solve the weaknesses and boost the strengths. Hence, the initial proposal was prepared.

The last data stage is the feedback validation of the initial recommendations. After the initial proposal was prepared, the Unit Director and Head of Department were interviewed to validate the proposal and creating a final proposal during March-April.

This section gives a clear picture of the Project Plan for this thesis. It is followed by the analysis of the current information exchange approach being utilized in the case company, in the section ‘Current State Analysis’.

3 Analysis of case company's information exchange approach

This section analyses the current state of the information exchange approach in the case company. It starts with an overview of the data collection for conducting the analysis and proceeds to describe the current approaches of information exchange being used in the case company's Real estate and Building unit department. After detailing the information exchange approach among the stakeholders, this section presents the findings as strengths and weaknesses.

3.1 Overview of this data stage

Data Collection 1 was carried out in accordance with the data plan described in the previous section. The semi-structured interviews were undertaken by asking questions regarding the information exchange approach.

To conduct the analysis of the current information exchange approach, the author started with an informal interview with the Head of Department (HOD) of the Real Estate and Building units of the case company. An interview session was planned with the HOD at the company's premises. The other interviewees were selected by the Project Manager who is currently working in the ongoing project. They were the internal stakeholders working in the case company. The interview questions were forwarded a few days earlier to ensure smooth conversation. The interview questions can be found in Appendix 1. The conference room was booked for the whole afternoon of the interview day where 1 to 1 interview was conducted that lasted 30-35 minutes with each interviewee. Apart from the interviewees, the external stakeholders were communicated through email with the set of questions found in Appendix 2. Additionally, the questions set for analyzing the current data management system used in the case company can be found in Appendix 3.

The first set of questions given to the internal stakeholders were mostly about the communication channels used in the company, which gave an overview of the strengths and weaknesses in the communication channels. The second set of questions forwarded to the external stakeholders of the current project gave an overview of the strengths and weaknesses of the communication channels used for formal communication between internal and external stakeholders. The third set of questions were forwarded to the internal stakeholders specifically focusing on the Data Management System. Its questions were constructed to identify the strengths and weaknesses of the current data management system adopted in the case company.

The interviewees showed their interest in the objective of this thesis “to propose recommendations for an improved information exchange among the project stakeholders” as this was the key challenge faced at work. The main theme of the interview was to analyze the current information exchange means, ways and approaches used by the stakeholders. During the interview, they expressed the challenges faced in day-to-day work life due to miscommunication, presence of multiple stakeholders, and data management issues.

The next sub-section describes in detail the current information exchange approach with both internal and external stakeholders in the existing project of the case company.

3.2 Description and illustration of the current information exchange approach

A detailed description of the current information exchange approach based on the interviews and observations conducted with the internal stakeholders, and external stakeholders could be shown in the process map created with the help of Microsoft Visio. Internal documents were not provided by the case company as the author was not the employee of the company during the thesis study. However, when the project manager was asked if there were any written guidelines to follow for the smooth information exchange in the project

coordination, it was answered that there were no such written documents or guidelines to follow. Generally, all the stakeholders involved in the project are verbally briefed about the communication channels, data management systems, schedules, and access to project data.

All the responses from the interviewees were carefully analyzed to map a current approach of information exchange which is shown in Figure 2.

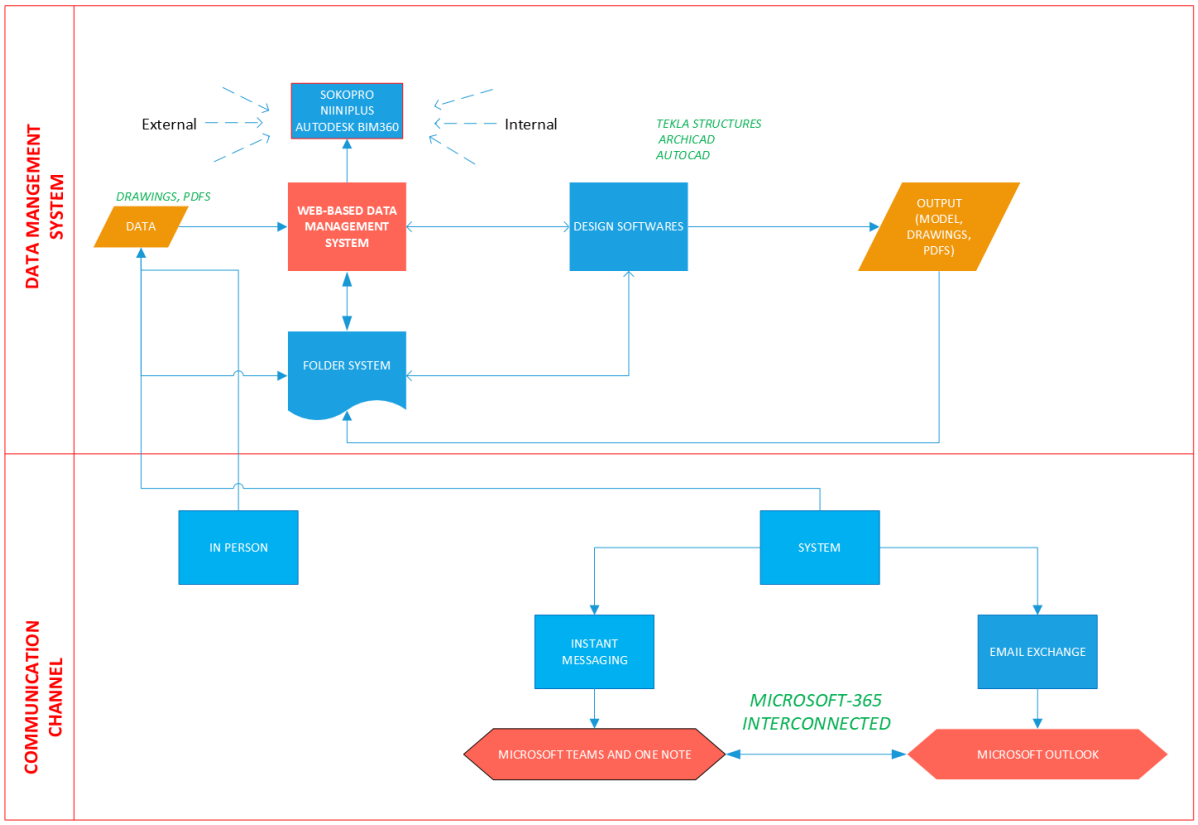

Figure 2. Current Information Exchange approach in a project

Based on the interviewees' responses, the information exchange approach of the case company has been broadly divided into two categories, namely Data Management System, and Communication Channel as shown in Figure 2. The description of these individual categories is provided in the following sub-sections.

3.2.1 Communication Channel

The responses received from the interviewees for the questions related to communication channels being used in the case company which are found in Appendix 1 and Appendix 2, have been visually presented in Table 2. The communication modes in the case company are divided into two categories: On-site (In-person communication) and communication through Use of System (for example use of device like computer, phone, tablet, etc.). The mode of communication used in in-person communication is face-to-face and there is no use of any system. Whereas communication necessitating the Use of system is mostly carried out by using Microsoft Teams (MS Teams) and OneNote as instant messaging applications among internal stakeholders. While communicating with the external stakeholders, Email is mostly used as a formal mode of communication. Different communication channels used in the case company have also been categorized in terms of frequency of usage as shown in Table 2.

Table 2. Communication channel in the Case company

Communication Channel			
Internal Stakeholders		**External Stakeholders**	
Regular	1. Teams 2. One Note	*Regular*	Email (Outlook)
Irregular	1. Email (Outlook) 2. Phone call	*Irregular*	Phone call

As shown in Table 2, for regular communication, internal stakeholders use Microsoft Teams and One Note which allows varied features for instant messaging, calling, video conferencing, document attachment, note taking, screen sharing, etc. Email and phone calls are used, when necessary, among the internal team members. The emails are forwarded to internal members when external bodies send or requests documents. Phones are rarely used to

call the worker at the sites, element factories and emergency calls to external stakeholders. For regular communication between internal and external stakeholders' email is mostly used, and phone call is used if necessary.

These communication channels used in the case company facilitate data flow and management which is another element of the case company's information exchange approach, shown in the upper section of Figure 2.

3.2.2 Data Management System

Data being the major input to the case company's operations, significant attention has been given to its effective management. The case company utilizes two types of data management systems: Folder structure and Web-based data management system.

As shown in Figure 2, project data can be in the form of drawings, pdf files, documents, specifications, budgets, and schedule plans which are stored in a network-based folder which is internally accessible by the internal stakeholders. Web-based data management systems, on the other hand, are used for file sharing among the stakeholders, subcontractors, and clients. The case company uses SokoPro, NiiniPlus, and Autodesk BIM 360 (pilot project and not in use) as web-based data management systems for the information exchange with the external stakeholders, and clients.

The Folder structure is used internally to store and access the project data. The network folder in the system is created once the project is started. The Web-based data management system is used internally and externally to store, access, update and retrieve the project data. Figure 3 below shows which parties involved in the project have access to those two data management systems.

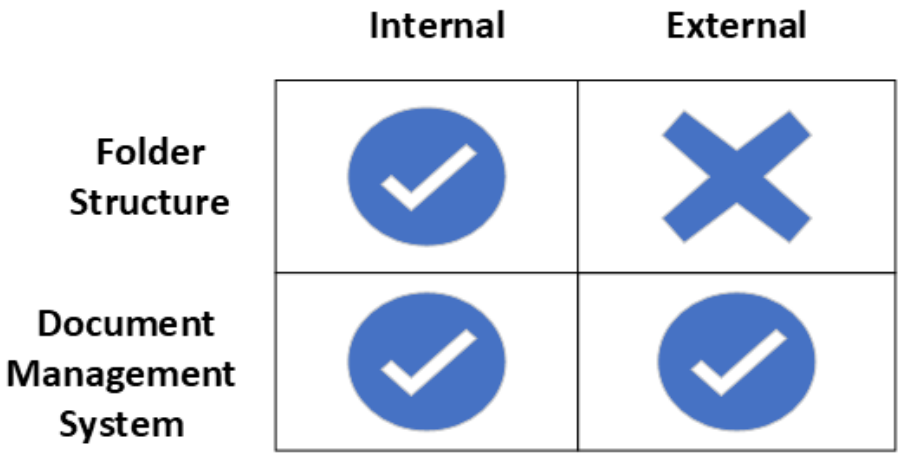

Figure 3. Use of Data Management system by the stakeholders

As depicted in Figure 3, internal stakeholders can access both the folder structure and web-based system whereas external stakeholders have rights to access the web-based data system only. The network-based folder structure is built for internal stakeholders in the case company to store and access the project data. The system is built in such a way that every person involved in the project adds the copy of files to the network-based folder from the web-based system or vice versa.

The two aspects of the information exchange approach of the case company shown in Figure 2 are interconnected with each other and they facilitate each other. Hence, an improved information exchange approach demands improvement in both aspects for smooth project delivery and coordination.

3.3 Strengths of the current information exchange approach

Based on the interview responses, the current approach utilized in the case company has strengths that have been helping every stakeholder to work effectively. Table 3 lists the strengths of the communication channels and data management system.

Table 3. Strengths of the information exchange approach

Communication Channel	Data Management System

• **Instant Messaging**
  • Daily communication is very smooth
  • Video Conferencing and screen sharing helps to optimize the work with team members
  • Part of Microsoft software so it is integrated and connected with One Note/Outlook and other too
  • One Note is a convenient note taking platform
• **Email**
  • Information and record of communications are documented
  • Documents, drawings, and other project related files could be shared through the attachments
  • Accessible using any device
	• **Folder System**
	  • Internal storing of data accessible to internal stakeholders
	  • File system to store the data according to project, data of access, and type of data
	  • Anyone in the case comapny can access the folder to view, upload and remove the data
	• **Document Management System**
	  • Data transfer applicable to all the stakeholders associated to the project.
	  • User interface is easy to locate and share data.
	  • Project information such as drawings, schedules, documents, and budgets are accesible.
	  • Accesible with any device connected to internet

As shown in Table 3, the major strengths of the communication channels are categorized as strengths of instant messaging apps like MS Teams, and strengths of email communication. Also, the strength of the data management system and folder system being used in the case company constitute a strength of the overall data management system of the case company.

The instant messaging platform used in the case company made the daily communication easy and smooth, has features such as video calls, screen sharing, and note taking to communicate with the employees who are working

from home. Similarly, email exchange is done using Microsoft outlook which is an integrated tool with Microsoft Teams and One Note. Being an integrated tool, the calendar could be accessed on all the communication channels, which helps to coordinate the project. For example: an account of an employee sets a meeting for a certain data and time, it will be seen in the outlook calendar as well. The person does not need to set a different meeting in outlook. It means the stakeholders who are only connected through email can see the schedule of the internal stakeholders and plan the communication accordingly.

The Folder Structure is used as a file storing platform named according to the project. This platform needs internet access to be accessible. The data stored in the folder can be accessed internally whenever possible and necessary. The person does not have to be working on the project to access the data for that following project. Similarly, the Web-Based data management systems like SokoPro, NiiniPlus, and BIM 360 allows both the internal and external stakeholders including sub-contractors, and clients to access the files stored in the system. As the case company use SokoPro in most of the projects, SokoPro guarantees data security and easy interface for all the stakeholders (SokoPro, 2023).

3.4 Weaknesses of the current information exchange approach

The interviews revealed the following list of weaknesses in the case company's information exchange approach. Table 4 and 5 below shows the list of weaknesses in both the information exchange platforms.

Table 4. Weaknesses of the communication channel

Communication Channel
Instant Messaging (Teams and One Note)
Complex UI/UX
Ineffectual communication
Internet dependency
Misplaced information (information gets piled up in long conversations)
Unreliable (Use of status in Microsoft teams)
Email (Outlook)
Chain email (Difficulty to find intended message)
Long response time
Chance of misunderstanding

The weaknesses mentioned in Table 4 are the weaknesses of the communication channel in the case company. When asked about the weaknesses of communication channels, one of the informants stressed a challenge faced while using the MS Teams as follows:

> "*Of course, the weakness is that if the issues get posted daily there and they get multiple and there are many discussions about what should be done, then some of the issues get lost in the chat like very far away. And then you can't remember where it was. So that's like basically there's too much information to keep it that way*." Data 1: Interviewee 1

Interviewee 2 also stressed the challenges posed by misplaced information and said that it has affected his work when he wanted to look for important information in the chat.

Interviewee 3 talked about the user interface and some complicated features in Microsoft Teams. He mentioned that some of the older employees find it overwhelming to use Microsoft Teams and they prefer face-to-face conversations and phone calls. He also said that the multiple features in MS Teams are both helpful and complex at the same time. Interviewee 2 expressed the importance of feature 'status' in Microsoft Teams saying some people misuse the green and red status while doing distant work. Similarly, most of the interviewees' responses about the email were on a 'chain of email' and long response time from email recipients. They mentioned that sometimes it takes a great deal of time to receive a reply to the email. Also, in chain email, replies to the main email could sometimes be more than 20 which results in misunderstandings and individuals can miss the main subject of the email.

Table 5. Weaknesses of the data management system

Data Management System
Web Based System
Inconvenient due to use of multiple platforms for different projects
No notification of updated data
Manual retrieval of updated plans
Dependency on internet (Data Security)
Folder Structure
Improper file naming System

As shown in Table 5, the interviewees response helped the author to put together the weaknesses of the data management system in the case company. As both systems rely on the internet, most of the interviewees mentioned that internet speed affects the system. Similarly, one of the interviewees expressed the use of multiple systems for different projects which makes the work overwhelming and confusing. When asked about the weaknesses of the data management system, Interviewee 1 said:

> *“Well, the old SokoPro used to send out notification emails when some files have been updated. But now with the updated version, it's not possible when someone updates a drawing into the project like that. It is downloaded automatically to our folder, or at least it's not from the provider of that project. We need to manually fetch all the plans.”* Data 1: Interviewee 1

When asked about the folder structure, interviewee 1 stressed and said:

> “*Yes, the name and number information can prove it difficult to handle. For example, if you have same drawing with a different name, then you update the one of the drawings and forget to update the other one. This can lead to some difficulties in the projects.”* Data 1: Interviewee 1

The folder structure has the issue of file naming system when the drawing file of the same project needs to be accessed by a municipal organization which requires them to change the name and number of the same files. It means one of the drawings gets updated, but the other one could remain unchanged which could lead to some difficulties.

3.5 Selected areas and themes for improvement

The interviews and observations led to the identification of numerous strengths and weaknesses of the current information exchange approach of the case company. Due to the limitation of time and resources, it was practically impossible to work on all the weaknesses identified through the interviews, due to which the author has selected the major weaknesses to be given immediate attention to and be addressed for an improved information exchange approach. Figure 4 shows the focused weaknesses from all the weaknesses listed from the interviewees’ responses.

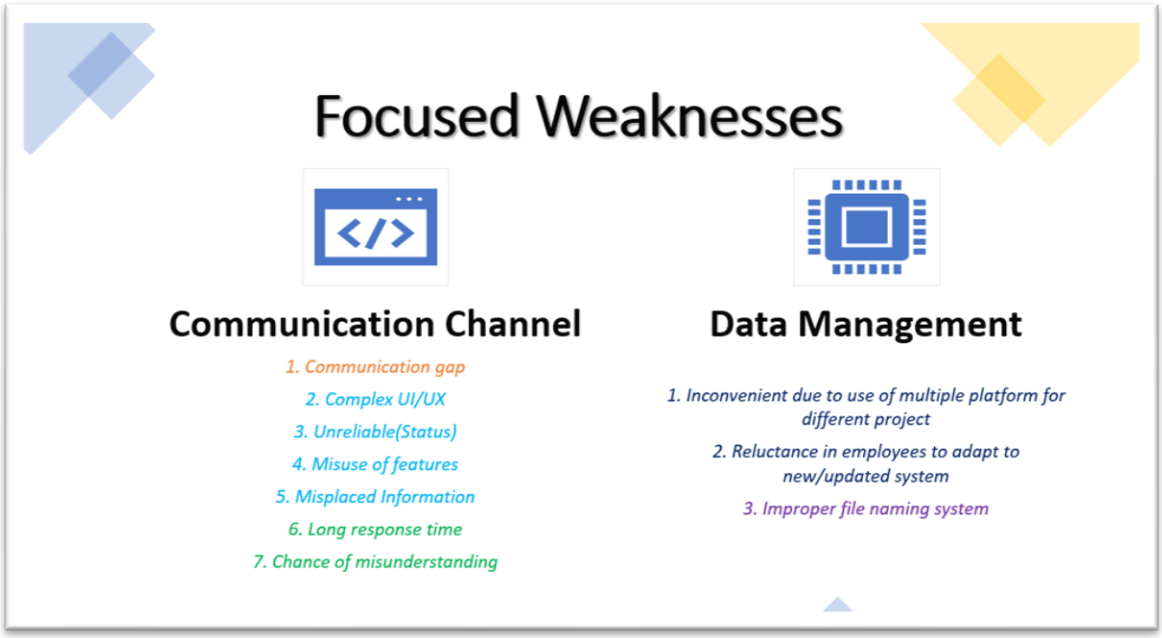

Figure 4. Focused weaknesses from CSA to conduct Literature Study

As shown in the above Figure 4, these are the selected areas for improvement which would be improved with the ideas and knowledge gathered from the literature study. The previous sub-section described all the weaknesses mentioned by the interviewees.

Table 6. Key Challenges from the Current State Analysis

Information Exchange Platform		Findings
Communication Channels	1	Communication Gap in in-person communication.
	2	The complex features of Microsoft Teams creating difficulties for the elderly people.
	3	Status used in the team is unreliable. For e.g. One can have Red (busy) status and still be working.
	4	Employees tend to misuse some features like reporting non-working hours.
	5	Information gets lost in the chats and it is difficult to find the desired information when needed.
	6	Sometimes it could take a longer time to get the response in email communication.
	7	The choice of words and sentences could result in misunderstandings for the email recipient.
Data Management System	1	Use of multiple data management systems in different projects lead to issues and inconveniency.
	2	Updated plans were not notified to the employees via email or message due to which employees show reluctance to updated system.
	3	File naming system is improper, and it creates problem as one drawing could have two different names and one version remains updated and the other one untouched.

As shown in Table 6, in the communication channel, seven weaknesses were identified for deeper study in the next stage of literature research. These were the responses from most of the interviewees and the way they stressed the above weaknesses. There were other weaknesses identified from the interview which are not mentioned in the above table. Those were also important, but the author realized that if the focused weaknesses are improved, the rest of the unaddressed weaknesses would be improved while working on the above

focused weaknesses. Similarly, some of the weaknesses did not affect the work at the case company.

The above-mentioned weaknesses in the data management system are all to be focused on. It means all the weaknesses are the most important ones to be addressed and improved.

3.6 Summary of strengths and weaknesses of current information exchange approach

The author studied and analyzed the responses from the interviewees carefully. The findings were then listed according to the order of importance and the most important ones were selected for a deeper study to be done in the next section. Figure 5 below is the summary of strengths and weaknesses of the current information exchange approach utilized in the case company.

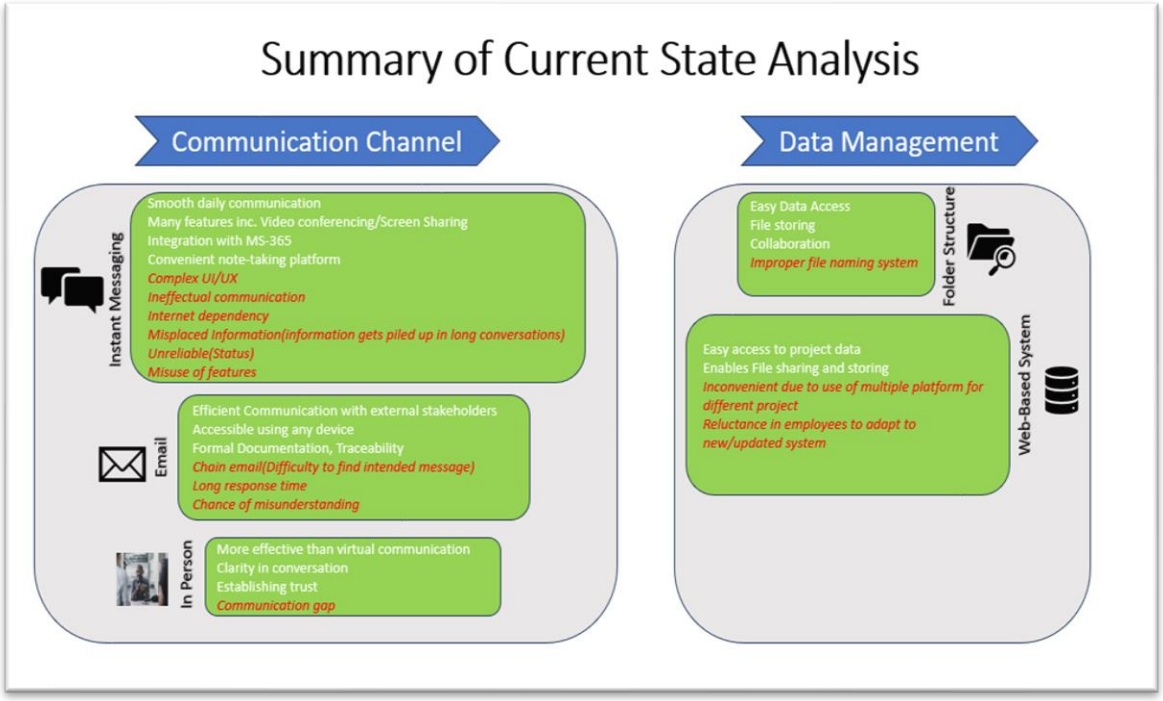

Figure 5. Summary of Current State Analysis

As depicted in figure 5, the findings of the current state analysis were divided into two groups: Communication Channel and Data Management System. The interviews were held at the case company's premises where the interviewees were asked open-ended questions in the semi-structured interview. From the interview answers, all the strengths and weaknesses were noted, recorded, and transcribed.

The answers were then filtered to determine the important weaknesses that the case company is facing in the current projects. The reason to filter the weaknesses was to find the most critical issues to be addressed and solved with further research in the next section focusing on literature research.

This completes the current state analysis of this study. The next section below explores best practice discussed in relevant literature to tackle the weaknesses identified in this section.

4 Ideas on Improving Information Exchange Approach from the Literature Review

This section discusses best practice through literature study on improving the information exchange approach in the case company. It also creates the conceptual framework of thesis study. The outcome of the current state analysis was grouped into two categories of Communication Channels and Data Management System. Based on the findings of the current state analysis, which is described in Section 3, relevant study was conducted on previous research and literature.

This section examines the importance of communication and data in the construction industry, and how the information exchange approach of the case company can be improved through improvements on the key challenges that are found in their communication channels as well as data management system.

4.1 Importance of Communication and Data in the construction industry

Back-to-back Covid pandemic and the ongoing global economic downturn due to the war in Europe has put the entire world in chaos. The Case company is not untouched by the negative impact caused by these two distressing events. The covid-19 pandemic in 2020 forced many countries all over the world to lockdowns which resulted in many organizations switching to remote working. And currently, after the lockdowns posed due to the Covid pandemic, many companies have grasped a hybrid working model which combines remote work and on-site operations (Nyktarakis, 2022). Out of many approaches to the hybrid working model, the most common approach is that employees work a few days on site and few days remotely, i.e. from home (Beno, 2021).

Within the case company, the hybrid working model has experienced a notable surge in prevalence after the pandemic. Starting from January 2023, the

employees working under a hybrid model were required to book a workspace in the office for the day they need to work on site. Operating within this model requires heavy dependence on the information system and technology and has resulted in many new challenges as well as opportunities that reshape work methodologies and collaborative practices (Ozkaya, 2021). The team members and project managers need to frequently communicate via computer applications and systems, and the working technique is more complicated due to which employees' collaboration and its management become more important to meet the organization's goals (Chaleff, 2021).

In addition, the reality of the construction industry which is characterized by a fragmented structure due to presence of multiple stakeholders including owners, architects, contractors, engineers, regulatory bodies, etc. working on a common project, requires utmost importance to be given to effective management of communication among both internal and external stakeholders (Nagipogu, 2023).

On the other hand, the construction industry has been the worst hit due to the economic downturn. Since the beginning of 2023, approximately 400 companies have closed their operations in Finland. The increase in interest rates by the European Central bank has brought concerns about the residential construction, and a wave of bankruptcies has picked tension in the people because of the downturn in the construction industry (Hasnat, 2023). Hence, currently the supply side of building construction projects is weaker than the demand side due to a decreased number of projects and more competition. Thus, it is equally important for the case company to stay competitive in the industry that is rapidly changing and turning into a 'red ocean'. Red ocean is an industry situation where companies attempt to do better than their competitors in order to grab a greater portion of the current demand. The industry space of red oceans gets crowded, there is cutthroat competition among the competitors turning the red ocean bloody, and the anticipation for profits and growth get reduced (Kim & Mauborgne, 2005).

Hence, to stay relevant and competitive, apart from competing on price, brand, relationship, etc. investing substantially in the factor that is key to the construction industry is a must. This key factor to the case company is data. Construction projects create a large volume of data. It plays role of a major input in the case company's operations. And it goes through input and output of a large volume of data which can be in the form of drawings, pdfs, etc. for each project. Through an effective data management practice in place, companies can not only reduce costs and improve quality, but can also enhance their overall performance (Kimsey, 2023). Therefore, the fragmented structure of construction industry as well as its nature of operations requiring the exchange of large volumes of data and information helps to conclude that information and data management, and communication process develop a decisive factor for the efficiency of human resource cooperation (Chassiakos & Sakellaropoulos, 2008).

4.2 Model of Communication

The word "communication" in Latin is communicare, it means to share, or making something common (Weekley, 1967). Similarly, Pearson and Nelson define Communication as the process of understanding and sharing meaning (Pearson & Nelson, 2000). From both definitions of communication, it is clear that to communicate is to share and understand what has been said or meant.

As we live in the information age, the use of technologies enhanced possibility to reduce the limitations of time and space forced on communications.

It is important to understand communication as it creates issues such as privacy, efficiency, security, and authenticity. It has affected human, and technology interactions and control. Therefore, the study of communication covers the features of system such as personal, social, technical, and organizational forms. Models are one of the important tools to study communication (Adetan, 2007). A communication model is considered as a

roadmap which helps understand how communication works. It breaks down the workflow into different parts briefing how messages are sent, delivered, received, and understood. A good communication model makes it easier to grasp and helps to find new ideas for any problems that might occur during the process (Mortensen, 1972).

The foundation for communication models used at the technical level is the Shannon-Weaver (Shannon & Weaver, 1949) data transmission model and the concept of communication in a linear way or one-way from source to receiver is shown in Figure 6.

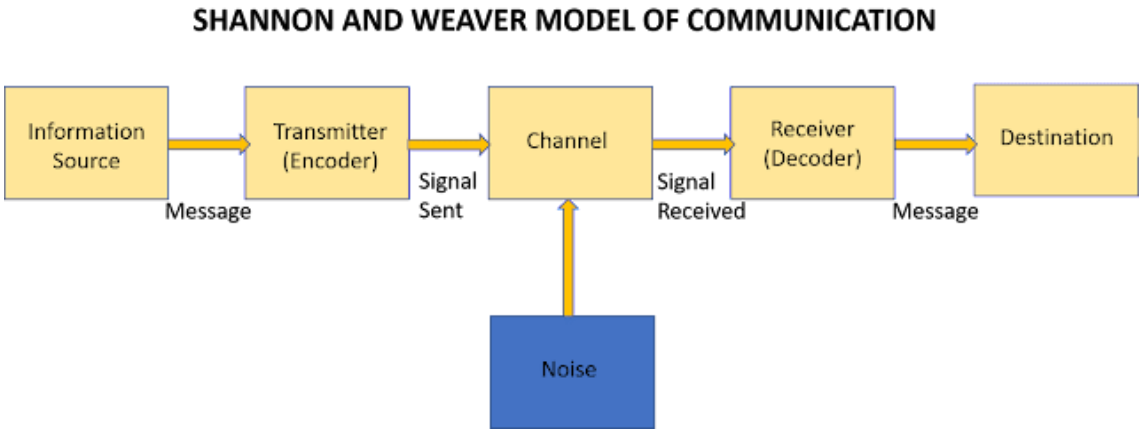

Figure 6. Shannon and Weaver Model of Communication (Shannon & Weaver, 1949)

As shown in Figure 6, the linear diagram of the Shannon-Weaver model of communication is represented. The communication operation starts with a Sender who is the originator of information/message. Sender selects the desired message, and it is forwarded to the Encoder/Transmitter. It could be a person or machine that encode words using binary digits or radio waves. The next step is the channel also known as medium through which the information is actually supplied for example Internet, phones (cables or electrical wires). Before the message reaches the intended destination or Receiver, the message is decoded which converts signals into valuable information (Shannon & Weaver, 1949). This flow of information may not always take place smoothly or

as intended as the communication channels may be impacted by a factor termed as Noise or Barrier of communication.

The next section 4.3 discusses the barriers in the communication and the ideas to improve and overcome those barriers for smooth communication.

4.3 Communication Barriers

Shannon and Weaver mentioned noise as the barrier of communication. It occurs in the channel when a sender sends a message to the receiver. To quote George Bernard Shaw, “The greatest problem with communication is the illusion that it has been accomplished” (Shaw, 2011). Figure 7 depicts the communication process with barriers added to it.

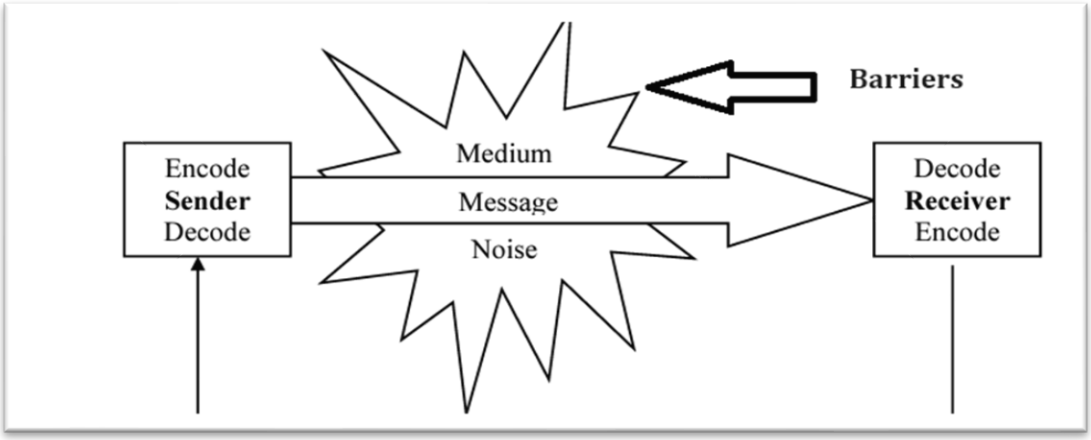

Figure 7. Communication Process with barriers (Cheney, 2011)

As depicted in figure 7, when the message is forwarded to the receiver, noise may occur which is considered as the barrier. According to Shannon-Weaver (1949), noises are all those factors that interrupt the information flow and keep the message away from getting through. Due to such interruption, the receiver does not receive the intended message at all.

There are two types of barriers: internal and external. Internal barriers of communication might include factors such as individual biases, resistance to change, lack of clarity in conveying messages, poor listening skills, poor communicating skills, fear of speaking up, mistrust, etc. which can distort

message reception. External barriers of communication, on the other hand include noise, external distractions, poor internet connection, poor infrastructure for communication especially in virtual communication, among others (Saleem, 2020).

It is believed that poor communication resulting from interruptions created by internal and external barriers mentioned above, is the prime reason for organizational failure. Hence, it is very important for any organization to identify the communication barriers for an undistorted and effective flow of communication as it is the heart of any organization (Rana, 2013). And since the case company uses two modes of communication actively, In-person and Virtual, the study about barriers present in those modes is explained in the below subsections 4.3.1 and 4.3.2 respectively.

4.3.1 Overcoming Barriers in In-Person Communication

In-Person Communication takes place between or among employees who are working on-site or in office. Yusof & Rahmat (2020) identifies the lack of clarity as a major communication barrier which results in a communication gap. In in-person communication, there is often a high chance of failure of communication or miscommunication that is caused by lack of clarity. The internal barriers of communication such as poor listening/communicating skills, fear of speaking up, resistance to change, etc. as mentioned above, may lead to lack of clarity. The findings from an interview carried out by Yusof & Rahmat (2020) show the lowest mean score for ‘cannot question seniors at my work’. It means that the respondents at their workplace were not provided with an environment to question their senior when needed. This ultimately leads to a communication gap which occurs when the intended message sent by the sender is not clear to the receiver, or both to the sender and receiver (Yusof & Rahmat, 2020).

Initially, when the Shannon and Weaver model of communication was created, communication was taken as a linear process, where a sender sends a message to the receiver, and the communication process ends as soon as the

receiver receives the message from the sender. But in practice, the model was not completely relevant because communication is not a linear process. Figure 8 shows the addition of ‘feedback’ component to the Shannon-Weaver model of communication.

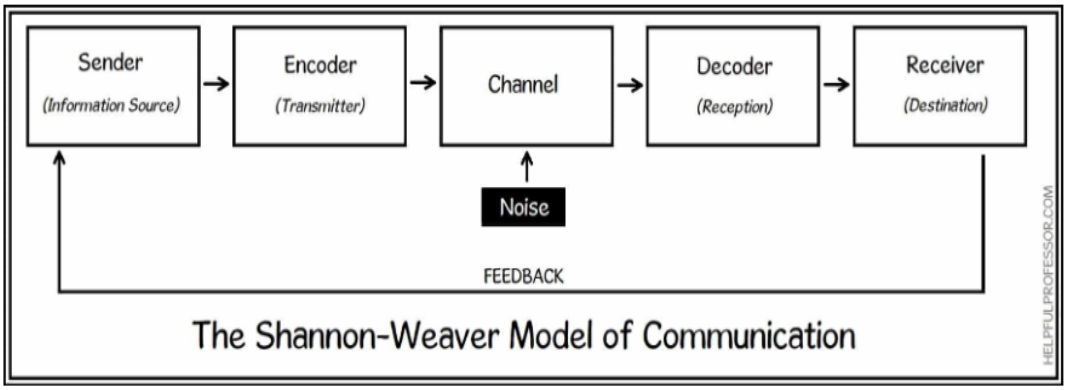

Figure 8. Feedback added in the Shannon-Weaver model of Communication (Shannon & Weaver, 1963)

Hence, in 1963, as shown in Figure 8, an addition was made to the traditional Shannon and Weaver model of communication by Norbert Weiner, in the form of ‘feedback’ given by receiver to the sender after the receiver receives the message. It means that the communication process ends only after the receiver conveys a message to the sender that the original message has been received (Shannon & Weaver, 1963). There have been more improvements in the traditional communication model in the recent days, where the communication model is rather seen as a cyclical process where the communication process keeps repeating until the receiver understands the message as it was originally intended or meant by the sender.

At any rate, for a communication process to be effective, the message should be clear to both the sender and the receiver (Shannon & Weaver,1963). The organization should establish a culture or environment where employees are motivated to perform their best at work, also by speaking up their opinions and questioning their seniors or colleagues instead of assuming, when they do not

understand something (Yusof & Rahmat, 2020). Also making it clear that project managers understand various ways of leading and encourage open conversations can make it easier to tackle with communication barriers (Zuofa & Ochieng, 2020).

4.3.2 Overcoming Barriers in Virtual Communication

Virtual communication is the mode of communication that takes place between or among virtual teams. Virtual team is defined as a geographically dispersed, electronically communicating team working on a same project (Zuofa & Ochieng, 2020).

Zuofa & Ochieng (2020) have examined the barriers in project delivery using virtual teams in Nigeria. It was found that the barriers in in-person communication among a co-located team are also experienced in virtual communication, but to a greater magnitude. They shed light on the fact that members in virtual teams cannot see one another in person which results in limited performance monitoring. Other barriers in virtual communication were limited information richness, miscommunication, lack of trust and ineffectual communication. Another key barrier to virtual communication identified in this thesis is technology adaptation.

Nyktarakis (2022) examines the use of technology in virtual team collaboration taking Microsoft Teams (MS Teams) as an example. The research has identified the benefits and challenges that virtual teams experience when using MS Teams for their collaboration in hybrid working. The findings showed that many team members were reluctant to explore and use MS Teams due to its multiple and complex features. The inability of the employees to make the best use of the system while collaborating through a virtual mode of communication is a major barrier of communication. Another barrier is the abuse of flexibility provided by remote working model. Many employees were seen to report non-working hours and also abuse or have no idea to rightly use the feature of ‘status’ present in MS Teams. Another key barrier identified in this research was

information storm due to an increase of information to be shared via MS Teams. The findings illustrate that due to the easy exchange of information allowed in MS Teams, it has greatly surged the amount of information and some users may find it hard to handle it effectively (Nyktarakis, 2022).

To overcome the barriers in the use of MS Teams, Nyktarakis (2022) highlight the need for training and appropriate guidelines to its users to be able to use all the functionalities of MS Teams efficiently and effectively. It has also been emphasised to establish rules and procedures on how to use the features of MS Teams as well as other collaborative tools effectively. The knowledge about which tool to be used in which situation helps the users to take full advantage of the collaboration tools. In this way, the problem of too much information in a single tool leading to misplaced information will be overcome. Also, team members can keep up to date with new features, best practices and share with entire team to find out how they can be tailored to the team needs (Nyktarakis, 2022). In addition, creating norms and rules for team members early in the team's life cycle can enhance effective communication and improve performance during complex tasks (Morrison-Smith & Ruiz, 2020).

Another commonly used collaborative tool especially for formal communication is 'Email'. Morrison-Smith & Ruiz (2020) states that there is a need to put extra effort while communicating through computer-mediated modalities such as Email, which can hinder communication. Furthermore, in email communication, it is difficult to determine whether the information sent via email was understood by the receiver due to absence of vocal and non-verbal cues. This might also lead to chances of misunderstanding (Morrison-Smith & Ruiz, 2020).

To overcome this, Marlow et. al (2017) recommend the use of closed-loop communication to prevent misunderstanding by providing opportunities for timely clarification of information (Marlow et. al, 2017).

Soucek & Moser (2010) introduces deficient communication quality as one of the three facets of information overload, which can be improved with a training

intervention. It is stated that superficially and ambiguously formulated emails fail to give the recipients enough information to act upon and hence, promote misunderstandings. Hence, to cope with superficial and ambiguous communication, it is recommended to enhance email literacy among employees. It means trainees should learn how and when to communicate via email effectively. For example, participants can learn how to write effective subject lines and write messages that are more concise and to the point. In addition, trainees need to understand when it is best to use emails. For example, emails are appropriate for formal tasks or sharing facts. Whereas, in case of issues that need further clarification should be conveyed via richer media like telephone or face-to-face communication (Soucek & Moser, 2010).

The literature studies mentioned above covered one of the two important elements of information exchange approach, i.e. Communication Channel, and helped to identify possible barriers that can distort communication flow in in-person as well as virtual set up, and ideas on how to overcome those barriers. The below section 4.4 presents literature studies related to another important element of information exchange approach, i.e. Data Management.

4.4 Project Bank as a Data Management System

In Finland, the most commonly used Data Management System is known as “Projekttipankki” which means Project Bank in English. Joose (2020) enlists different project banks used in Finland, along with their individual features. Some of the most common document management software or project banks listed in the report are Congrid, SokoPro, NiiniPlus, Net Project Bank, Tocoma site, ALMA, etc. While the main fuction that all these software carry out is the same, they have their individual strengths in different aspects. SokoPro, which is the major data management software used in case company, provides an unmatchable security to its data. NiiniPlus, which has growing usage in the case company, provides the advantage of an unlimited number of users. Similarly, Net Project Bank is another data management software used in the construction

industry. When a document has been uploaded to the system, each member receives a notification (Joose, 2020).

All these project banks are good in their own way, but it is not possible for any organization to reap all the advantages of a data management software from a single project bank. This is why, the case company has been using a different project bank as per the project requirement. The constant need to change systems with each change in a project has been increasing tension and confusion in the users. Hence, a single system/software that can meet all the requirements of an effective data management system can provide a solution to this problem.

4.5 Application of Common Data Environment in the construction projects

Preidel et. al (2016) describes a Common Data Environment as a shared digital workspace for a project which gives different people involved in the project with clear access to the information they need, along with clear instructions on how and what ways the tasks are managed (Preidel et. al, 2016). The authors propose a framework that facilitates seamless integration of CDE access and management functionality into standard BIM authoring and analysis applications. Figure 9 below demonstrates the implementation of Common Data Environment.

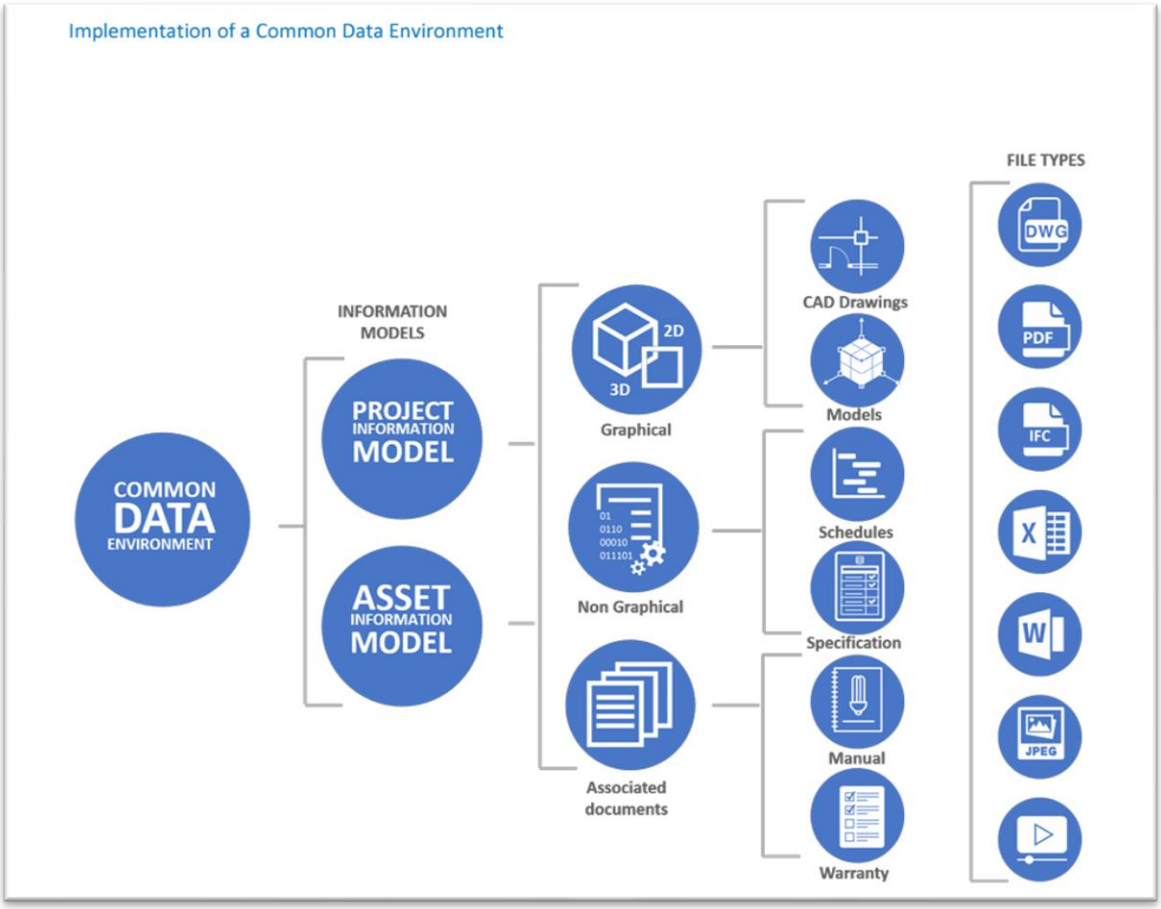

Figure 9. Common Data Environment (Mordue, 2018)

As shown in Figure 9, according to Mordue (2018), when different system uses proprietary information exchanges, stakeholders involved in the projects can share desired results digitally in a structured and reusable manner. Information models get developed during the project lifecycle. The common data environment is the space where information models such as graphical, non-graphical, and associated documents are stored. The benefits from the utilization of a common data environment are enabling improved collaboration, greater reliability of data and reduced risk, as well as reduced time to check and reissue information (Mordue, 2018).

Kirby (2022) states that a CDE brings all project workflows under one roof. CDE enables the centralization of project data storage and access, related to a

construction project and Building Information Model (BIM) workflows. Formerly, data and information of BIM is stored in CDE. However, today, documents for example project contracts, estimates, Bill of Quantity (BOQ), reports, material specifications, and other relevant information related to the project's design are also included in a CDE. Hence, CDE as a one-stop solution for data management, can be considered as an alternative to project banks which lack direct accessibility and integration (Kirby, 2022).

4.6 Employee Adaptation and the role of management in transition to updated system

Since the construction design industry relies heavily on technology, the introduction of new and updated technology as per the user's demand should be embraced, while also keeping in place the back up plans in case of any interruptions. The technology being used in the company should be relevant to the project needs or needs of the time, because what is relevant today may not be relevant tomorrow (Zuofa & Ochieng, 2020).

While technological adaptation is a necessity for every construction design organization, it comes with a large number of difficulties and challenges. One of the major challenges they face in this process is employees' reluctance to change (Saleem, 2020; Hussain, 2023).

Hussain (2023) analysed the ability of employees to adapt to technological change and studied the impact of organizational change on productivity after collecting primary data from respondents of multiple companies. The findings showed that training has a positive impact on organizational efficiency and productivity. However, the findings also showed that the majority of employees faced difficulties while adjusting to new technology during the training due to which they preferred less occurrence of changes. Thus, to cope with this challenge, Hussain (2023) highlights the importance of monitoring and thoroughly planning what and how the technology will be introduced. It was recommended that proper concentration be given to employees while providing

training since employees are the end users of any system. Also, before switching to a new or updated system, the sustainability of the organization needs to be considered (Hussain, 2023).

Additionally, training and agreement on appropriately using the file naming system should be provided to employees. Antin (2016) defines the file naming convention as a structured way of naming files. It is the most powerful method for organising and retrieving information. A descriptive file naming convention assists in many ways such as information management, usability, and readability. Hence, to eradicate the chance of missing the latest updates on files/folders that are used by multiple stakeholders (internal & external), an appropriate file naming convention should be followed by giving special attention to those files. In addition, for collaborative projects, a shared file naming convention should be established, version control should be implemented, and team members should be regularly informed about any changes or updates to the file naming conventions. Also, to ensure consistency in file naming across teams, a clearly defined file naming rules and guidelines should be established. Employees should be provided with training and support regarding its importance and effective implementation. Finally, regular review and update of the file naming guidelines should be conducted (Antin, 2016).

4.7 Conceptual Framework

All the literature studies researched in this section have provided a detailed concept of information exchange approach which has been summarized in Figure 10 as a conceptual framework. The figure below is the representation of the concept utilized for improving the information exchange approach of the case company.

Figure 10. Conceptual Framework

Figure 10 shows the Conceptual Framework, which is broadly divided into two categories, which when improved together, will result in an improved information exchange approach.

The first category, i.e. Communication Channel answers ‘how to communicate effectively’ to improve the information exchange approach. The author has first started with the meaning/concept of communication, followed by various models of communication, and then the channels used in communication. Next, the author has shed light on barriers/noise that disrupt the communication flow, first in in-person setup and the next in virtual communication setup. The author has divided the barriers in virtual communication into two parts, namely barriers in the use of instant messaging apps, and barriers in the use of email mainly for formal communication. And the last and the most important part of the study was the ideas on overcoming those barriers for an effective communication flow. This served as the most important part of the study because the weakness in the case company’s information exchange approach, as identified in the Current State Analysis, were serving as barriers to the case company’s communication model. Hence, the literature review related to overcoming communication barriers has given sufficient ideas on overcoming the weaknesses present in the case company’s communication model.

The second category of the conceptual framework, i.e. Data Management System covers ‘what to communicate’ aspect of the information exchange approach. Highlighting the fact that it is the data & information that is shared in the information exchange approach, the first aspect covered in this category of conceptual framework is data management systems currently being used in Finland, along with their individual features. This gave background and sufficiency of the current system being used in case company. Next, the study of their possible alternative was carried out and mentioned in the conceptual framework, as Common Data Environment. This study included how it can be advantageous and serve several purposes in addition to what is currently being served by the existing systems. Since the case company is heavily dependent

on technology, the last section of the conceptual framework gave an idea about how to support the employees and handle changes while transitioning to updated technological systems.

This concluded the Literature review of this study. The next section below contains the initial proposal created by the co-creation with the stakeholders and ideas from the Current State Analysis and the Literature study.

5 Building Proposal for an Improved Information Exchange Approach

This section describes the initial recommendation/proposal for an improved information exchange approach of the case company. This section first provides an overview on how this stage of the study was conducted. It is then followed by the findings of Data Collection 2. Data 2 is the additional suggestions or input from the stakeholders of the case company, which together with the findings of CSA and CF, help in drafting initial proposal. The draft of initial proposal is the final subsection of this section.

5.1 Overview of the Proposal Building Stage

This thesis was carried out with the objective of proposing recommendations for an improved information exchange approach of the case company. To meet this objective, current state analysis (CSA) of the case company was done first, and literature study was done to build a conceptual framework (CF). The CF built from the findings of literature study and CSA gave the author an idea about how the weaknesses in the current information exchange approach of the case company can be improved. The ideas needed to be presented to the case company to determine what in addition can be done to make the ideas more operative and functional. This step of receiving suggestions on CF from the stakeholders is called co-creating with the case company. And the result of this co-creation is the initial proposal draft.

To carry out this stage of study, the author first booked a time for conducting the workshop with all the participants of Data Collection 1. The presence of all the interviewees of Data 1 was important because the CF was built based on the weaknesses of the information exchange approach mentioned by those participants. Hence, the author sought input from all those internal stakeholders in order to create a proposal draft.

The internal stakeholders who participated in co-creating the proposal involved Project Managers, Structural Designer, Project Engineer, and Element Designer. The author first presented a summary of the key CSA findings and CF, showing the link between weaknesses present in the current information exchange approach and the ideas to overcome them which was presented in the CF. Detailed discussion was done on ideas presented for each weakness of the approach. Major elements of the discussion were documented in writing by the author. And to cover all aspects of the workshop, discussions were also recorded and later transcribed for documentation.

Most of the ideas concerning the Communication Channel, and Data Management System were considered to be doable as per the discussion in workshop. However, additional input or suggestions were provided by the stakeholders with respect to some elements of focused weaknesses which are mentioned in the subsection below.

5.2 Findings of Data Collection 2

Communication Channel and Data Management System are two aspects of the case company's information exchange approach. Through the improvement in both of these aspects, this thesis aims to design an improved information exchange approach for the case company.

In case of communication channel, the weaknesses in it were categorized into weaknesses in in-person communication, and weaknesses in use of system (Instant Messaging & Email). Suggestions were given by participants with regard to weaknesses in the use of instant messaging system, i.e. MS Teams which were unreliable features, misuse of features, and misplaced information, as well as long response time, and chance of misunderstanding in email communication. The suggestions have been presented in the Table 7 below.

Table 7. Stakeholder's Suggestions for Communication Channel (Data 2)

	Focused Weaknesses from CSA (Data 1)	**Suggestions from Stakeholders (Data 2)**	**Description of Suggestion**
1	Misuse of features (MS Teams)	-Motivate employees for individual goal setting. -Conduct informal meetings or gatherings to establish bond and trust among employees and to make them feel included.	Several recreational activities, games that require team spirit & participation, food & fun activities like Pizza Party at office helps employees to know each other and to build bond and trust among each other.
2	Misplaced information (MS Teams)	Provide written guidelines/user manual for users of the system.	Written guidelines are good as long as the work can proceed as guidelines dictate. Hence, guidelines in understandable and implementable words should be designed for users.
3	Long response time (Email)	Use phone calls in urgent matter that require prompt response from external stakeholders.	In occasion where external stakeholders are busy and no timely response, phone calls are ok in urgent matters but if the answer in the phone is suspicious, it requires writing in email as well.
4	Chance of misunderstanding (Email)	Provide writing, email etiquette training to employees, managers who frequently communicate with external stakeholders.	The training related to email etiquette enhances managers' knowledge on how to write clear, concise, effective, and meaningful message which can reduce the chance of misunderstanding.

Table 7 depicts the suggestions or input provided by the stakeholders during the workshop. The suggestions were provided for both categories of communication via system, that are communication through instant messaging system, and email communication.

5.2.1 Stakeholders' Suggestions for overcoming barriers of Instant Messaging system

Since the case company uses MS Teams as an instant messaging application while collaborating with team members, the author, based on the literature study provided solutions on making the use of MS Teams optimal, convenient, and less complex for the users. Additional improvement ideas were provided by the stakeholders during the workshop.

One of the key challenges in the use of MS Teams was misuse of features and flexibility provided by the system, like employees reporting non-working hours. It was very common among employees as reported by the Project Managers. Discussion was done on the possible reasons why employees tend to do so. The importance of clearly defined rules was highlighted during the discussion. Hence, establishing rules and norms early in the projects and team's life cycle can help to reduce this challenge. Employees should be motivated to set individual goals and be productive during their working hours even if it is less than 8 hours a day, unless they meet their set goals. In time vs. productivity, importance should be given to productivity. Apart from that, informal meetings and gatherings, recreational activities, outdoor activities with group games and food events can help to boost bond and trust among team members.

Another challenge while collaborating via MS Teams was misplaced information due to information storm. During the workshop, discussion was done about all the possible information type that require communication, and what channels they use to communicate that information with team members. It was agreed that regular chat related to work and queries requiring prompt response from the team member can be communicated via MS Teams. But a list of guidelines

or direction to carry out a specific task is not expected to be communicated in MS Team, as it can be difficult for the user to go through or find those guidelines again, if there have been more conversations between the team members already. For such guidelines or directions, a more formal documentation channel like OneNote or Email can be used. Hence, it is important for the users not just to use the features effectively and rightly, but to know which channel is to be used for what kind of information. Therefore, written guidelines or manuals in understandable and implementable words for guiding employees to choose communication channel based on the information to be communicated can be helpful.

5.2.2 Stakeholders' Suggestions for overcoming barriers of Email Communication

Highlighting chances of misunderstanding and long response time in email communication as key/focused weaknesses of email communication, discussions were held to determine best possible solutions to deal with those weaknesses.

Email communication in case company is mostly used for communicating with the external stakeholders in formal matters. The projects often get interrupted due to no timely response from the stakeholders, and sometimes due to misunderstanding of message. Sometimes, email message lacks clarity, and also in some cases, message can be lengthy but not to the point, all of these increasing the chance of misunderstanding. As mentioned in Table 7, to ensure that the email responses are timely, it was suggested by Project Manager that phone calls be used in urgent situations that require prompt response from the external stakeholders. In addition, if the response received in phone seem suspicious, it is suggested to require documentation through email as well.

And to reduce the chance of misunderstanding in email communication, enhancing email literacy of employees was deemed most important. It can be done by providing training concerning how and when to use email effectively.

Writing, and email etiquette training to managers who frequently communicate with external stakeholders, sharpens their skills on writing clear and concise message, writing meaningful subject line, and providing clarity to their message.

5.2.3 Stakeholders' Suggestions for improving Data Management System

Data Management System is the second aspect of the case company's information exchange approach. The major challenge in the case company's web-based data management system is the inconveniency arising from use of multiple platforms (project banks) for different projects. Suggestions regarding approaches to overcome this challenge were received from the stakeholders during the workshop which is presented in the table 8 below.

Table 8. Stakeholder's Suggestions for Data Management System

	Focused Weaknesses from CSA (Data 1)	**Suggestions from Stakeholders (Data 2)**	**Description of Suggestion**
1	Inconvenient due to multiple platforms for different project	In case of multiple projects at a time, organize team also considering common Project Banks to be used in the projects. For instance, One PM manages two projects that use a same project bank.	Application of CDE is possible but it cannot substitute all other project banks that are currently being used. PMs should adhere to client's requirements regarding the DMS to be used for a project. Hence, approach to make use of multiple platform effective without making it inconvenient for the users should be followed.

Table 8 is the illustration of suggestions received for improving data management system in the case company. Based on the findings of literature study, application of Common Data Environment seemed a viable option for case company's projects. However, the Head of Department (HOD) suggested that Common Data Environment cannot be implemented as a substitution for other project banks being used. Before any project initiates, the client requires a specific project bank to be used for that project and PM should adhere to the client's requirement regarding the project bank to be used. Hence, an approach where multiple project banks as per clients' requirement can be used without making it overwhelming and inconvenient for the project managers and other team members, can be implemented. It can be done through proper team planning and structuring early in the projects' life cycle. In case of multiple projects where different project banks need to be used, one of the criteria to organize a team should be 'common project bank'. In this way, the use of the system can be made less overwhelming for the users.

5.3 Proposal Draft

After the findings from current state analysis and conceptual framework were presented to the stakeholders, their additional input and suggestions on the findings led to co-creation of an initial proposal or proposal draft. The summary of the initial proposal is presented in Figure 11.

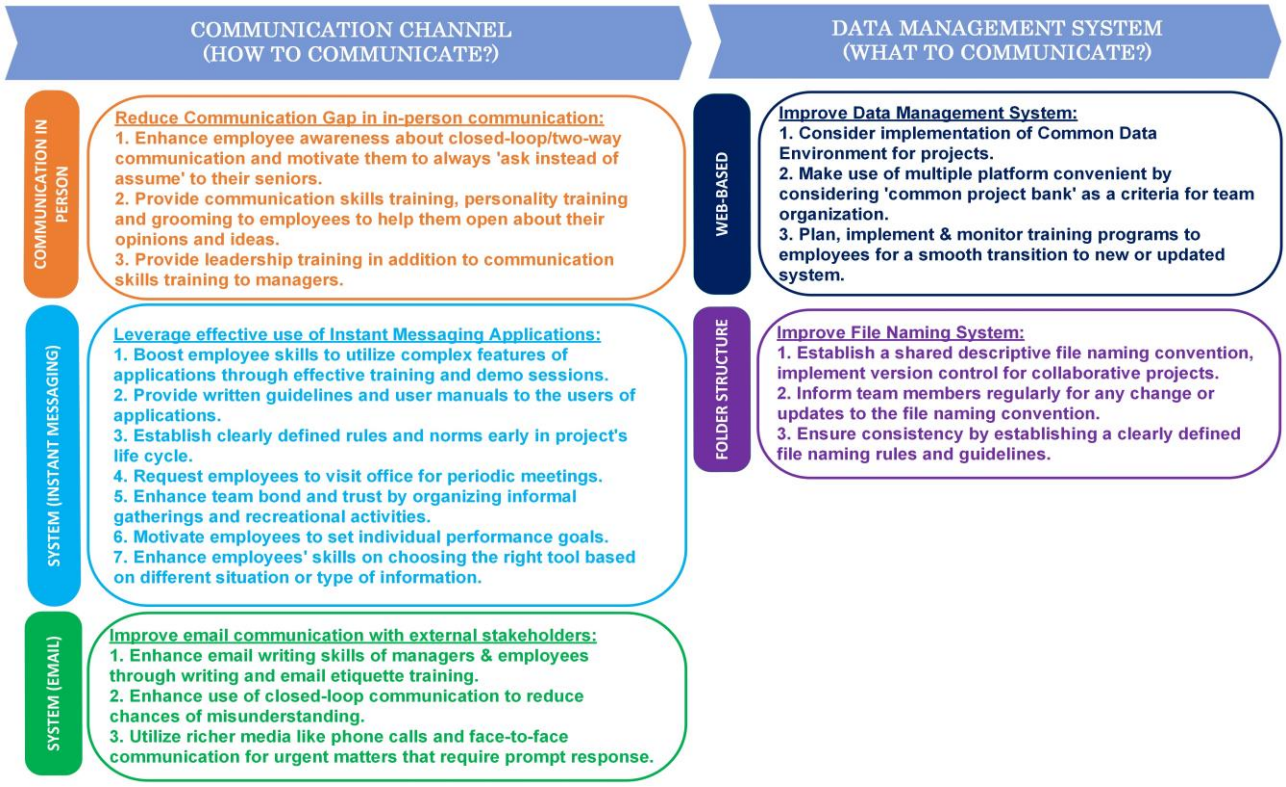

Figure 11. Summary of Initial Proposal

Figure 11 depicts the draft or initial proposal that has been co-created with the stakeholders. The recommendations are concerned with both the aspects of the case company's information exchange approach, which are Communication Channel, and Data Management System.

Recommendations related to communication channel answers how barriers or challenges of in-person communication as well as communication through use of system can be overcome and how communication can be made effective. For

an overall communication channel to be effective, case company should mainly focus on three things. Firstly, approaches should be taken to reduce communication gap that arises in in-person or face-to-face communication. The approaches can be behavioural, for example, through training and motivation to employees. Secondly, considering the increasing use of collaborative tools for communication in the case company, it should focus on leveraging an effective use of instant messaging applications like MS Teams, by enhancing employees' skills of using the applications. Lastly, email communication should be improved as it is an important channel which the case company uses for communicating with external stakeholders. A detailed description of recommendations on these three approaches have been mentioned under heading 5.3.1.

Similarly, Figure 11 also shows recommendations related to data management system. The recommendations answer how the case company's overall data management system can be improved. The focus should be on two elements, which include improving the web-based data management system that is accessible by both internal and external stakeholders, and second, improving the folder structure which is accessible only by internal stakeholders. The detailed description of how these recommendations can be achieved have been mentioned under heading 5.3.2.

5.3.1 Proposal to Improve Communication Channel

The recommendations listed in Figure 11 is an outcome of current state analysis and conceptual framework, together with additional input and suggestions from the stakeholders of the case company. Figure 12 below shows link between (current state analysis + conceptual framework) and initial recommendations for improving communication channel by overcoming barriers present in the channels.

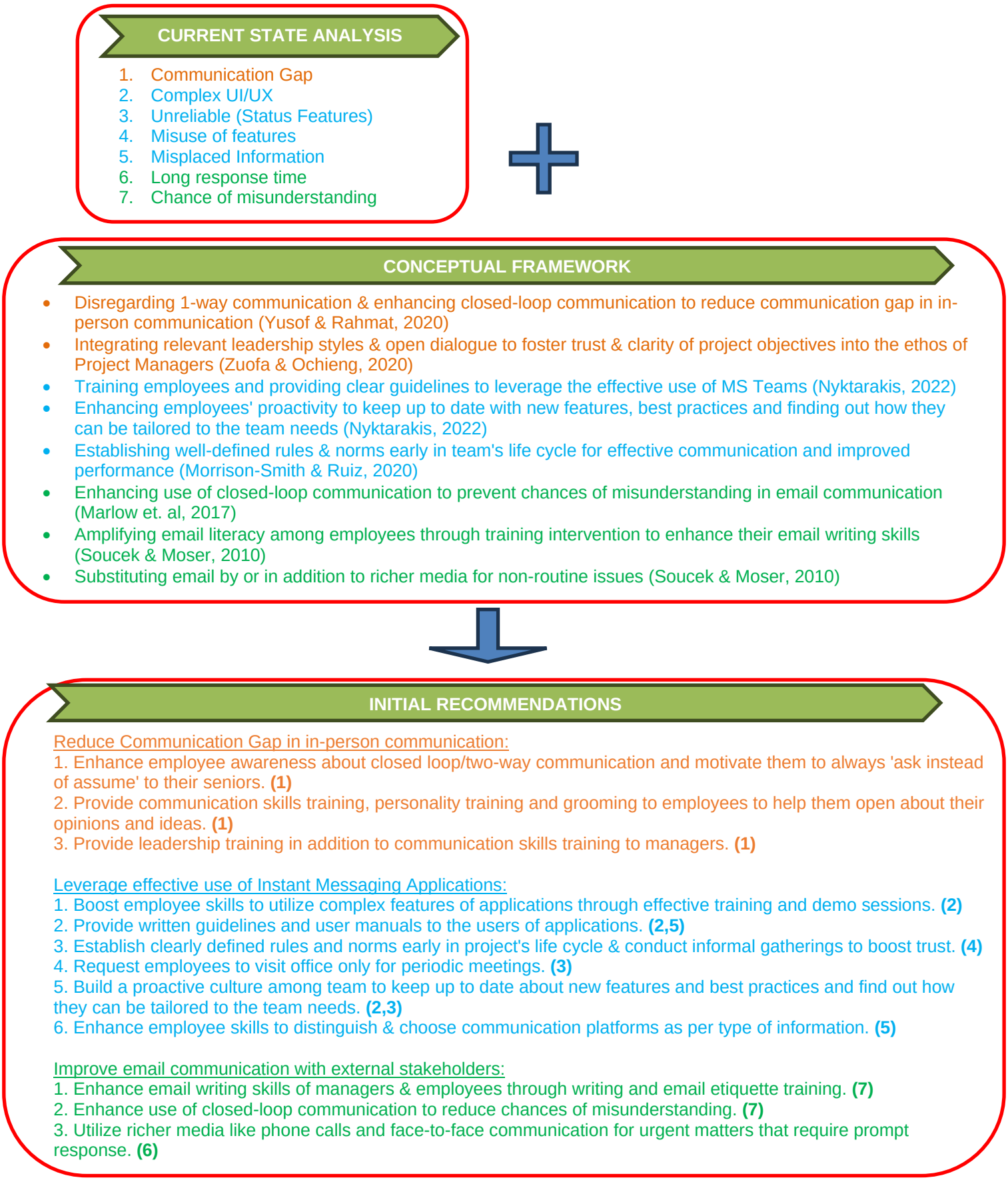

Figure 12. Initial recommendations to improve communication channel

The Figure 12 shows a list of weaknesses of communication channel, a list of literature study done to generate ideas on overcoming the weaknesses of communication channel. And finally, it shows a list of recommendations made, based on the conceptual framework as well as the stakeholders' additional input.

Based on CSA findings, chance of communication gap in in-person or face-to-face communication was a major barrier in the case company's communication channel. Hence, reduction of the communication gap present in in-person communication should be the first approach to create an improved communication channel. To do that, employees should be motivated to implement two-way communication system. When superiors give direction to their subordinates, communication process should be continued until the subordinate understands the direction completely, and the superior is assured about that. It is always good to know that the subordinate has not understood the direction prior to the work than to know that at the deadline.

The major reasons for such communication gap leading to misunderstanding can be personality barriers, intimidating superior, complex language, etc. The case company should take measures to motivate the employees with shy personality, or those who cannot question their seniors or open up about their thoughts to always 'ask instead of assume'. Most of the communication problems in organizations arise due to employees' nature of making assumptions about what they are supposed to do. Therefore, employee grooming sessions, communication skills training, and personality training should be provided to the subordinates to boost their communication skills. Also, leadership training should be provided to superiors who work both as technical experts and team managers. The managers with technical expertise should also be expert in maintaining smooth and effective communication with their subordinates.

For communication among internal stakeholders that takes place with the use of system or collaborative tools like MS Teams, measures should be taken to leverage their effective use. To make the features of MS Teams less complex to the users, support from administration should be provided demonstrating the use of complex features, also user manuals and guidelines should be prepared so that they can be referred to by the users as and when required. Also, it is important to establish a culture where team members are self-motivated to learn and grow together as a team. It helps them to stay proactive in keeping up to date about new features and best practices in the collaborative tools and sharing them among the team members.

Communicating through system sometimes is not as authentic as communicating in person, which results in problem such as unreliability of features like ‘Status’ feature. In a co-located work environment, it is easier for team members to see who is available, who is on break or who is on call during work. However, while communicating though MS Teams, the ‘status’ feature can be unreliable if it is not used rightly. The problem arises often because people tend to be less active when it comes to updating their every status on computer application. The case company is recommended to enhance employees’ knowledge and skills on utilizing this feature rightly through training and demonstration. Employees can be motivated to visit office for periodic meetings. Team members can be more welcomed to work in office, so that there will be less use of instant messaging applications.

Similarly, as mentioned under heading 5.2.1, establishing clearly defined rules and guidelines early in the project’s life cycle can help to discourage employees from misusing certain features, for example reporting non-working hours. Additionally, motivating employees to set individual goals and be productive during their working hours even if it is less than 8 hours a day, and focusing on productivity rather than time can help to cope with this challenge. Also, conducting informal meetings and gatherings, recreational activities, outdoor activities like group games and food events can help to boost bond and trust

among team members. Trust and understanding of team members play a pivotal role in hybrid working model, since it's not every day that they can see and work alongside each other at office.

Through guidelines and training, the case company could not only enhance employees' skills on effectively utilizing the features of collaborative tools, but also on choosing the right tool for specific type of information. As mentioned under heading 5.2.1, any specific message in different situation may require utilization of different communication channel. For instance, regular chat related to work and queries requiring prompt response from the team member can be communicated via MS Teams. But while sending a long list of formal guidelines or direction about how to carry out a specific task, a more formal documentation channel like OneNote or Email can be used so that it can be easily accessed as and when required without any misplaced information. Hence, written guidelines or manuals in understandable and implementable words for guiding employees to choose communication channel based on the information to be communicated can be helpful in overcoming challenges of communication tools.

Also, as email is the main channel used in the case company to communicate with the external stakeholders, approaches should be taken to improve email communication as well. As mentioned under heading 5.2.2, the case company should focus on increasing employees' email literacy by enabling them to write meaningful subject, clear, concise, and effective message which leaves no room for misunderstandings. In addition, employees should be made aware of when to stick to email communication and when to find its substitute for any message. For instance, email can be an appropriate option for routine information sharing and updating with the external stakeholders. But, for non-routine information, or which requires prompt response can be communicated via other richer media like phone calls or face to face communication. Both email and phone calls should be utilized in case of suspicious response.

Hence, by overcoming underlying barriers in three different communication modes, which are in-person communication, communication through instant messaging tools, and email communication, an improved communication channel as a whole can be achieved by the case company.

5.3.2 Proposal to Improve Data Management System

The second approach to an improved information exchange approach is to have an improved data management system in place. Figure 13 shows the initial recommendations to improve the data management system.

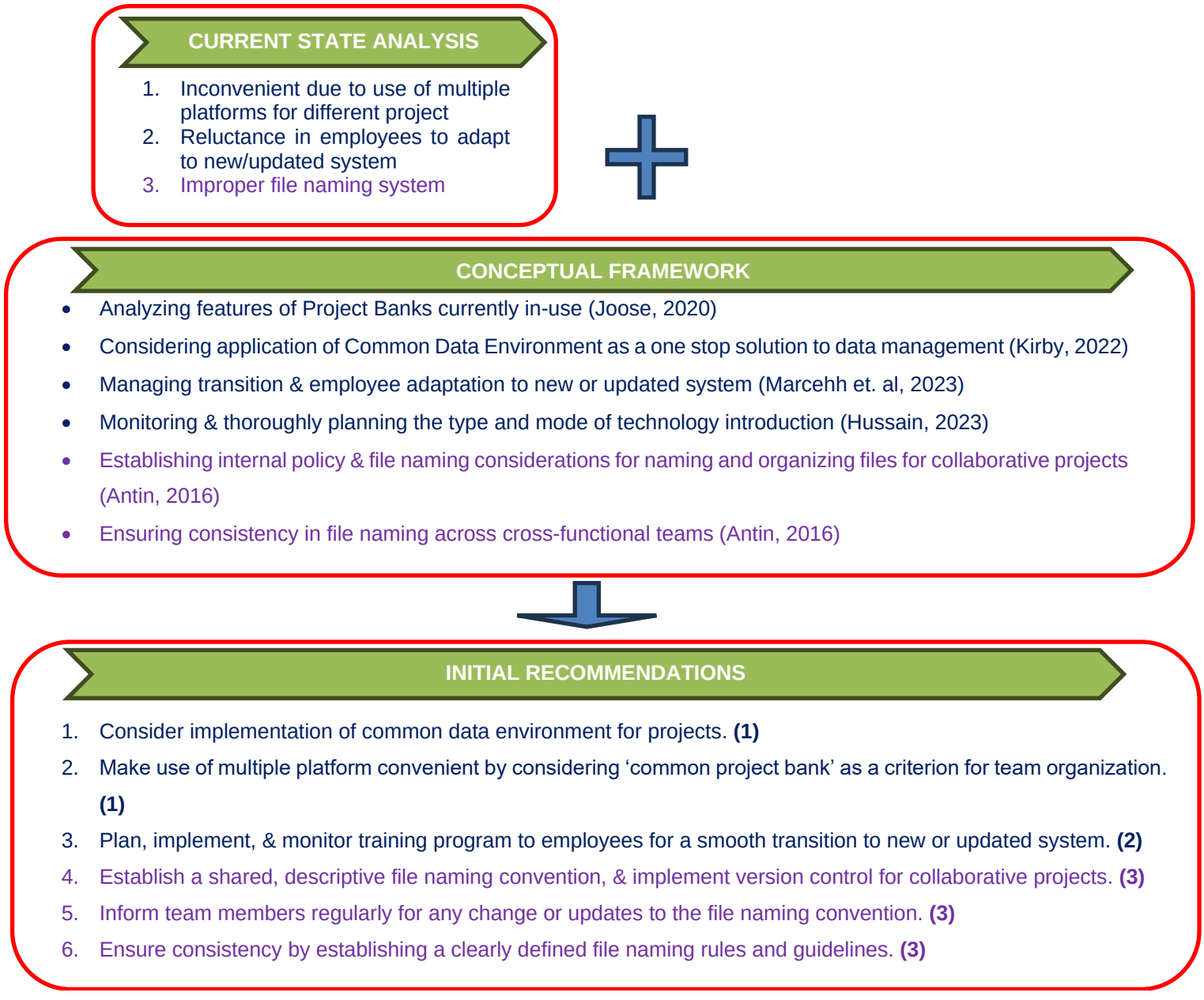

Figure 13. Initial recommendations to improve data management system

Figure 13 shows the link between (current state analysis + conceptual framework) and initial recommendations for improving data management system of the case company. The figure depicts a list of weaknesses of the case company's web-based data management system and folder structure, a list of literature study done to generate ideas on overcoming the weaknesses of the data management system. And finally, it shows a list of recommendations made to create an improved data management system, based on the conceptual framework as well as the stakeholders' additional input.

The biggest challenge in the case company in utilizing a web-based data management system based on the CSA was the inconveniency arising from the use of different/multiple platforms for different projects. As suggested under the heading 5.2.3, common data environment which brings all the project workflows under one roof, can be implemented. However, since it cannot be implemented solely as an alternative to all other project banks that are being used in the case company, due to its operational requirement (client requiring the company to use different platforms for different projects), focus can be on utilizing multiple platforms without making it overwhelming and difficult for the users. To do that, based on the suggestions generated in the workshop, an extra criterion can be added to team organization, which is 'common project bank'. While structuring team, members and project managers can be assigned on the basis of a common project bank. If four projects start at a same time, team members can be assigned in such a way that one project manager manages two projects that uses a same project bank. Hence, the uniformity in the project bank being used in running the projects can help to make it less complex for the users by reducing the number of applications to be used.

Similarly, to improve the folder structure, approaches should be taken to overcome its major challenge which was problem in naming files for collaborative projects. The necessity to name a same file differently for different tasks, all aimed at a same purpose, made it hectic for the users. Hence, to cope with this challenge, a shared, descriptive file naming convention could be

established, and version control implemented. In case of any changes or updates to the file naming convention, informing team members regularly can be helpful in avoiding any lagging issues. In addition, establishing a clearly defined file naming rules and guidelines helps to ensure consistency in the system. All these approaches are aimed at improving the data management system of the case company.

An improved communication channel and improved data management system helps in creating an improved information exchange approach as a whole. Initial recommendations to create the improved information exchange approach were presented in this section. The next section describes the validation of the initial recommendations to create a final proposal.

6 Validation of the Proposal

This section provides the validation of the initial recommendations. It describes the validation stage in general which is followed by the illustration of the findings from Data collection 3. It includes the changes and adjustments made to the initial recommendations. And finally, it presents the final recommendations to improve the information exchange approach of the case company, as the outcome of the study.

6.1 Overview of the Validation Stage

Validation was the last stage to finalize the recommendations to be made to the case company. The participants or stakeholders involved in this process were the case company's Unit Director and the Head of Department (HOD) /Project Manager (PM). Their feedback and comments on the initial recommendations were crucial to assess the feasibility and applicability of the recommendations in the case company.

To validate the initial recommendations, open-ended questionnaire (Appendix 4) and a group interview were utilized as data sources. The HOD/PM has been involved in data collection 1 for current state analysis as well as data collection 2 for co-creating initial recommendations. However, the Unit Director was a new participant in data collection 3. Hence, a questionnaire was prepared along with a short introduction about the author followed by a description of the business challenge, objective, and the expected outcome of the study. A short group interview session was scheduled where the summary of the current state analysis and an overview of the conceptual framework were presented. It was followed by the summarization of the initial recommendations. The questionnaire in Appendix 4 had a column section representing feasibility of the recommendations. The stakeholder could choose if the recommended action could be implementable practically. For the recommendations which were not implementable, feedback was expected which the stakeholders have elaborated

on the questionnaire's feedback column. Also, the feedback and comments were collected as field notes by the author.

After the initial recommendations were presented, the key stakeholders expressed their comments and feedback which formed Data 3 for this study. With the modifications and adjustments made to the initial recommendations on the basis of the feedback provided under Data 3, final recommendations which serve as the outcome of this study were formulated.

6.2 Adjustments to the Initial Proposal

This subsection includes a list of feedback provided to the elements of the initial recommendations which required adjustment. In Table 9, the summary of their feedback is listed which forms Data 3 for this study.

Table 9. Stakeholders' feedback on initial recommendations

	Initial Recommendations	Stakeholders' feedback (DATA 3)	Description of the feedback
COMMUNICATION CHANNEL	Request employees to compulsorily visit office for periodic meetings.	Request employees to compulsorily visit office only for **very important/very urgent meetings**.	Compulsory visits are viewed as a negative approach by employees and hence, it should be used only in very hectic/urgent situations where one person needs to coordinate the workload of many.
DATAMANAGEMENT SYSTEM	Improve web-based data management system.	**Implement unit-wise system/program and training related to their implementation.**	Due to the nature of the case company's operations, any system/program implementation and training requires unit-wise and not company-wide implementation.
	Ensure consistency by establishing a clearly defined file naming rules & guideline.	Ensure consistency by establishing a **company-wide**, clearly defined file naming rules & guideline.	The file naming convention should be common for the entire case company, which means every unit should follow the same guidelines and convention.

Table 9 depicts all the list of feedback given by the key stakeholders. The feedback has been categorized into two elements of information exchange approach, which are communication channel and data management system.

The first recommendation to request employees to compulsorily visit office for periodic meetings was aimed at coping a challenge related to unreliability of ‘status’ feature in MS Teams. The feedback to this recommendation was given by the HOD/PM as follows:

> *Compulsory visits are viewed as a negative and should be used only in very hectic or urgent situation where one need to coordinate the workload of many. (The HOD)*

Based on the CSA findings, one of the key challenges while collaborating through MS Teams was its unreliable feature of ‘Status’. This problem would specially arise when few members were working from home, and few were working from office. And team members would not pay much attention to updating their status in MS Teams. Hence, while trying to call a team member when his/her status is online, that member can actually be busy in a meeting so s/he may not respond to the call. While someone with ‘busy’ status could be available or free. Team members often tend to miss out on utilizing these features, reason might be system’s complexity (Data 1) or less preference to use system especially by old-aged group and new users (Data 1).

Appropriate training and user manuals to the users can help them to use the features of MS Teams in an optimal way. In addition to that, an indirect approach to the challenge was recommended initially, to motivate the employees to be present in office for periodic meetings. However, as per the feedback from the HOD, employees cannot be made to visit office compulsorily as it creates negative impact on the work approach. Compulsorily visiting office can be a solution only for the employees who do not want to work from home, or who do not want to use applications. But it will not be a good solution for those employees who loves to work from home and who are tech-savvy. Hence,

it is recommended to provide employees with a liberal approach where they can make a choice. Those employees working under hybrid model can be more welcomed in office and booking of workspaces should be made easy if they want to work from office. However, it is recommended to motivate the employees who have to coordinate the workload of many to be present at and work from office.

Other initial recommendations regarding improvement of communication channel were considered to be implementable by the stakeholders. Feedback was further given to the initial recommendations for improving the data management system. To improve the data management system, an approach was suggested in addition to the other initial recommendations by the HOD. The feedback was stated as follows:

> *It is always difficult to form a company-wide system or program as work differs in different offices quite a lot. Unit-wise implementation is possible. (HOD)*

Hence, while implementing any new or updated system or program as well as training related to them, the focus should be on unit specific implementation.

While the web-based data management system requires unit-wise implementation, the folder structure should follow company-wide and not unit-wise file naming conventions as per the feedback given by the Unit Director. The feedback was stated as follows:

> *As for file naming, company-wide standards should be used and enforced. (Unit Director)*

The feedback was concerning the initial recommendation to improve the case company's folder structure by establishing appropriate file naming convention and ensuring consistency among collaborative projects. The feedback helped to make the recommendation more precise by adding a crucial element, which is

scope of implementation. The key stakeholders' feedback and suggestions as a whole assisted in modifying the recommendations and create the final proposal.

6.3 Final Proposal

Based on Data 3 obtained through the validation phase, the final proposal to improve the case company's information exchange approach was created. In Figure 14, the final recommendations are presented which are sorted to the

same categories utilized throughout this study. The changes to and addition made on the initial recommendations are highlighted in Figure 14.

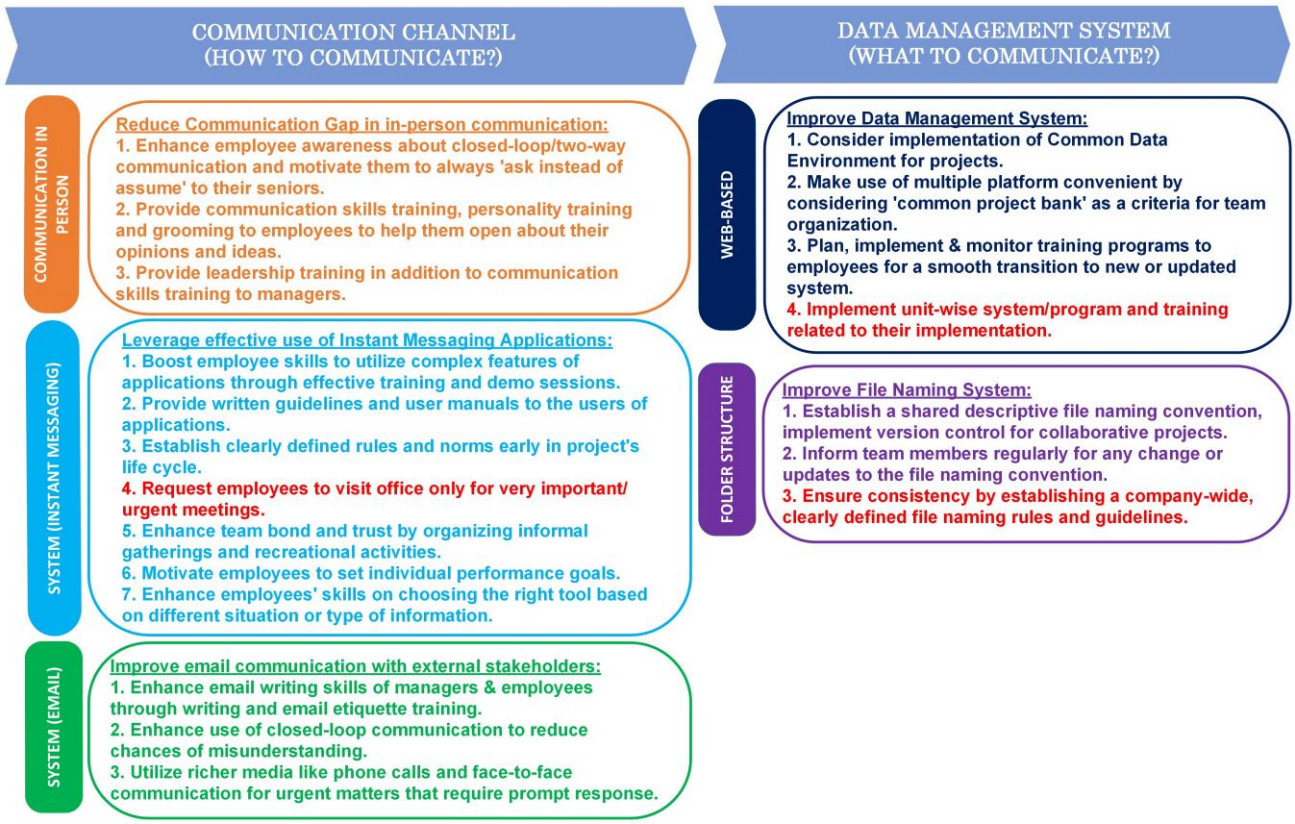

Figure 14. Final Proposal

As seen in Figure 14, the final recommendations are aimed at improving communication channel and data management system, similar to initial recommendations. To formulate the final proposal, two adjustments and one

addition was made to the initial recommendations, which are shown in red colour in Figure 14. First, an adjustment was made to a recommendation made for improving communication through use of instant messaging system, which is described in section 6.2 in detail. Another adjustment was made to the recommendation concerning improvement of the folder structure, which is described in section 6.2 in detail. To sum up the adjustments, it is recommended to request employees to participate in meetings from office not periodically, but only when they are very urgent. Another adjustment was made to make the initial recommendation more definite where it is recommended to establish a company-wide and clearly defined file naming conventions to improve the folder structure.

An addition was made to the initial recommendations for improving the web-based data management system, which is also elaborated in section 6.2. It highlights the importance of implementing unit-wise program and system related to web-based data management for an improved system. The recommendations which were considered implementable by the key stakeholders, and therefore did not need adjustment are same as the initial recommendations, which are described in detail in section 5.3.

The validation of the initial proposal was conducted according to the planned research design. The next section which is the final section of this study covers the summary of the study, suggestions to implement the recommendations, and a self-evaluation of the study.

7 Conclusion

This section concludes the thesis, first with the executive summary, which is then followed by practical next step recommendations, self-evaluation and finally closing words about the thesis.

7.1 Executive Summary

The case company for this thesis is a Finnish consulting and planning company working in three different areas including infrastructure, digital solutions and real estate and building unit. The study was concentrated in the Real Estate and Building Unit. Construction projects involve multiple stakeholders both internal and external due to their fragmented structure and a large volume of data as input to their operations. Therefore, the project faces challenges related to information exchange issues which implies that there is not an effective approach for information exchange among the stakeholders. The objective of this thesis was to propose recommendations for an improved information exchange approach. The output of this thesis is recommendations for an improved information exchange approach among the stakeholders.

Applied action research approach was utilized for this study which was categorized into four phases out of which three were data collection phase and one was literature study. For the data collection, qualitative methods with multiple approach were inherited which were one to one interview, open ended questionnaire, and workshop. Data collections were categorized into three stages-Data 1, Data 2, and Data 3. Data 1 was done to collect data about the current state analysis and Data 2 and 3 were conducted for co-creation and validation of the recommendations respectively. The research started with the analysis of the current information exchange approach in the case company. It gave the strengths and weaknesses of the current approach. Then, the literature study was conducted to prepare the Conceptual Framework which generated ideas on tackling the weaknesses. Once the Conceptual Framework

was developed, the stakeholders were involved in the co-creation of the initial recommendations. Finally, the initial recommendations were validated, and additional ideas were added to prepare the final recommendations.

The current state analysis started with one-to-one interview with the stakeholders. First the open-ended questionnaires were forwarded to all the participants where the questions were focused on the current information exchange approach in the case company. After the discussion with the stakeholders, the information exchange was categorized into two parts, Communication channel which deals with “How” the data is communicated and Data management System which deals with “What” is communicated. Then, summarized strengths and weaknesses were noted. Communication channel is divided into in-person communication and that through use of system (MS Teams, Email, and One Note) where communication gap, complex UI/UX, misplaced information, misuse of features, unreliability, chance of misunderstanding, and long response time were found as the focused weaknesses. Similarly, data management system is divided into web-based data management system and folder structure where inconveniency in use of multiple platforms, reluctance in employees to adapt change, and improper file naming convention were found as the focused weaknesses. These focused weaknesses were considered for literature study to overcome and improve them.

During literature review stage, communication models were studied and barriers in communication were identified, which were the issues mentioned by the stakeholders in current information exchange approach. Then, the ideas on overcoming the barriers in in-person communication as well as communication with the use of system were generated. Next, the study was done to develop ideas on improving the data management system. In this regard, the features of project banks currently being used in the case company and in Finland were studied. Also, study on implementation of Common Data Environment was

done. It was followed by studies related to managing employees' resistance to change and improving file naming convention of the case company.

The next step started with a workshop with the stakeholders to co-create the initial proposal. To improve an overall information exchange approach, communication channel and data management system both should be improved. Communication channel can be improved by improving in-person communication as well as communication via use of collaborative tools. To improve in-person communication, two-way communication should be enhanced through communication skills training, personality training, and leadership training to the employees and managers. Similarly, communication using collaborative tools can be made more efficient by providing employees with the trainings such as email etiquette training, written manuals, and guidelines. Informal gatherings should be promoted to develop trusts among the employees, and they need to be motivated to set individual goals. The case company should enhance employees' skills not just on "how to" but also "when to" use the appropriate tools. And to improve data management system, application of common data environment can be considered. Since, CDE cannot be used as a substitute of all the project banks, the use of multiple project banks needs to be made convenient for employees. It can be done by structuring team on the basis of "common project bank". For example, one project manager can handle two projects which utilizes a common project bank. The transition to new and updated system can be managed by properly planning, implementing, and also monitoring training to the employees.

The final proposal was created after validation of the initial proposal. The validation was done by the Unit Director and HOD through a semi-structured interview and open-ended questionnaire. Few changes on the initial proposal were addressed which included two adjustments and one addition. The stakeholders suggested a slight change where the initial recommendation was to request employees for compulsorily visiting office for periodic meeting. However, it was suggested that only those employees who are coordinating the

workload of many need to work from office. Requesting every employee to visit office mandatorily creates negative impact on them. The second adjustment was to implement company-wide file naming standard throughout the organization. The new addition made to the initial proposal was to implement unit-wise system and program as well as training related to it. The final recommendations provide practical ideas to tackle with the weaknesses in the case company's current information exchange approach.

7.2 Next Step Recommendations

Before implementing the final recommendations by the case company, it should take measures to bridge the gap between its planned actions and employees' knowledge about the same.

Most of the recommendations are focused on employees' behavioural aspects which includes enhancements of their communication skills. So, the case company needs to involve employees in implementing the recommendations by assessing their individual needs with respect to training as well as designing the training, principles, and guidelines. Similarly, the case company needs to hear the voice of employees in planning changes and creating requirements for any changes or updates related to the system, software, and program. This step helps in implementing the recommendations successfully which assists in improving the information exchange approach.

7.3 Self-Evaluation of Thesis

The author was no longer a part of the case company when the thesis started. Hence, after receiving guidance from supervisor and reflecting on practical issues faced by the author during employment at the case company, the idea about the thesis topic was generated. The author had to experience challenges resulting from inefficient information exchange approach in the case company.

When the title or area of study was communicated to the case company's key stakeholders, they mentioned additional issues in the current approach faced by the employees in their day-to-day operations and which needed to be improved. Hence, the objective of this study was to recommend actions to improve the current information exchange approach. The final outcome of the study is the recommendations for an improved information exchange approach. It was validated by the responsible stakeholders of the case company.

The study was conducted with multiple approach for data collection including multiple informants with dynamic roles. However, since the author was not a part of the case company during the thesis, access to internal documents was not allowed. Similarly, for data collection, all the conversations were formal. If the author was working at the case company, the data collection would have been more convenient with the informal conversations that could take place as well. And due to time limitations, the study was concentrated only on Real Estate and Building Unit, but the future study could be conducted in other two units of the case company as well.

7.3.1 Validity and Reliability

Validity of this thesis indicates to the validity of the outcome and results developed by the author. According to Bryan and Bell (2005), Validity is the term used for Quantitaive reseach. It is a research which that is focused on collection and analysis of the data. The validity is categorized into two parts, Internal Validity and External Validity (Bryman & Bell, 2005).

Internal Validity of a study focuses on how well the study was conducted. For example, research design, different operational definitions and how and what ways the variables are measured.

Similarly, External Validity of a study focuses on the ability to generalize a study. This is determined by the calculation and measurement to ensure generalizability for example measurements, and samples.

The Applied Action Research is designed to focus on the current issue of the company. Hence, the external validity to generalize the study does not work in this thesis. Therefore, internal validity is applicable in this thesis.

The thesis ensures the reliability as the study follows the research design and data collection throughout the research. The data collected were the input from the stakeholders and it was the current issues in the case company. The actual facts were utilized throughout, and involvement of the stakeholders in all data collection phases helped in achieving the objective of the study.

7.3.2 Credibility

The credibility of this study was achieved through the triangulation approach, and it was maintained throughout the study. Qualitative method was utilized for the study. During data collection 1, one-to-one interview with multiple stakeholders with dynamic roles for example, Project Manager, Project Engineer, and Designers was conducted. In addition to interviews, multiple approaches for data collection were used for example open-ended questionnaires and workshop.

Also, while reviewing literature, articles and previous research of latest years were considered as the topic is related to communication which has models and concepts that keeps evolving and need to get updated with it.

7.3.3 Relevance

The objective and outcome of the thesis is relevant to the case company as it was designed based on the key challenges underlying its information exchange approach. The increase in hybrid working system, presence of multiple stakeholders, and large volume of data flow created multiple challenges that disrupted smooth flow of communication and efficient data management system.

All the challenges considered for the study were mentioned by the case company's stakeholders themselves. And the same stakeholders were involved in co-creation of the initial proposal which were then validated by the Unit Director and Head of Department.

Hence, the outcome of the research which was to propose recommendations for an improved information exchange approach was generated according to the research plan and it is relevant to the research topic.

7.3.4 Logic

The logic should be followed throughout the sections and stages of the study in order to conduct a research study. The logic for selecting the thesis topic was followed to recommend suggestions to improve the current issue of information exchange approach in the case company.

To justify the logic of this thesis, applied action research was chosen and research design and plan were implemented to achieve the objective of the study. The data collected from the interviews, open ended questionnaires and workshop were recorded as audio, noted in written text and transcribed for further analysis for the study.

7.4 Closing Words

The achievement of the thesis objective was very rewarding as it developed practical recommendations which can be applied by the case organization for an improved information exchange approach.

The complexity of the construction industry is ever-increasing due to increase in technology utilization and its fragmented structure. However, that complexity can be tackled well with a right balance between 'human resource' management and 'technology' management. When the use of technology increases, it can create convenience but also complications if not managed

well. Hence, the recommendations of this thesis are targeted towards leveraging the benefit that arises from use of technology by ensuring effective management of data and smooth flow of communication. When the organizations master the use of multiple technology, they should not lessen their concentration towards their employees' development. Technological adaptation should go together with employees' skills enhancement. Thus, the outcome of this thesis will help the case company to create the balance by having a better information exchange approach.

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Appendix 1: CSA questions for Internal Stakeholders

Questions for Interview

Would you provide me the previously completed project document/report for the comparative study and reference? (Communication framework part)

Interviewee: Team members of a project team including Project Manager (Internal Stakeholders)

Communication framework: one note/ any inbuilt software/system

Open Ended Questions

1. What is the means of communication between the team members?
2. How often do you report the work? (daily/weekly/fortnightly)
3. Is there any common communication framework where you share the issues/problems while working?
4. What are the weaknesses in the communication framework? What can be improved?
5. Is there the same communication framework or different framework in different projects that you have worked on? If different, what it is?
6. Do these issues/problems come by repeatedly? If yes how often and any suggestions to resolve it?
7. Does it affect your performance? If yes what should be done to improve your performance?
8. How do you feel about the presence of external stakeholders in a project? What are the challenges?
9. What information exchange system do you use with the external stakeholders? (email/common framework)
10. How do you feel about the information exchange process among the stakeholders?
11. What kind of critical moments can you recall in the projects so far?
12. How do you communicate if there is a need for change in the project with own team members and external stakeholders?
13. Any Suggestions…

In Finnish

1. Mikä on ryhmän jäsenten välinen viestintäväline?
2. Kuinka usein ilmoitat työstäsi? (päivittäin/viikoittain/kahdesti viikossa)
3. Onko olemassa yhteistä viestintäkehystä, jossa voit jakaa ongelmia/ongelmia työskennellessään?
4. Mitkä ovat viestintäkehyksen heikkoudet? Mitä voidaan parantaa?
5. Onko eri projekteissa, joissa olet työskennellyt, sama viestintäkehys tai eri viitekehys?
6. Esiintyykö näitä ongelmia/ongelmia toistuvasti?
7. Vaikuttaako se suorituskykyisi?

8. Mitä mieltä olet ulkopuolisten sidosryhmien läsnäolosta projektissa? Mitkä ovat haasteet?
9. Mitä tiedonvaihtojärjestelmää käytät ulkopuolisten sidosryhmien kanssa? (sähköposti / yhteinen kehys)
10. Mitä mieltä olet sidosryhmien välisestä tiedonvaihtoprosessista?
11. Millaisia kriittisiä hetkiä voit muistaa projekteista tähän mennessä?
12. Miten kommunikoit omien tiimiläisten ja ulkopuolisten sidosryhmien kanssa, jos projektissa on muutostarve?
13. Mitään ehdotuksia…

Appendix 2: CSA questions for External Stakeholders.

Questions for External Stakeholders

1. What information exchange system do you use with the external stakeholders? (email/common framework)
2. How efficient is the communication flow among the external stakeholders with regards to project schedule?
3. How often does the communication flow take place?
4. Are there weaknesses in the communication framework?
5. Have there been issues in the work due to the weaknesses? How often does it repeat?
6. Any Suggestions...

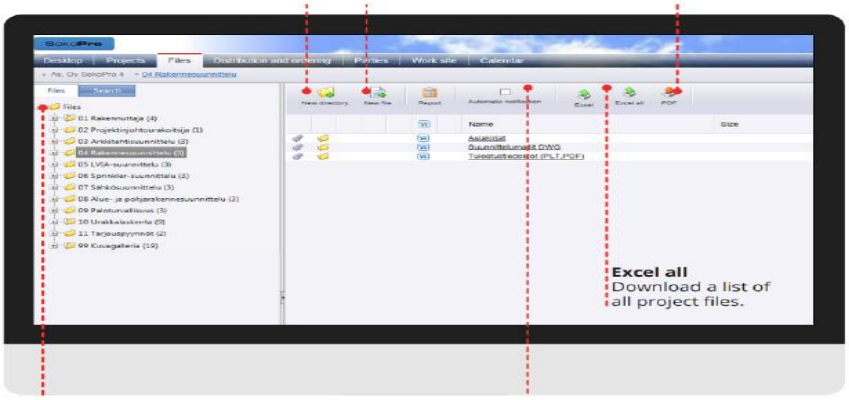
Appendix 3: CSA questions about Data Management System

Questions regarding Data Management System

1. Are you familiar with the data management system in the project?
2. What software or web-based services do you use for file sharing (drawings, pdfs, documents, etc.) with the client and external stakeholders?
3. Is it efficient and easy to use?
4. Any weaknesses or strengths of the data management system?
5. How effective is the folder structure and server usage for accessing data in a project?
6. Is it efficient and easy to use?
7. Any weaknesses and strengths of the folder structure and server usage?
8. Suggestions.

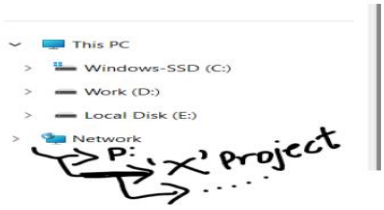
Data management system examples are:

1. Soko Pro



2. Niini Plus
3. Or any inbuilt system

Folder structure example:



Appendix 4: Discussion with Unit Director

An Improved Information Exchange Approach

Thank you in advance for your time on this assignment. My name is Prasant Pradhan, a student at Metropolia University of Applied Sciences. As a part of curriculum for Master of Engineering in Industrial Management, I chose Sitowise Oy as case company for my thesis project. The whole idea of this project was to identify business challenges existing in the case company and suggest ideas to overcome those challenges.

I chose 'Information Exchange/Communication' as a broad subject for my thesis, and interviewed Project team members, and HVAC Designer as external stakeholder. The interview gave an idea about areas that can be improved which were categorized under two headings 'Communication Channel' and 'Data Management System'. This completed my Current State Analysis (CSA) Process.

Note:

1. *Not all weaknesses identified from the interview were considered for further analysis but only the ones that were considered important.*
2. *The weaknesses/challenges of the information exchange approach do not absolutely mean those areas are bad-functional. They might already be doing good, but the study is done to improve those areas and make them better and effective.*

Based on the CSA findings, I did an extensive Literature Study and prepared a draft Conceptual Framework (CF) (Fig. 1) based on which I have suggested solutions that can help to overcome the challenges. However, the feasibility of those approaches' rests upon the case company. Hence, I am sending this document for Finalization and Validation of my study, as a last stage of receiving input from case company.

Below table consists of category-wise areas which can be improved (Column 2). The literature study done for those improvement areas are presented in Column 3. Based on the study, I have suggested some actions to overcome the challenges in Column 4.

I request you to assess the feasibility of my recommendations in **Column 5 by choosing an option (Doable/Not doable)**. Your valuable insights or **additional suggestions, recommendations or feedback can be provided in Column 6** of the table below. I have also attached the Conceptual Framework in Figure 1 below the table for your reference.

This process might take around 20-30 minutes of your time approximately. Its outcome will not only have great impact on my findings, but it will also greatly enhance my learning process, and help me to process and present a meaningful output at the end of this project. Thank you very much!

1. Categories (Data 1)	2. Improvement Areas	3. Ideas from CF to overcome challenges	4. Recommended Actions (Data 2)	5. Implementable?	6. Suggestions for Improvement (Data 3)
Communication Channel	In-Person Communication:				
	Chances of Communication Gap	Identifying barriers of face-to-face communication and ideas on overcoming them	Communication skills training to employees and managers	Choose an item.	
			Motivating employees for 2-way communication & feedback (receiver-sender)>Personality training, Grooming	Choose an item.	
	Use of System:				
	Complex UI/UX due to multiple features	Identifying communication barriers in remote working and ideas to make the use of systems effective and optimal	Provide training on effectively using the most used software	Choose an item.	
	Unreliable/Misuse of features		Mandate employees to compulsorily visit office for important periodic meetings	Choose an item.	
			Conduct informal meetings/gatherings to establish bond and trust among employees and to make them feel included	Choose an item.	
	Misplaced Information in MS Teams		Provide written guidelines/user manual for users	Choose an item.	
	Long response time (Email)		Written agreement/understanding with external stakeholders to promote timely response	Choose an item.	
	Chance of misunderstanding (Email)		Provide writing, email etiquette training to managers who frequently communicate with external stakeholders	Choose an item.	
Data Management System	Inconvenient due to multiple platforms for different project	Features of Project Banks, Possibility of application of Common Data Environment (CDE)	1. Project Banks to be used as per client's requirement, hence good Client Relationship is needed. 2. While organizing team, consider project bank to be used in projects, eg. One PM manages 2 projects that uses a same project bank.	Choose an item.	
	No notification of updated data (like in V.1 SokoPro)	Managing change and dealing with employees' reluctance/difficulty to change	Thorough planning, implementing, and monitoring of Training programs related to new or updated system to employees	Choose an item.	
	Difficulty and reluctance in employees to adapt to new/updated systems				
	Improper file naming system for multi-application files	Study of File naming convention	Follow appropriate file naming convention	Choose an item.	