Faezeh Mojtahedi

Communication and User Involvement in Complex Construction Projects

Master's thesis in Project Management
Supervisor: Bjørn Andersen

June 2022

Master's thesis

NTNU
Norwegian University of
Science and Technology

Faezeh Mojtahedi

Communication and User Involvement in Complex Construction Projects

Master's thesis in Project Management
Supervisor: Bjørn Andersen
June 2022

Norwegian University of Science and Technology
Faculty of Engineering
Department of Mechanical and Industrial Engineering

NTNU
Norwegian University of
Science and Technology

Summary

With the increasing focus on sustainability and concentrating more on long-term success, the importance of constructing a building, which suits users' needs and requirements for a longer duration, is increasing. Especially, when the building is part of the infrastructure, it becomes more significant to make it in a way that is compatible with public's today and future demand. One of the recent methods to improve project success is user involvement. It can provide an opportunity for project team to understand users and know their real needs.

The purpose of this study is to investigate benefits and challenges of user involvement in complex projects. It is concentrated on exploring the process and study its different aspects. It has more focus on the role of communication in the process. The study will try to look at the effect of communication in the user involvement process on project success. To gain proper knowledge on various aspects of complex projects, complexity factors with the focus on complexity in construction projects is examined. In addition, various aspects of communication with focus on its characteristics in the project and different tools possible to utilize, have been discovered.

The study is done in a qualitative method by means of both literature review and empirical data. Empirical data is collected from interviews conducted with employees of Statsbygg, NTNU and Advansia who have had experience in the user involvement process. There were two sets of primary and secondary interviews, which are used and analysed. Discussions are carried out based on findings of both literature review and interviews.

The findings show that user involvement is a vital process in assisting the projects to achieve success. However, the way it is performed, has effect on the amount of benefits the project can gain. It needs to be planned during the project in detail with focus on deciding when, who and how users need to be involved. It is also so important to involve the user organization as early as possible with the main purpose of management commitment. Communication is shown to have an important role to make trust and give space to people to express themselves. Many barriers have been found in the process of communication between project actors. The most-mentioned barrier was technical language which arises from people's background. However, by means of good communication skills and utilizing proper tools, some of the barriers can be removed. The role of coordination in the process is also significant. Facilitators from project side and representatives from user side need to be dedicated and skilled to ease the process. Facilitators should train the users and prepare them for decisions, while representatives should have a holistic view and represent their groups honestly. In addition, it is resulted that the early involvement is beneficial for the project and will allow both sides to understand each other's perspective and familiarize themselves with the project culture. However, too early involvement may cause more problems than leading to benefits. The involvement time and degree needs to be planned for each user group. It is also important to consider that in complex projects all user groups should be involved, but in a hierarchy way and in the right time for each group, and a good communication process should be in place to ease the knowledge sharing.

Sammendrag

Med økende fokus på bærekraft og mer oppmerksomhet mot langsiktig suksess i prosjekter, stiger viktigheten av å bygge et bygg som passer brukernes behov og krav over lengre tid. Spesielt når bygningen er en del av infrastrukturen, blir det viktigere å gjøre det på en måte som er forenlig med publikums etterspørsel, både i dag og i fremtiden. En av metodene for å sikre suksess i et prosjekt er brukerinvolvering. Det kan gi en mulighet for prosjektteamet til å forstå brukere og skjønne deres reelle behov.

Formålet med denne studien er å undersøke fordeler og utfordringer ved brukerinvolvering i komplekse prosjekter. Det var fokus på å undersøke prosessen og forsøke å forstå dens forskjellige aspekter. Det ble konsentrert mer på kommunikasjon og dens rolle i prosessen. Oppgaven studerer hvordan kommunikasjon i brukerinvolveringsprosessen påvirker prosjektsuksess. For å få kunnskap om komplekse prosjekter, undersøkes kompleksitetsfaktorer for byggeprosjekter. I tillegg er det sett på kommunikasjon med fokus på dens egenskaper i prosjektet og ulike verktøy som er mulig å utnytte.

Forskningen er gjennomført med en kvalitativ metode og inkluderer både litteratursøk og semistrukturerte intervjuer. Empiriske data er samlet inn fra intervjuer med ansatte i Statsbygg, NTNU og Advansia som har hatt erfaring med brukerinvolveringsprosessen. Det var to grupper av primær- og sekundærintervjuer. Det er gjennomført analyser basert på innsamlet informasjonen fra både litteratursøk og intervjuer.

Rapportens funn viser at brukerinvolvering er en viktig prosess for å hjelpe prosjektene til å lykkes. Måten som prosessen er utført på, kan påvirke fordeler prosjektet kan oppnå. Det må kontinuerlig planlegges i detalj med fokus på å bestemme når, hvem og hvordan brukere skal involveres. Det er også veldig viktig å involvere brukerorganisasjonen så tidlig som mulig, med hovedformålet å oppnå ledelsesengasjement. Kommunikasjon har vist seg å ha en viktig rolle for å skape tillit og få mennesker til å uttrykke seg. Det er funnet mange barrierer i kommunikasjonsprosessen mellom prosjektaktører. Den mest nevnte barrieren var fagspråk som benyttes av ulike fagpersoner. Men ved hjelp av gode kommunikasjonsevner og bruk av riktige verktøy kan noen av barrierene fjernes. Koordineringsrollen i prosessen er også svært viktig. Tilretteleggere fra prosjektsiden og representanter fra brukersiden må være dedikerte og dyktige for å lette prosessen. Tilretteleggere bør lære opp brukerne og forberede dem på beslutninger, mens representanter skal ha et helhetlig syn og representere gruppene sine ærlig. I tillegg er det et funn at tidlig involvering er fordelaktig for prosjektet og vil gi mulighet for begge sider til å forstå hverandres perspektiv og sette seg inn i prosjektkulturen. Imidlertid kan for tidlig involvering forårsake flere problemer enn fordeler. Involveringstiden og -graden må planlegges for hver brukergruppe. Det er også viktig å involvere alle brukergrupper i komplekse prosjekter, men det må gjøres på en systematisk måte og til rett tid for hver gruppe. Videre trengs det en god kommunikasjonsprosess for at det skal være lett å dele informasjon.

Preface

This study is done as aspecialization project during autumn 2021 and further work as a Master's Thesis in "project managemnet" program during spring 2022 at Norwegian University of Science and Technology (NTNU). The project has 30 credits in the course TPK4920 - Project and quality management, Master's Thesis.

Peoples and the social aspects of projects have always been of interest to me. It is exciting to explore how these social issues should be managed, and what they can add to the project. With the chance of having a broad topic of "campus project", I had the possibility to look at the social aspects of the project, which landed in "communication and user involvement in complex projects" topic. "Campus project" is a huge ongoing project at NTNU, which will be introduced in the study.

The thesis is a motivation to learn how to conduct an academic reserch while focusing on a specific topic. In connection to work on the report, I was lucky to be connected to Statsbygg, Campus Development Department at NTNU, employee and students of NTNU, and Advansis to conduct interviews for having some practical views on the topic. Collecting emprical data via interviews is an opportunity to examine the topic in industry and be prepared for connecting theory and emprical data to solve problems in real work life. It is also a starting point to learn about industrial problems and challenges in the work life.

Although the project is developed individually, it was not possible without guidance and consultance of some others. A special thanks to Bjørn Andersen for the great supervision, every moment support and valuable feedbacks. Any time there was a problem, he had a solution that perfectly solved the problem. I also aprreciate the dialogues with Martin Loeng and Håkon Fyhn, who were the first people who introduced "early user involvemnet" topic in this path. I would like to express my respect to people in Statsbygg, NTNU and Advansia who were open and helpful, and their knowledge and experince in the topic was a big support in the project. Finally, heartfelt appreciation goes to love of my life, Hamid, who was always supportive and patient.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

NTNU	The Norwegian University of Science and Technology
TOE	Technical, Organizational and Environmental
AEC	Architecture, Engineering, & Construction
BIM	Building Information Modelling
VR	Virtual Reality
AR	Augmented Reality
ICT	Information and Communications Technology

1 Introduction

With the increasing focus on projects being sustainable, construction projects cannot be an exemption. Sustainability is not just being green by means of green material or reducing energy consumption in construction. It is also about increasing the functionality of the buildings and avoiding dead spaces (Barbosa et al., 2017). Architects and designers have large focus on making spaces as attractive and desirable as possible for their users. It is not just the aesthetic aspects of the building, but also its functionality and universality is under focus. However, it is not difficult to say that they are not always successful. The main reason in most cases is that they are not aware of real needs and desires of the people who will use those buildings. Indeed, they design and construct based on their assumption of use. While people might have other definitions of usage (Redström, 2006).

To fill this gap, adjustability with its various aspects is introduced. Flexibility in product as a matter of generality and giving the users the chance to change the space easily afterwards is discussed (Arge, 2005). However, the renovation of building costs a lot and the best way is to build something that can serve users' needs. The solution is users' collaboration in the project. User involvement is recently introduced in projects (mainly IT projects) to make users and project teams closer together. It will give the opportunity to designers to listen to users and discover their needs and thereafter design based on those needs (Kujala, 2008). On the other hand, it lets the users participate in the project which will affect her/his future life. This can provide a sense of ownership and therefore result in more success (Eriksson et al., 2015, Fischer et al., 2020). It can also prepare users for the new situation (Jensen, 2011). User involvement can have many mental affects in addition to increasing functionality. It is supposed to be a win-win situation. The idea of user involvement has come also in the construction projects, especially for the public ones. Public construction buildings are assumed as infrastructure and their functionality and sustainability are of high significance. Since these projects are conducted based on tax, people in the society (taxpayers) has higher expectations for them. These projects are also on the focus of the media and their success is so important.

Recently, a huge project has been started at NTNU regarding moving Dragvoll campus to an area around Gløshaugen to have a unified campus. The purpose is to bring together the humanities and social science faculties close to the technical departments to strengthen the student's education and facilitate interdisciplinary activities between different science areas (NTNU, 2021). User involvement has been planned as a part of the project, and same as most construction projects, user satisfaction is considered as a success factor (Atkin and Skitmore, 2008). Aforementioned project will be the main case in this thesis, and discussions will be done around it. It will be called "campus project" hereafter. "User involvement in complex project" in general and "the role of communication in user involvement of complex projects" in more special are the interests of the author.

1.1 Rationale

Although user involvement has many benefits, it has many challenges, as well. The process needs to have special features to make it beneficial than adding more challenges and complexities to the project. On the other hand, the complexity factors in large projects, like "campus project", adds to difficulties of the process. In order to have a successful user

involvement process, which is assumed to contribute to the project success, the various aspects of process itself should be studied. Complexity factors as influential issues also requires to be investigated.

Furthermore, the beneficial effects of early contract involvement are vastly studied recently. Different types of involvement is studied and several models is suggested (Kujala, 2008, Steen et al., 2007). Studying about user involvement, early user involvement comes to mind as an option. Moreover, the whole process of involvement consists of various aspects of communication. Indeed, if one wants to exaggerate the issue, it can be said that user involvement is mainly about communication. Communication not only needs to be in place within the project members, but also some degree of communication needs to be conducted with project's surroundings. Considering the diversity and huge amount of information in complex projects, like "campus project", one needs to investigate different aspects of communication, various communication tools, challenges in the process and not the least its effect on trust.

This study will explore various aspects of user involvement in complex projects, with focus on early user involvement. It will evaluate its benefits, challenges and possibilities in construction industry. Moreover, communication as an important success factor will be investigated and discussed in the context of "campus project".

1.2 Research aim

The main purpose of the topic is to investigate different aspects affecting user involvement in complex construction projects, including its possibility, benefits, and challenges. Studies show that earlier involving users will contribute to more success in projects. However, there are some challenges in the process, which need to be recognized and managed. Otherwise, involving users in the project will harm project actors than having benefit for them. To make it possible, one needs to understand the context of both project and user involvement. Complexity, its type and degree, needs to be recognized, and the challenges and benefits of the involvement process needs also to be studied. The study will look at various issues influencing the process. In addition, communication as an important factor in projects needs to be investigated. Especially its effect on trust between project members is highly significant and needs more in depth studying.

It is good to clarify that the current study is the continuation of specialization project conducted in the previous semester (Autumn 2021). Part of the theoretical studies and empirical work was done last semester and during this semester theoretical part is extended and more interviews were conducted to collect empirical data.

Research questions

By having the above background, based on the author's interest and consulting with the supervisor and researchers from previous project (Bedre brukerinvolvering), below research questions are chosen:

- What are the benefits and challenges of user involvement in complex construction projects?
- How can early user involvement contribute to project success?
- What is the role of communication in user involvement in complex projects? And how can it contribute to more success?

To answer the research questions, different types of research methods have been explored and the proper one for the study is chosen. Theories around the main topics including "complex projects", "user involvement", "early user involvement" and "communication in project" have studied to have a better understanding of the topic. Focus was on the construction projects, so literatures with the focus on the complexity issues, user involvement and communication aspects in construction projects were studied. Primary interviews done by the author and secondary interviews, which the author had access to are used to have an empirical view on the topic. Analysis and discussions are done with regard to both literature and empirical findings. And at the last chapter, conclusion and recommendations are also presented.

2 Method

This chapter will cover the methodology used in the study and will elaborate on research design, literature review method, interview process, data analysis and assessment of research design. It will also present the reasoning of methods and elaborate on their appropriateness to answer the research questions.

2.1 Methodological approaches

There are two research approaches that can be used in research. Deductive method, which entails moving from the general to the particular. It can be started from theory, deriving hypothesis, testing those hypotheses, and revising the theory. Inductive on the other hand, involves moving from the particular to the general. It can be initiated by some empirical observations about some phenomenon of interest and forming concepts and theories based on them. Induction method is valid for developing theories, and afterwards they can be tested and redefined by deduction. Inductive research is typically started with an observation of an interested phenomenon usually in the form of a question or research idea, while deductive method can start from any theoretical base, from which any alternative hypotheses could be deducted (Woiceshyn and Daellenbach, 2018). When there is little to no literature on a topic, it is common to perform inductive research because there is no theory to set. However, deductive research starts with a theory and continues with testing them (Streefkerk, 2019).

While collecting and analyzing data there can be two research approaches. Quantitative approach, which deals with numbers and statistics in comparison to qualitative data which deals with words and meanings. Quantitative data is usually collected through surveys, experiments and observations, while qualitative data is collected via interviews, focus groups, ethnography, and literature review (Streefkerk, 2021). Qualitative researcher is looking through a wide lens and searching for patterns of inter-relationship between a previously unspecified set of concepts. In contrast, the quantitative researcher looks through a narrow lens at a specific set of variables (Brannen and Coram, 1992).

2.1.1 Choice of reserch design

Based on to the gained knowledge from theory, and considering the specifications of this study, the inductive method is chosen. Study has done based on research questions and the aim was to look at the questions from different angles to have a broad overview. In addition, due to the nature of the topic, qualitative method was selected. Literature review and interviews are the main data that study has been founded on them.

2.2 Data collection

Data collection was done in the form of literature review and interviews. Regarding interviews, there were two sources, primary and secondary interviews. First, a brief study will be done on various types of data and then details of two sources of data collection will be discussed.

2.2.1 Different types of data collection

There are different types of data used in a study. It can be categorized based on the person or team who has collected the data and the aim of data collection (primary vs secondary), and it can be categorized based on the methods to deal with the collected data (descriptive vs experimental).

Primary vs secondary data

Primary data is the one which has been collected for a specific research goal, while secondary data has been collected for a different purpose than a study at hand and it is reused (Hox and Boeije, 2005). Primary data is gathered specifically for the purpose of investigation at hand, while secondary data is gathered not for the immediate study at hand, but for some other purposes (Rabianski, 2003). People involved in the analysis of primary data have some involvement or at least are familiar with the research design and data collection processes. Primary data is collected to answer the questions examined in the analysis. Both primary and secondary data can be used in research (Boslaugh, 2007). Secondary data can be available form original source, who has collected and organized data and from sources which summarize data and market the information. Secondary data should be validated, and its accuracy should be checked. If validation cannot be achieved, data should be discarded (Rabianski, 2003).

The use of secondary data has some advantages. It is economic and the researcher can reduce the cost by eliminating the data collection cost. It can also provide a broad range of data to the researcher. People involved in a data informing process may not be available for smaller research projects, and collected data from such medium can be of help for other researchers as secondary data. However, its major disadvantage is that the data is not collected to answer the questions of the research at hand, and particular information one would like to have may not have been collected. Another disadvantage is that the researcher is not familiar with the data collection process. In other words, the researcher does not know how well the data is collected and if the data is affected by any issue (Boslaugh, 2007). Both primary and secondary data should be accurate, reliable, precise, unbiased, valid, appropriate and timely (Rabianski, 2003).

In this study, both primary and secondary data is used. More details will be explained in part 2.2.3.

Descriptive vs experimental research

Descriptive research is the type of research where characteristics of the study group or a certain occurrence are described. It is useful in gathering data on a certain population or a specific occurrence (Upen, 2018). Rather than limiting its approach to qualitative or quantitative methods, it is mostly observations. In this method, the variables are not influenced by external variables and are observed to derive results from it. It is done by means of observations, surveys and case studies (Voxco, 2021).

Experimental research is the type of research that manipulates variables to come to a conclusion. It is useful in finding out the cause-effect of a causal relationship or correlation between variables (Upen, 2018). It helps to make meaningful insights out of the gathered data. It is useful in testing hypothesis and making decisions about it (Voxco, 2021).

Descriptive method is used in this study, since the author had not the opportunity to manipulate variables and analyze the effects. She had some interviews and asked for the current situation that can be categorized as observation.

2.2.2 Literature review method

Literature review can be done in two ways of "narrative literature review" or "systematic literature review". In the narrative method, the main aim is to "describe and discuss the state of the science of a specific topic or theme from a theoretical and contextual point of view". These articles do not discuss the methodological approaches used to conduct the review. They have an important role on education and provide the reader updated knowledge. While systematic literature review is "a well-planned review to answer specific research questions using a systematic and explicit methodology to identify, select, and critically evaluate results of the studies included in the literature review" (Rother, 2007). Ideally systematic literature review should be done before empirical research to assist the researcher with background knowledge (Xiao and Watson, 2019).

In this study, systematic study review has been chosen as the method for conducting literature review. Xiao and Watson (2019) have suggested a process consists of eight steps as Figure 1, which has been the reference for the study.
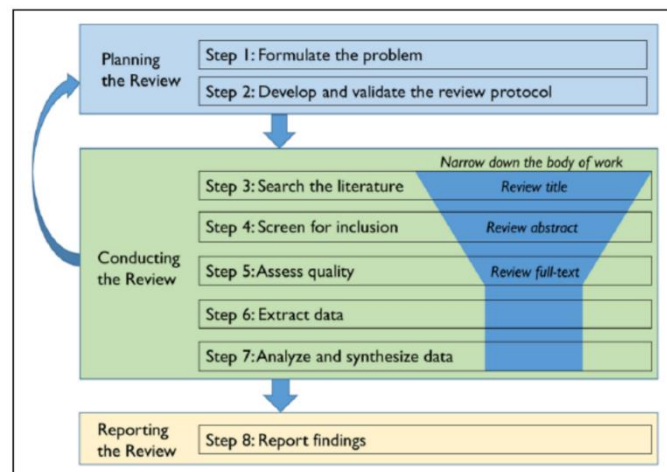
Figure 1: Process of systematic literature review (Xiao and Watson, 2019)

Step 1: Formulate the problem
The first step in literature review is identifying the research questions. The selection of studies to be included in the review, methodology for data collecting and analysing, and reporting should be conducted around answering the research questions. It should be mentioned that research questions should not be so broad that make the author confused among a huge amount of data and articles. The selection process can be done iteratively to find reasonable research questions. If the questions are so broad, it should be narrowed down, and sub-topics should be considered.

It is helpful if the author makes an initial search of literature. Pre-review mapping is beneficial in deciding whether it is feasible to review the materials, or they need to narrow down to a more specific research question (Xiao and Watson, 2019).

In this study, the first area of the work has been defined by the author's supervisor. However, since the area was so broad, the author had the chance to look at the problem from a specific angle, which she found interesting. The broader area was "campus project" and some previous researches were done on the topic "user involvement in the projects with complex environments" with the background of public construction projects.

The author was interested in the social aspects of the projects and by consulting with the supervisor and other researchers from "The Department of Social Anthropology" at NTNU, the main topic for the first part (which was done during autumn semester) was chosen as "early user involvement". For the spring semester that author should continue the work, she consulted with a few people both from Statsbygg and campus development team at NTNU, and they suggested some issues that might need more studies. The author found some parts of the mentioned issues related to "communication" area, and since she found the topic interesting, after consulting with her supervisor, she decided to focus on "communication issues during user involvement in complex projects". To make the topic more specific and to the point, research questions formulated as mentioned in 1.2.

Step 2: Develop and validate the review protocol
The review protocol is crucial for rigorous systematic reviews. It is necessary for improving the quality of the report and reduce the possibility of researcher bias in data selection. It can increase the reliability of the study, as well, because others can use the same protocol and cross-check the study for verification. The review protocol should describe all the elements of the review, including the purpose of the study, research questions, inclusion criteria, search strategies, quality assessment criteria and screening procedures, strategies for data extraction, synthesis, and reporting. Including a timetable is also suggested to help the authors to keep track. It is recommended that master students validate the protocol by their supervisors (Xiao and Watson, 2019).

The protocol in this study has been defined by the author and her supervisor in the beginning of the study in an oral way and through meetings. Furthermore, the main structure of the report has been discussed, commented and modifies based on the first draft. Further drafts and discussions both via meetings and emails helped in making the final version of the report.

Step 3: Search the literature
The quality of the literature review is highly dependent to the quality of the materials used. A systematic search of literature should be selected to collect high quality literatures.

Channels for literature search: There are three types of literature that can be used in generating research: articles in academic and professional journals, reports, and books (Saunders et al., 2009). Xiao and Watson (2019) also introduces three ways of literature finding: 1) electronic database, 2) backward searching, and 3) forward searching.

They argue that most of the publications can be found in electronic database nowadays. According to investigations, Google Scholar is the most powerful engine to find literature and have most of the literatures open access. However, there can be found lower credit literatures in Google Scholar, as well. So, the researcher should validate them and select the high-quality ones (Xiao and Watson, 2019).

To obtain a complete list of literature, researchers should conduct a backward search to identify relevant work cited by the articles. Using a reference list at the end of articles can be helpful in this matter. A forward search can also be done, by searching for the articles, which have cited a relevant and special literature. Search engines such as Google Scholar and ISI Citation INDEX allow forward search of article. Searching by key author can also be a method to find literature (Xiao and Watson, 2019).

In this study, the main literatures have found via electronic database. Google Scholar and NTNU Library (Oria) were the main engines. Backward searching is also utilized by the

author to find relevant literature in the main topic. The author has not used forward searching.

In addition, the author has used some printed books found at NTNU library. The books were suggested by Oria, in search of the relevant articles.

Keywords used for the search: The keywords should be derived from research questions. Two concepts should be considered in choosing them: degree of exhaustiveness and precision. The researcher should have a balance between them. By using a broader keyword, the degree of exhaustiveness will be increases and wider range of literatures will be found. However, by using more precise keywords, more specific literatures can be found, while some might be excluded. On the other hand, if cross country studies will be done, the use of different words for a same aspect in various countries should be considered. It is also important to document the date of search. For having better overview, searches should be done regularly to utilize new literatures (Xiao and Watson, 2019).

The keywords used in this study are as below:

- Complexity in projects
- Complex projects
- Complex construction projects
- User involvement
- User involvement in complex project
- User involvement in construction projects
- User involvement in complex construction projects
- User involvement in buildings
- User participation in construction projects
- Early user involvement
- Early user involvement in complex projects
- Early user involvement in construction projects
- Communication in projects
- Communication in construction projects
- Communication tools in projects
- Communication tools in construction projects
- Visualization tools in projects
- Visualization tools in construction projects
- Communication in user involvement

Most of the selected literatures were in English and a few Norwegian literature were used, as well. The criteria for date of publication was the last 20 years since the topic is almost new. However, there were some founding literatures regarding basic topic and definitions that were older, but still valid and worth to use. The search stopped when repeated articles were found and there was not much new relevant ones.

Step 4: Screen for inclusion
Researcher should screen the articles in this step to decide if it will be included for data extraction and further analysis. An effective way is to review the abstract and a quick full-text review (Xiao and Watson, 2019).

There were not any specific criteria set for the inclusion in this study. There were not any geographical inclusion criteria, but the interest was to include more articles, which have been studied in Scandinavia.

Step 5: Assess quality

In this step, researcher should assess the quality of the full texts by reading through and reviewing it. Quality standards in dependent to the type of study. For example, in descriptive study there is no need for being strict regarding the quality since it will discover the breadth of studies. Reviewers can judge the quality of the study by analyzing the logic from the data collection method, to the data analysis, results and conclusions(Xiao and Watson, 2019).

In this study, the quality of found literature have been investigated according to their data collection method and their analysis and discussions. There has been an effort to use articles with higher quality.

Step 6: Extracting data

It is common to code the literature to extract data. Data extraction can be done by creating forms or using content analysis to extract items related to the topic of interest. Extracting key concepts, second-order interpretations, and theoretical constructs are extraction methods, which suit qualitative research. Extracting evidence in support or in opposition to a prior conceptual model is also suitable for qualitative research. Extracting data related to probability is a common extraction method way in quantitative research(Xiao and Watson, 2019).

In this study, content analysis, extracting items related to topic, extracting key concepts, theoretical constructs, and extracting evidence in support or opposition of suggested model for "complexity", "user involvement" and "communication" topic has selected as the extraction method for literature review.

Step 7: Analyzing and synthesizing data

Tables, charts, and narratives are methods of analyzing and synthesizing which suit almost all the research types. Meta-regression and Bayesian statistical methods are more appropriate for quantitative research. While, contextual sentences, summary matrices/tables, using existing theory and evidence to create third-order interpretations, reporting findings, and adjusting conceptual model can be more suited to qualitative method(Xiao and Watson, 2019).

In this study, contextual sentences, summary tables, reporting finding and adjusting conceptual models is used to synthesize and analyze findings from literature review.

Step 8: Report findings

The process of literature review should be reported to make it reliable and independently repeatable. It should contain enough details to allow others to follow the same step described and arrive at the same results. Criteria for inclusion and exclusion should be specified and rationale for each selection should be explained. The author should be sure that the process is transparent and the conclusions are supported by data(Xiao and Watson, 2019).

There has been an effort to include all the above-mentioned points in literature review and method part to make it clear for reader how the process has occurred.

2.2.3 Interviews

As mentioned before, interviews are a way to collect qualitative data. They are open-ended questions asked verbally to respondents (Streefkerk, 2021) and can provide many practical

information. Two sets of interviews have been utilized in this study. The primary interviews that are conducted by the author, and the secondary interviews that were performed by "Martin Loeng" and "Håkon Fyhn" from NTNU, which the author had access to.

For the primary interviews, seven sets of interviews were conducted with people who have been involved in user involvement in construction projects. One of the sets was in the form of group interview and others were individual interviews. In the group interview, three people from Statsbygg were answering the interview questions. People involved in this set, one more from Statsbygg, in addition to four people from NTNU were involved in the user involvement process of "campus project". Three out of four informants from NTNU were users who will be affected by "campus project". The last informant, from Advansia, was not involved in "campus project", but had a long experience of user involvement in construction projects. The summary can be found in Table 1.

Interview objects were selected based on their experience with the user involvement process. Since "campus project" was the main case of the report, most of the informants were selected due to their participation in the case project. However, one interview was done with an informant who is not involved in this project to have some degree of variety in the collected data. There was an effort to include people from both project and user organization to have information from both sides of the project. All of the informants from project organizations had a long experience in the area, while some of the people from user organization had not such a long experience, and this project was their first involvement in the process. One of the interviewees from user organization was chosen from campus development department who are responsible for organizing the process from NTNU side. Moreover, the other three were selected due to their involvement in the process, in addition to the fact that they are from the departments who will be affected by the movement. Another motive was informants' connection with the author's supervisor in one or another way and their availability to contribute. It should be mentioned that some other people within the mentioned criteria were selected to be interviewed, but due to different reasons such as time-pressure at their workplace, the interview did not perform.

The aim of the interview was to get empirical data from people who have been involved in one or another way in the user involvement process. A semi-structured interview guide was developed and got approved by the supervisor at NTNU. The interview process was submitted to NSD (Norsk Senter for Forskningsdata) for approval. This was performed to ensure the compliance of the interview with GDPR (General Data Protection Regulation).

Interviews were done in a qualitative method based on the interview guide. They were rather in the form of conversation than a strict questioning. The interview objects angled the questions based on their experiences and the conversation was flexible based on the answers. The interviews were done physically or digitally (via Microsoft Teams) according to the possibilities or preference of interview objects and author. All of the interviews were recorded, and transcription was performed afterwards. Sound recording was the option for physical interviews, and video recording was used for the digital meetings. All the data were stored at NTNU Cloud. The recording files will be deleted as soon as finishing the project. The interviews were in English and Norwegian based on the convenience of the informants. For the Norwegian ones, there was a need to translate the main points to English. Translated documents and transcriptions were analysed electronically by highlighting the main points. Transcriptions are not included in the report, but they can be provided in case of request.

Secondary interviews are done as a part of study in "Bedre brukerinvolvering i prosjekter med komplekse brukermiljøer" project carried out at NTNU. These sets of interviews have been completed before starting the current study. The author had not detail information about the selection criteria of the interview objects and could not influence them either. The author was honoured to have access to those interviews and two interview transcriptions were used in this study.

Details of the primary informants' organization, position and their relevance to the topic is provided below:

1. Helga Melhus Loholt is project director for Campus collection (Campussamling) NTNU in Statsbygg, with the client's responsibility for the project on behalf of KD and the state. She came to Statsbygg just over a year ago after having been head of the Construction and Environment Department at Metier OEC, where she was also project manager for the police's national emergency center (politiets nasjonale beredskapssenter), where she took care of users' needs. The project was carried out in accordance with Design to cost. Before that, Loholt was responsible for construction, design and architecture for the new expansion of OSL-Gardermoen, the T2 development. She is educated as a Civil Engineer in buildings (siv. Ing bygg) at NTNU and is also an interior architect.

2. The interview object is an employee of Statsbygg as project manager in early phase, on the NCS project. She has a degree in architecture at NTNU, and has experience with designing several large construction projects, including OSL T2, and the Police National Emergency Response Center (politiets nasjonale beredskapssenter).

3. The interview object is also an employee of Statsbygg and has worked on the project for 2.5 year.

4. The interviewee is an architect, engaged as project manager in Statsbygg, who has worked a lot with user involvement.

5. Hanna Maria Jones is communications manager for campus development at NTNU. There are separate departments who work with campus development at NTNU. She is currently responsible for communications related to all the projects in a portfolio including five large projects. Colocation of the campus (Campussamling) in Trondheim is the largest and complex project she works with right now.

6. The informant is a historian and is the Head of department of history and modern society at NTNU. They are one of the departments that should move to the new campus and their work condition will be influenced by the project a lot. In addition, the informant participates in the user involvement process of the project.

7. The interviewee is a professor who is also currently a representative of the leadership in one of the faculties that are supposed to move to the new campus. In addition, the informant participates in the user involvement process of the campus project.

8. Emilie Faarup Storvik is a student at NTNU and represents students of human science in the "campus project". She belongs to the group of study programs, which should move to the new campus. Their new study life will be influenced by the project. She participates in the user involvement process of the project.

9. Randi Lile is a project manager in Advansia, where she works mostly in the early phases of the building projects. She has led, and been involved in many user involvement processes, both as an architect, city-planner and as a project manager in the municipality of Trondheim.

Since some of the interview objects were not willing their names, be revealed in the report and be recognized, the author has used abbreviations to refer to the entire interview objects to have consistency.

Name	Abbreviation used in report to be referred	Organization	Project / User organization	Involved in "campus project"? (Y/N)	Group or Individual interview	Primary or secondary
Helga Melhus Loholt	PS1	Statsbygg	Project	Y	Group	Primary
NA	PS2	Statsbygg	Project	Y	Group	Primary
NA	PS3	Statsbygg	Project	Y	Group	Primary
NA	PS4	Statsbygg	Project	Y	Individual	Primary
Hanna Maria Jones	PN1	NTNU	User	Y	Individual	Primary
NA	PN2	NTNU	User	Y	Individual	Primary
NA	PN3	NTNU	User	Y	Individual	Primary
Emilie Faarup Storvik	PN4	NTNU	User	Y	Individual	Primary
Randi Lile	PA1	Advansia	Project	N	Individual	Primary
NA	SS1	Statsbygg	Project	Y	Individual	Secondary
NA	SS4	Statsbygg	Project	Y	Individual	Secondary

Table 1: Summary of the information of interview objects

2.3 Data analysis

There can be a variety of methods for data analysing including statistical analysis, content analysis, discourse analysis, thematic analysis and textual analysis.

Statistical analysis means investigating trend, patterns, and relationships using quantitative data (scribbr.com, 2021). Content analysis is a research method used to identify patterns in recorded communication. To do that systematic collection of data should be done from a set of texts which can be written, oral or visual (Luo, 2021). Discourse analysis is a research method for studying written or spoken language in relation to its social context. It mostly focuses on how language is used in real life situation (Luo, 2020). Thematic analysis is a method of analysing qualitative data. It is usually applied to a set of text such as interview transcripts. The researcher examines data to identify common themes/topics, ideas and patterns of meaning which appear repeatedly (Caulfield,

2021). And finally, textual analysis is a broad term for various research methods used to describe, interpret, and understand texts. It often aims to connect the text to a broader social, political, cultural, or artistic context (Caulfield, 2020).

By having above mentioned information in background and considering the topic of this study, content analysis and thematic analysis are best suited to the report. There were two main sources of data in this study including literature review and interviews. As for literature review part, analysis was done by extracting key concepts, contextual sentences, summary tables, reporting finding and adjusting conceptual models as described before.

Analyzing of the interviews is done by highlighting main points of each interview and categorizing them. Color coding is used to categorize relevance of points and sub-sections. Different colors were selected for different topics, and in case of appearance of any new topics in the interviews, a new color was defined. At the end, all contexts with the same color gathered, analyzed, summarized, and interpreted. Qualitative analysis was the main method in studying the interviews findings. There was an effort to look in more detail on similarities or contrasts in the collected information.

The final step of analyzing was interrelating data from two sources. There has been an interest to look for any relevance of literature review findings and interview results. There was also an intention to find any contrasting subjects in two sources.

2.4 Assessment of research design

In this part, the selected research design will be assessed by means of three main criteria, validity, reliability and generalizability. It is crucial for qualitative works to be investigated regarding their credit and relevance.

Validity in qualitative research means appropriateness of the tools, processes, and data. It is about choice of research questions, methodology, design, results, and conclusion. All the steps should be valid in order for report to guarantee its validity (Leung, 2015). In this study, there was an attempt to include both literature from all over the world to have a broader overview, and literature from Scandinavia to include the cultural issues related to the topic. There was an emphasize on utilizing recent published literature to encompass the newest theories and models. However, older literature were also used to study the trend of progress in the topic. Interview objects were selected according to their relevance to the topic by having experience and involvement in construction projects. The main interest was user involvement in construction projects with more focus on "campus project". There is a hope that interview objects were honest on answering the questions.

Reliability refers to the repeatability of the process and the results. In case of quality research, consistency can be considered as a factor of reliability (Leung, 2015). In this study, the process of literature review was done with consistency and there was an attempt to include literatures, which can be available easily. Open sources literature were mainly used, however there were some printed books or limited-access literatures that are utilized, as well. Regarding the interview parts, there can be some deviations if the process is about to repeat. The interview guide was a semi-structured one and according to the nature of human-being, no answer is repeated to one question in different times. The interviews were more in the form of conversation, and it might happen that some parts were not consistent and completely relevant to the topic.

Generalizability is about how well the results can be applied to other contexts(Leung, 2015). Regarding literature review in the study, literatures have been selected from

different study areas, so they can cover other contexts, as well. However, some special parts are dedicated to construction industry, which might not be relevant to the other industries. As for the interviews, since there are not so many people from various backgrounds involved, the generality might be of question. There has been an effort to include both user and project side in interviews to have more angles. In addition, there was a single interview, which is not about "campus project" that might help to have a wider overview. However, it cannot still assure the generality of the data for the whole industry or other industries.

3 Theory

In this chapter theories related to the topic is discussed. It is based on the findings from literature and publications. The main selected topics are "complex projects", "user involvement in projects" and "communication in projects". However, since the report has been executed based on the case project, there was an interest to have focus on construction industry. Therefore, theories about "complexity in construction projects", "user involvement in construction projects" and "communication in construction projects" have also explored. In addition, "communication in user involvement", "communication tools", and "communication via visualization techniques" have also studied as a supplementary topics in this chapter. Since the construction industry is a huge scope, the author has eliminated the topic to user involvement and issues around that. Topics such as delay factors and bottlenecks in the industry have been excluded elaborately.

3.1 Complex projects

Baccarini (1996) discusses about complexity in relation to two aspects: "differentiation", which is the number of varied elements, and "interdependence" or "connectivity", which is the number of interrelations between these elements. He proposes the definition of project complexity as "consisting of many varied interrelated parts". Williams (1999) has added the level of uncertainty, as an important factor influencing the project complexity. He refers to Turner and Cochrane (1993) , and divides the uncertainty into uncertainty in the definition of goals, and uncertainty in the method to achieve those goals.

Pich et al. (2002) defines complexity in terms of inadequate information, when too many parameters interact in the system. Remington and Pollack (2007) describes complex projects as the ones which "vary dramatically, exhibiting different characteristics and aspects of systemicity". Vidal and Marle (2008) state that "project complexity is the property of the project which makes it difficult to understand, foresee and keep under control its overall behaviour, even when given reasonably information about the project system". They discuss that project complexity is driven from four main areas including project size, project variety, project interdependence and project context. Dunović et al. (2014) have added constraints as an element of project complexity. They categorize it into constraints of the environment, constraints of resources and constraints of objectives. Bakhshi et al. (2016) have carried out a literature review and defined project complexity as "an intricate arrangement of the varied interrelated parts in which the elements can change and evolve constantly with an effect on the project objectives".

Traditional management approaches, which are mostly based on control, can be considered as the main approach in simple projects. Simple projects are the ones in which the outcome might be so well defined and pre-determined (Remington and Pollack, 2007). However, in more complex context, control cannot be the only method to manage the project (Baccarini, 1996). Traditional static methods may fail considering multiple feedback processes, non-linear relationships, and dynamic environment of the complex projects. It can end in providing unrealistic estimations (San Cristóbal, 2017). Complex projects can gain more benefit from approaches based on complex system thinking. It might be some parts of the project (sub-project) which are complex and need other approaches (Remington and Pollack, 2007).

Baccarini (1996) categorizes complexity into two main groups of "organizational" and "technological" complexity. By organizational complexity, he argues the differentiation and interrelation within the project organization. Issues like organizational structure, number of hierarchical levels, number and type of people involved, and type of their interdependencies affect the organizational complexity. While, by technological complexity, he discusses more about the transformation process and challenges in converting inputs to outputs.

Remington and Pollack (2007) suggest four types of project complexity as the basis for analysis. They believe each type of complexity will need various approaches and tools. They categorize them as:

- Structural complexity
- Technical complexity
- Directional complexity
- Temporal complexity.

Structural complexity sources from difficulties in managing and keeping track of huge number of different interconnected tasks and activities. This kind of complexity is common in large construction and engineering projects. To manage these projects, the outcome is divided into smaller deliverables, which are manageable as discreet units.

Technical complexity is found in projects, which their outcome will be a product that has never been produced before. They are involved with technical and design problems and face issues regarding using techniques, which are unknown or untried. The complexity arises from interconnection between multiple interdependent solution options. It is common in architectural, industrial design, engineering, explorative IT projects and R&D projects.

Directional complexity is found in projects in which the goals and goal paths are not shared for any reason, and project has unclear meanings and hidden agendas. The complexity stems from ambiguity regarding different interpretations of goals and objectives. It can be seen in change projects which do not have clear and defined goal.

Temporal complexity is caused by changing environmental and strategic decisions which are out of direct control of the project team. They arise from uncertainty regarding future constrains, the expectation of change and even concerns regarding the future existence of the system. They are common during the change of government in public sector, and during periods of merge and acquisitions in private sector (Remington and Pollack, 2007).

Any large or small project can have one or more types of above mentioned complexities (Remington and Pollack, 2007).

Geraldi et al. (2011) have done a systematic literature review and introduced five areas as dimensions of complexity. 1) Structural complexity which covers size, variety, and interdependence issues. 2) Uncertainty which is related to novelty of the project, experience of people concerned, and availability of information and its ambiguity. 3) Dynamics which is about changes in projects such as changes of specifications, goals, management team, suppliers as well as environmental context. 4) Pace which is about the speed of delivering. And 5) Socio-political complexity which covers the importance, support from stakeholders, fit/convergence with organizational strategy, and transparency. They state that projects can exhibit a mixture of these dimensions, and the dimensions themselves are interdependent.

Bosch-Rekveldt et al. (2011) introduce a model called TOE (Technical, Organizational and Environmental) framework. They divide project complexity into three main areas of technical, organizational, and environmental. Each of the areas has grouped in subcategories. Technical element includes goals, scope, tasks, experience, and risk. Organizational element is categorized into size, resources, project team, trust, and risk. And the environmental element is also divided into stakeholders, location, market conditions, and risk. They even go further and subcategorize each of these subcategories in total of 50 elements which can be found in appendix TOE framework7.1.

IPMA (2016) has established an evaluation system regarding project, programme and portfolio complexity. They have categorized complexity in three main areas and sub-categorized each of them, as per below:

- Capability perspectives:

    o Input related complexity
    o Process related complexity
    o Output related complexity
    o Risk related complexity

- Context perspectives:

    o Strategy related complexity
    o Organization related complexity
    o Socio-cultural related complexity

- Management/leadership perspectives:

    o Team-related complexity
    o Innovation-related complexity
    o Autonomy-related complexity

Remington (2011) emphasizes on the importance of early recognition of the complexity in the projects. She argues that there is a positive correlation between project success and early recognition of complexity. It is significant to recognize how complex the project is and what type of complexity it has. It has also shown that assessing complexity early in the project is desirable and practical for stakeholders. Realizing the right level of the complexity, will assist the management to define experience requirements, select the right expertise and suitable project procurement, have a better resource allocation, time scheduling and reducing risks (Baccarini, 1996, Vaz-Serra et al., 2021, Wood and Ashton, 2009). Moreover, it helps to determine planning, coordination and control requirements (Baccarini, 1996). Poveda-Bautista et al. (2018) suggests a model for measuring complexity index of projects. They argue that defining complexity level of the projects can help the organizations to prioritize within a portfolio. It is beneficial to know key complexity areas as well as their factors and their corresponding weights. It should be considered that complexity evaluation is not a one-time thing, and it should be done regularly during project's life (Peñaloza et al., 2020).

Remington and Pollack (2007) suggests 14 various tools for evaluation of complexity and defining its sources. Remington (2011) emphasizes on engagement of key decision makers in identifying and assessing the level of complexity. It is also important that the whole project team understand and perceive the complexity correct, rather than trying to simplify it. There is a risk of choosing wrong pathways to simplify and underestimating the

complexity level of the project. Project Early Stage Complexity Assessment Tool (PESCAT) suggested by Vaz-Serra et al. (2021) is also a tool for evaluating complexity from any stakeholder's perspective in the early stages of the project. They believe that each stakeholder has different views of the complexity level in a given project. Stakeholder's perception, their experience, the environment and other pressures such as tight deadlines affect the project complexity (Remington, 2011). Decision-makers tend to perceive complexity differently. It is shown that their role in the project highly influence the perception of project complexity. Stakeholders have various mental models of the concept and focus on different characteristics as the most important one. For example, steering committee members have more focus on political issues and put less rank on structural complexity and unpredictability. In contrast, project managers show a strong focus on structural complexity and a weak one on political aspects. It is important for projects to include the perspectives of many individuals holding different roles in the project to have a better overview (Mikkelsen, 2020).

Furthermore, two terms of "complicated" and "complex" should be districted from each other. Complicated projects can be specified in advance, while complex projects are unable to be completely specified in advance (Ahern et al., 2014). Remington (2011) categorizes projects into four groups of simple, complicated, complex, and chaotic, based on the possibility of the control over them (Figure 1Figure 2). She argues that complicated projects can be challenging, but by having right experts working on the problem, the solution can be found. Whereas, in complex projects, the connection between cause and effect might not be easy to detect, and outcomes are difficult to predict with any degree of certainty. Complicated projects can be planned and most of the knowledge in the project is pre-defined, while in complex projects, due to emergent knowledge, not every aspect can be understood and planned (Ahern et al., 2014). The nature of emergent behaviour in the complex projects can lead to both opportunity and risk (Vidal and Marle, 2008).

Control	**Complicated**	**Complex**	**Chaos**
Process are clear Things go to plan	Expert-based Consultative leadership	Experimental Collaborative leadership	Crisis Risks events escalate rapidly

Figure 2: Continuum of projects between control and chaos (Remington, 2011)

Remington (2011) discusses uncertainty, decreasing level of trust and difficulty in relating cause and effect (non-linearity) as indicators of the project complexity. She argues the increased level of uncertainty causes ambiguity in goals and ways to achieve them, which affects the people's assumption of complexity. Furthermore, uncertainty affects people's confidence in themselves and in the leadership, which will negatively influence the trust level. The complicated information pathways in many large projects can result in non-linearity. Multiple decision points and multiple players can result in high levels of interdependence and interconnectivity. This can produce cycles of rework, which are difficult to anticipate.

Davies et al. (2016) suggest dynamic capability as a useful approach for "understanding how organizations develop the strategic organizational process required to manage varying degree of uncertainty found in many large and complex projects".
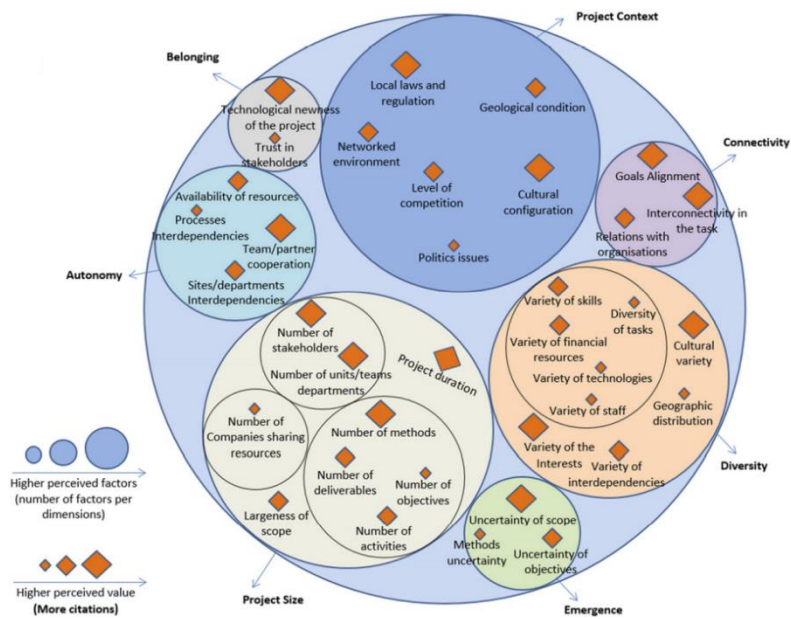
Figure 3: Project complexity factors according to number of citations (Bakhshi et al., 2016)

Figure 3 shows an overview of complexity factors made by Bakhshi et al. (2016) based on a literature review.

To have an overview on the factors contributing or affecting project complexity, the author has summarized the literature review findings in Table 2.

Differentiation	Baccarini (1996) Pich et al. (2002) Bakhshi et al. (2016) Bosch-Rekveldt et al. (2011) IPMA (2016) Remington (2011)
Interdependence	Baccarini (1996) Pich et al. (2002) Vidal and Marle (2008) Bakhshi et al. (2016) Geraldi et al. (2011) Bosch-Rekveldt et al. (2011) IPMA (2016) Remington (2011)
Non-linear relationship / anticipation and control challenges	San Cristóbal (2017) Remington (2011) Vidal and Marle (2008) Remington (2011) Baccarini (1996)
Uncertainty and risk	Williams (1999) Geraldi et al. (2011) Remington (2011) San Cristóbal (2017) IPMA (2016)

Variety and varying dramatically	Remington and Pollack (2007) Vidal and Marle (2008) Bakhshi et al. (2016) Geraldi et al. (2011) Bosch-Rekveldt et al. (2011) San Cristóbal (2017)
Change and ambiguity of: Specifications Goals Mangement Suppliers Environment	Geraldi et al. (2011) IPMA (2016) San Cristóbal (2017) Remington (2011)
Project size	Vidal and Marle (2008) Geraldi et al. (2011) Bosch-Rekveldt et al. (2011)
Contraints of : Environment Resource Objectives Location Time Finance	Dunović et al. (2014) Bosch-Rekveldt et al. (2011) Geraldi et al. (2011) Bosch-Rekveldt et al. (2011) Remington (2011) IPMA (2016)
Novelty of the project / access to information	Geraldi et al. (2011) Bosch-Rekveldt et al. (2011) IPMA (2016) Pich et al. (2002)
Stakeholders (Support and influence, Trust, Diversity)	Geraldi et al. (2011) IPMA (2016) Bosch-Rekveldt et al. (2011) Remington (2011) IPMA (2016)

Table 2: Summary of the factors contributing to complexity in projects

3.1.1 Complexity in construction projects

Construction projects are considered as one of the most complex projects (Baccarini, 1996, Vaz-Serra et al., 2021). They are one of the most dynamic, non-linear, risky and challenging businesses (Mills, 2001, Bertelsen, 2003). Complex infrastructure projects involve uncertain technical and social factors, distinctive investments and long supply chains (Marique, 2013).

As a result of literature review and questionnaire survey done by Wood and Ashton (2009) in construction projects, it has been shown that organizational complexity is scored the highest within the main factors contributing the project complexity. Poor channels of communication and poor generation and use of information were subcategories of organizational complexity, which were ranked the highest. Peñaloza et al. (2020) have linked complexity in construction projects to safety management. They have argued that complexity influences and is influenced by safety management. They have used TOE analysis and have shown that different aspects of complexity can have negative or positive

effects on safety management. Interestingly, "diversity of stakeholders' perspectives and skills" have contributed positively to safety management. On the other hand, safety performance measuring systems can produce information that can contribute to manage complexity by increasing the variety of controllers.

Bosch-Rekveldt et al. (2018) have also done comparative research to investigate how project complexity is conceived in different industry sectors in which one was construction and infrastructure. They have chosen TOE model to evaluate project complexity. Results have shown that organizational and environmental elements have contributed to complexity more than technical element in the sector. Results can be summarized in complexities related to interfaces, complexities related to planning and resourcing, and complexities related to content and stakeholders. Mikkelsen (2020) has also shown that complexity raised from element aspect (project consists of many varied interrelated elements) is considered more important than political or diversity issues in construction projects.

Bertelsen (2003) discusses that construction projects are highly fragmented due to the nature of subcontracting to individual enterprises. People working in the project, might have other projects in hand. On the other hand, the construction site is normally the place for workers, which belong to other firms that can affect their loyalty to the project. Furthermore, there are different groups of stakeholders involved in the project. They have different targets and objectives but should collaborate to complete the project successfully.

Xia and Chan (2012) have identified six complexity measures for construction projects. They have categorized them according to their weight, in the descending order, as: building function and structure, construction method, the urgency of the project schedule, project size/scale, geological condition and neighboring environment. While Cicmil and Marshall (2005) has looked at social interaction angle of complexity in construction projects and argue there is a need to facilitate the collective learning and shared understanding of long term benefits of collaborative work. They suggest three aspects of complexity in construction projects as: complex processes of communicative and power relating among project actors, ambiguity of project performance criteria over time, and the consequences of time flux (change, unpredictability, and the paradox of control).

He et al. (2015) have suggested a model for measuring the complexity of mega construction projects. The model evaluates organizational, cultural, environmental, information, and goal complexity as the basis of the project complexity. They also divide each element to subcategories and evaluate them, as well. Cultural and organizational complexity had the highest rank in their case study. Luo et al. (2017) have used the model and tried to correlate project complexity and project success in complex construction projects. They have showed that project complexity has a negative effect on project success. The results shows that information complexity and goal complexity have significant negative effects on project success. Vaz-Serra et al. (2021) argue that early assessment of complexity in construction projects contributes to better allocation of management resources. It can lead to a closer attention to particular aspects of design, or the adaptation of different management and control techniques that result in project benefits enhancement.

Chan et al. (2004) have divided factors contributing to construction projects' success into five major groups including project-related factors, project procedures, project management actions, human related factors, and external environment. They argue that projects need to consider all the factors to improve their success.

It should be mentioned that communication plays a vital role in management of complex projects. It includes communication within project team, between teams and across the firm or industry. It is shown that by increasing project complexity, the communication channels increase. While by increase in project complexity, the communication process is getting worse in infrastructure industry (Senescu et al., 2013). Complex projects should have continues learning as their strategy to be able to manage and utilize emergent knowledge in the project. They should have leading committee rather than a leader. They can develop more capacities through dynamic organizational learning during project life cycle (Ahern et al., 2015). Cooperation between the actors of the projects is essential for a better performance of the project network. It is significant to analyze the coordination and control of the complex project networks (Adami and Verschoore, 2018).

To have an overview on the factors contributing to complexity in construction projects, the author has summarized findings of literature in Table 3.

Technical factors (issues related to construction method, performance criteria and goals)	Marique (2013) Xia and Chan (2012) Cicmil and Marshall (2005) Bosch-Rekveldt et al. (2018) Luo et al. (2017)
Complexities related to interfaces (Long supply chain/highly fragmented/ coordination)	Bosch-Rekveldt et al. (2018) Marique (2013) Bertelsen (2003) Adami and Verschoore (2018) Xia and Chan (2012)
Organizational complexity	Wood and Ashton (2009) Bosch-Rekveldt et al. (2018) Mikkelsen (2020) He et al. (2015)
Cultural complexity and Communicational issues	Wood and Ashton (2009) Marique (2013) Cicmil and Marshall (2005) Bertelsen (2003) He et al. (2015) Senescu et al. (2013) Bosch-Rekveldt et al. (2018)
Information complexity (generation and use of information)	Wood and Ashton (2009) Cicmil and Marshall (2005) Luo et al. (2017) Ahern et al. (2015) Adami and Verschoore (2018)

Table 3: Summary of the factors contributing to complexity in construction projects

3.2 User involvement in projects

"Project Stakeholder Management includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution" (PMBOK, 2017). Project management teams need to have some soft skills in

addition to hard skills to be able to meet stakeholder expectations. Stakeholder identification, management and engagement are some of them (Atkin and Skitmore, 2008).

Majchrzak et al. (2005) have investigated the effect of collaborative learning on the results of informational system projects. They have collected data from 17 project groups, and by analyzing them, they have resulted that collaborative learning will improve client learning. Teams with more client learning have shown better design outcomes.

A dynamic perspective on programming of project means a continuous discussion and dialogue. Active participation and commitment from the project owner and users, becomes an important factor in project development (Arge, 2008). User participation is not a new phenomenon. It started in the 1960's as part of the increased focus on democracy in the workplace (Jensen, 2006). Users are a multifaceted group that industry actors find difficult to deal with (Eriksson et al., 2015). End users are considered as the people who will actually use the products, services or systems (Steen et al., 2007).

Kujala (2003) has argued the benefits and challenges of involving users. She discusses that user involvement has positive effects in projects. Designers can gather invaluable data from users. The data helps to understand customers' and users' need. It has also positive effects on project success and user satisfaction. In addition, active involvement results in a high degree of ownership, increased sense of participation and provides insights to design adjustment (Eriksson et al., 2015, Fischer et al., 2020). Moreover, designers might have difficulties in understanding users' need and empathize with them if they never have seen them. Direct contact can help them to understand the various context of use (Kujala, 2003). Users are experts of their own lives. Involving them in the design process can help to gain more detailed knowledge about their needs, wishes and requirements (Fischer et al., 2020).

However, user involvement has challenges, as well. Kujala (2003) has discussed some of them including: cost, , time spent on studies, difficulty in gaining direct access to users, overwhelming amount of data, difficulty in impacting design, communication and management of large amount of data, and users requesting changes. Eriksson et al. (2015) also mention that the risk and challenges of user involvement is higher, when the process does not have clear and well-defined strategy. They indicated an ill-conceived and ill-managed user involvement process could do more harm than good, producing largely irrelevant output, damaging trusts and legitimacy, and even ruining conditions for future collaboration. Bano and Zowghi (2015) call user involvement a "double-edged sword" and argue that user involvement contributes positively to success. However, if it is not managed carefully, it may cause problems more than benefits. Another challenge is that users are expert in their own fields, and they do not need to be experts on the project (Eriksson et al., 2015). In addition, users might not be able to communicate their requirements precisely, but they are able to explain their goals (Kujala, 2003).

Emergent knowledge is one of the characteristics of the complex projects. To gain all the knowledge in the project, good coordination is needed (Ahern et al., 2014). Baccarini (1996) also suggests that project complexity can be managed by integration. To achieve integration, coordination, communication, and control is needed. Communication problems and misunderstanding between users and the project team is the most prominent problem. The top challenge hindering effective involvement is users' lack of motivation and their attitude (Bano and Zowghi, 2015).

User involvement should be planned. The designers should be specific about how, when and where users should be involved. They should also be clear about which aim and benefit they have in mind (Fischer et al., 2020). Moreover, Eriksson et al. (2015) has also found that users are more satisfied when options are limited in some way. The complexity of the choices might be overwhelming to users. There is a risk at having too many options. It can ultimately lead to more stress than having a more limited number of alternatives.

Ives and Olson (1984) have suggested a descriptive model of user involvement in system development (Figure 4).
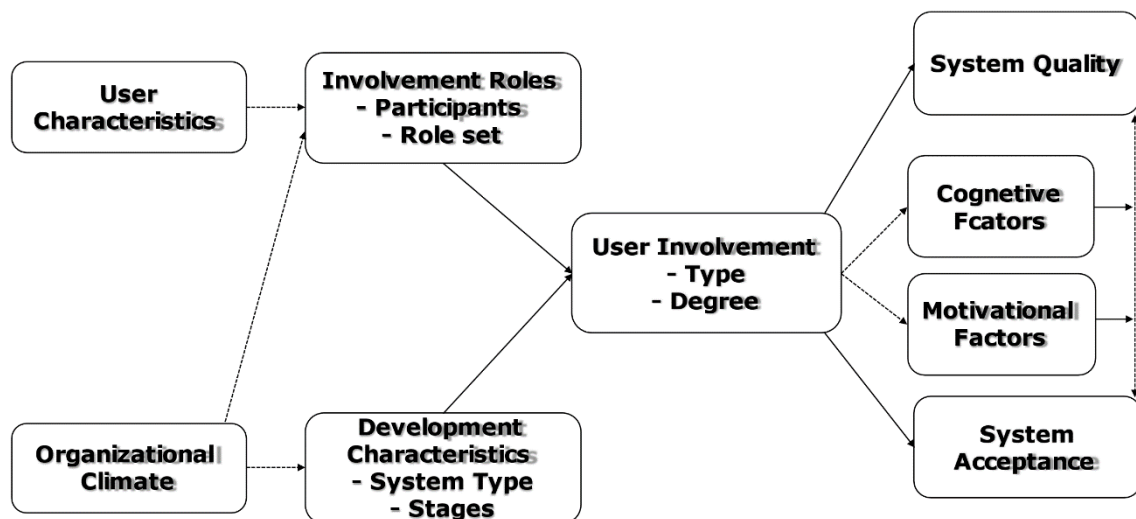
Figure 4: A descriptive model of user involvement (Ives and Olson, 1984)

They argue that two main sets of variables affect the appropriateness of user involvement. The first class is about who should participate and what their role should be, and the second class is about characteristics of the development process. They can be related to user characteristics and organizational climate. Regarding involvement role, they argue about who should be involved. "Primary users" who will use the output, "secondary users" who generate the input or run the system, or mangers? Regarding development condition, they discuss that the type of system is important. In some systems, user involvement can be inappropriate, while for others it is more beneficial, depending on the nature of the project. They also add that the stages of the development users should be involved, is important. It should be decided earlier in the project.

In addition, they discuss two topics regarding the facets of user involvement: type and degree. Regarding type of involvement, they mean the form of participation in which users can express their views and influence the process. They refer to Mumford (1979) and introduce three categories including consultative, representative and consensus. Regarding degree of involvement, they refer the amount of influence the user has over the final product. They categorize it into six levels: no involvement, symbolic involvement, involvement by advice, involvement by weak control, involvement by doing, and involvement by strong control.

They discuss that the outcome variables are system quality and system acceptance. They also introduce two types of variables, which act as intervening mechanisms between user involvement and outcomes: cognitive factors and motivational factors. Cognitive factor can lead to better system understanding, improved assessment of system needs, and improved

evaluation of system features. Motivational factors contribute to system acceptance, increase sense of ownership, decrease resilience to change, and increase commitment to the new system (Ives and Olson, 1984).

3.2.1 User Involvement in construction projects

Stakeholder management is a critical success factor in construction projects (Atkin and Skitmore, 2008). The process of stakeholder identification and engagement should begin as soon as the project charter has been approved, the project manager has been assigned and the team begins to form. To identify and engage all stakeholders in a proper way can lead to project success, and if the project team cannot be successful in it, it can end in failure in the project (PMBOK, 2017). The goal of user involvement is to increase the usability of the building and develop a suitable product that will function for its users (Kim et al., 2016).Due to the time pressure in most of the construction projects, there is no place for second try, and the project manager should act fast. Cooperation should be started from early days in the project and continue during its whole life (Bertelsen, 2003). Eriksson et al. (2015) has shown that user involvement is a continuous process, extending from project initiation to evaluating the finished project as a basis for future projects, in building industry.

It is common in construction industry to prepare a document called brief in the early phases of the project. It is often developed during discussions between the project, the client and probably users of the building. The document describes the mission of the organization, the vision of the building, the electrical and mechanical requirement, and relevant standards. It also includes the aesthetic and quality features and some detailed requirements for particular areas (Hunt, 2008).

With the increased focus on buildings being an important asset for the development of organizations and creation of attractive working environment for knowledge workers, the need to involve the users in the briefing process has increased. Briefing has changed from being a single process in a specific initial stage resulting in a final document with definite requirements to being a continuous and interactive process during the whole building project. During the process, the users' requirements and intentions for the different parts of the building process are presented and discussed with the design and construction team, and the design, construction and commissioning proposals are evaluated and optimized (Jensen, 2006).

Users have an expertise which is significant for the planning of the building's functionality (Lefdal, 2015). Jensen (2011) has found that the most important outcome of user involvement was that the end user felt ownership of the final result, and it led to buildings that suit the needs of users better. He argues that when the building project is part of the strategic change of an organization, involving users helps them to be prepared mentally for the move.

Hunt (2008) has indicated that involving staff in a university library building project has led to success in the project. One dedicated representative of the users was available during the whole project. All communication was done through the representative who was able to make decisions. She argues that factors contributed to the success of the project were: partnership principle and bringing the design and build team early on; structured workshops during the whole project including all parties; a detailed brief and generous allocation of staff time from the user. Støre-Valen (2021) has also done an empirical study on facility management and clinical employees' involvement in the design of eight

Norwegian hospital projects. She argues that involving them in the design phases is beneficial for the project. It will end in cost-effective technical solutions and reduce architectural design flaws. It is also shown that it has improved productivity and functionality by better choice of material and design of social functions. It will affect mutual respect between project actors, as well.

The client organisation has a crucial role in mediating between users on one side and design and construction team on the other side and in creating synchronized coordination and integration of the business processes and the building process (Jensen, 2006). Client organizations should pay more attention to communication to include information complexity. They should find more effective ways to communicate including using new communication technology, integrating work teams, adopting a project information management system, and providing a building information modelling (BIM) as a visual communication tool (Luo et al., 2017). Eriksson et al. (2015) found that in some cases, no communication is better than bad communication. They argue that if user knowledge and views are not going to be considered in any case, or have any real impact, it may be better not to engage users or pretend to be interested in their involvement. The role of facilitators is also so important in making a good communication. They should provide the right methods during the discussions in order to gain information and uncover and identify user values (Storvang and Clarke, 2014). Spiten et al. (2016) suggest establishing the building as a virtual model as a base for discussions. It allows taking enough time to explore end users' need and make changes up front. It will contribute to fewer changes being made after design and construction starts, and leading to avoid negative consequences for progress and cost.

Spiten et al. (2016) indicate that it is crucial for the implementation of user involvement that the user coordinator has previous experience of construction processes and design possibilities. Having a user coordinator with technical competence, will aid communication between parties in the process, and therefor possibly enhancing value throughout the lifetime of the building. It will contribute to achieve better communication and interaction between the actors and end users.

The most significant obstacle found in public construction projects is the length of the project. There might be some disconnections between project manager and end users due to the time. It is also possible that the end users change and hence their ideas. This issue emphasizes the constant and continues involvement of users (Spiten et al., 2016). Bosch-Rekveldt et al. (2018) have also shown that variety of external stakeholders' perspective, political influence and number of external stakeholders are among the highest mentioned elements, which contribute to project complexity in construction.

Generalizing user groups as a homogenous group like young people, elderly people... has been objected. There is a risk that if users been regarded as a homogenous group, their perceived needs will be oversimplified. The risk is mainly that those perceived needs will reflect assumptions or prejudices rather than actual user needs (Eriksson et al., 2015).

Kim et al. (2016) have developed a framework to categorize user involvement in AEC (Architecture, Engineering, & Construction) projects. The framework has two dimensions including: 1) the degree of user involvement and 2) the time span that is covered by the user involvement method. They have categorized different methods in their framework as per Figure 5.
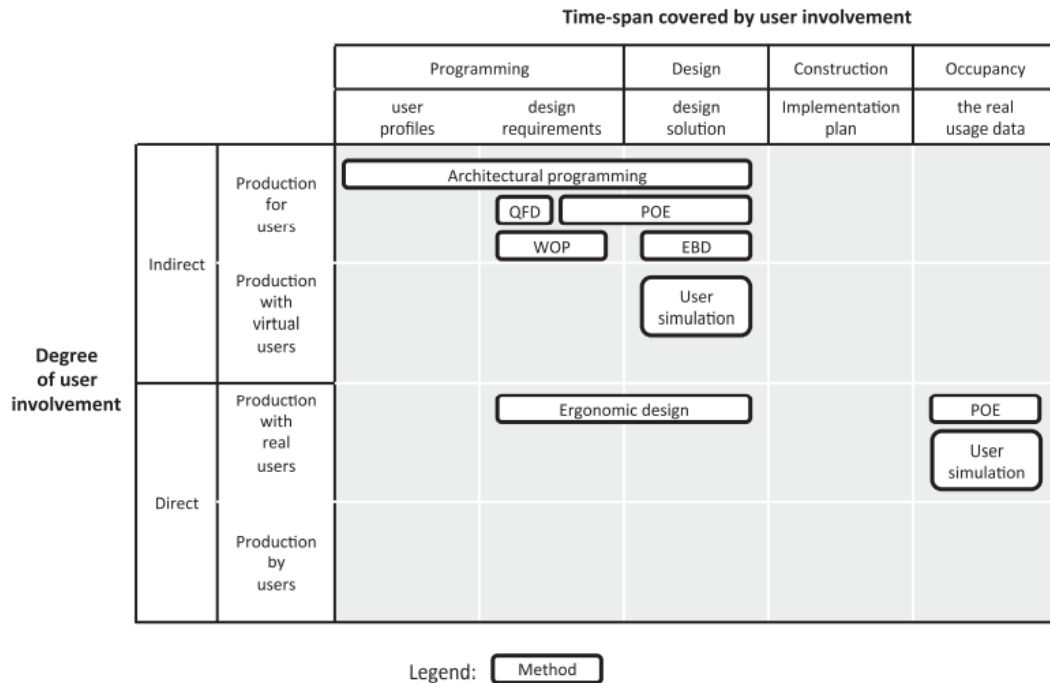
Figure 5: Mapping of seven user involvement methods onto the framework (Kim et al., 2016)

A brief description of each method is as below:

Architectural programming is a method of identifying the specific and functional needs and desires of users to achieve corporate objectives and perform tasks effectively and efficiently. It helps architectures to analyse users' needs and activity in detail and develop design requirement in a building (Pyburn, 2017). It uses various techniques such as observations, questionaries, hearings, and interviews (Pena and Parshall, 2012).

Quality function development (QFD) is a method of translating voice of customer into product or service features and deploying them through each step of development (Martins and Aspinwall, 2001). It cascades users' needs to downstream values such as the quality of the building and its concept (Kim et al., 2016) using the house of quality framework developed by Hauser (1993).

Post-occupancy evaluation (POE) is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some times (Preiser et al., 2015). It has mostly focus on the functionality of the building and client satisfaction. It acts as a feedback loop for continuous enhancement of improvement process. (Zimmerman and Martin, 2001).

Ergonomic design is a combination of top-down and bottom-up approach. Projects goals set by management, and then the complementary part is done by looking at processes and activities that will be performed in the new building. It will create the possibility to review a conceptual layout with process and tasks demands (Remijn, 2006). Users and ergonomic

consultants participate in the process and provide feedback to each other (Kim et al., 2016).

Evidence-based design (EBD) is done based on scientific research to make the best decisions of design. It is mostly used in health-care facilities. It is done based on the best available information form research and evaluations of projects (Sailer et al., 2008). It utilizes the evidence on users and their relationship with the building to make the design(Kim et al., 2016).

Workplace planning (WOP) is a method of evaluating the efficiency of the spaces and the fact that how much the space contributes to a better workday (Kim et al., 2016). It is a process where valuable requirements for workplace production are determined through evaluating the values of stakeholders against the organization's strategy (Pennanen et al., 2005).

User simulation is a method to predict users' behaviour in the building in different situations by means of virtual users and simulations. It evaluates the efficiency and effectiveness of the building (Kim et al., 2016).

Storvang and Clarke (2014) have suggested a socio-technical method for stakeholder involvement in construction projects. They investigate how to create a space to facilitate communication between professionals and stakeholders. They suggest workshops with the presence of stakeholders and interaction with them as the process. They categorize six central aspects that need to be addressed. 1) Who are the stakeholders? 2) what can the stakeholders do in the construction projects? 3) When to involve the stakeholders? 4) How to involve the stakeholders in the construction project? 5) How can a space be staged for the meeting of stakeholders? 6) What kind of information can be collected from the stakeholders? By having these aspects in mind, they introduce a framework for considerations when staging the process of a socio-technical space in a construction project (Table 4). They believe the method can overcome barriers and improve stakeholders' involvement. It will provide better insights into stakeholders' needs, values, and concerns.

Staging the workshop	
Stakeholders	Who to invite and why? Stakeholders, users, experts, lead users, professionals, others? Network and relationships? What briefing information do the participants need? Roles to be played? Who is the facilitator?
Social process	What will participants be doing? Exchanging knowledge and negotiations between participants? Mutual learning across professional skills? Push participants' opinions and development of tacit knowledge? Building and changing network? Random interaction, facilitated process, rules for communication and interaction? How will the workshop be broken down into activities that move through divergent and convergent thinking processes? What information will fuel the discussions? Size of groups, mixture of participants and individual work? How can the individual and the group be developed? What will the participants get out of the process?
Technical considerations	Context, time and place? How will the space be arranged and the furniture, walls, etc. be used? What type of workshop: dialogue, meeting, focus group, group session, study trip, conference, etc.? How should the activities be designed to facilitate knowledge capture? How will media be used during the workshop to capture activity? Which boundary objects should be applied? Technology available: computers, media, illustrations, drawings, photos, video, modelling material, prototypes, pen, paper, props, games, sales material, leaflets, brochures, posters, articles or other types boundary objects, artefacts, and things to think and work with, etc.? Will the participants have food, beverages, and snacks? How will the material, information and insights be developed?

Table 4: Considerations when staging the process of a socio-technical space in a construction project (Storvang and Clarke, 2014)

When planning public buildings in Norway, it is expected that users are involved in the process. This is grounded in legislation and agreements (Lefdal, 2015).User participation is of particular importance when a building project is part of an organisational change process (Jensen, 2006, Jensen, 2011). According to a research done on university buildings by Spiten et al. (2016), it has been indicated that value for end user is a building that creates optimal conditions for teaching, learning and research. To achieve adaptability in the building, which is needed to meet rapid changes in academia, end-user involvement in the pre-design phases, with a focus on excellent communication, an understanding of end-user value, and innovation is valuable and necessary (Spiten et al., 2016).

3.3 Early user involvement

Often the early stages are noted as important when discussing where efforts should be made (Lindahl and Ryd, 2007). It is worthwhile to involve end users in research and design early-on in a project and through a project (Steen et al., 2007). User involvement is considered to be most effective in the early stages such as requirements analysis and design (Bano and Zowghi, 2015). It is most efficient and influential in the early stages of product development. However, it might be time-consuming and the analysis of user needs can be challenging (Kujala, 2008).

The early user involvement can be a positive value for users. It can end in more user satisfaction and make the product fit with user needs. Changes made early cost much less than of what the same changes made late would cost. More efforts early in the project lead to much less efforts later and a better product at the end (Kujala, 2003).

Steen et al. (2007) describe six (dance) moves for user involvement: participatory design, ethnographic fieldwork, lead-user approach, contextual design, co-designing, and empathic design. They categorize each of the moves based on whose knowledge (of researcher/designer or of end users), and which kind of knowledge (about the present or the future) is privileged, and then suggest each of them for a specific category of project (Figure 6). For example, they suggest that if in a project, the goal is to imagine or envision a future practice or product, or to seek inspiration together with the end-user, then methods like co-designing or empathic design are appropriate. They also emphasize that it is common to mix these moves in one project or even modify a method specific for the project. Choosing the right method to involve end user can be considered as choosing the position on the dance floor, choosing dance partners, and then performing dance moves together (Steen et al., 2007).

Emphasis on 'is', on a current situation or on a problem

Participatory design   Ethnographic fieldwork

Emphasis on end-users' knowledge, and on their move towards research and design activities   Lead user approach   Contextual design   Emphasis on researchers' and designers' knowledge, and on their move towards end-users

Co-designing   Empathic design

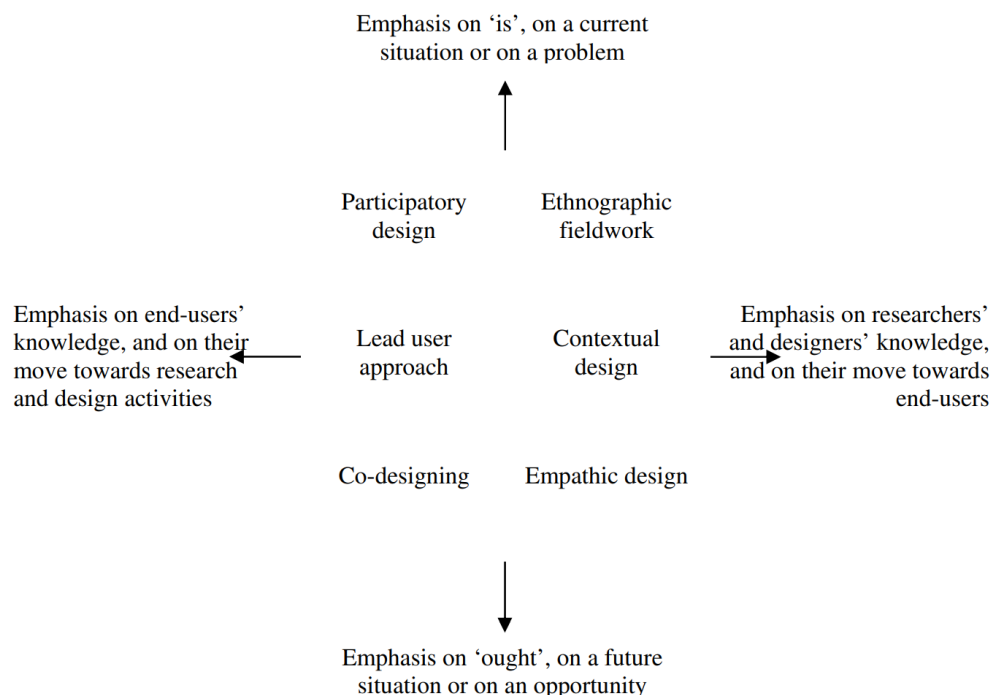Emphasis on 'ought', on a future situation or on an opportunity

Figure 6: Different human-centred design methods and practices (Steen et al., 2007)

Each of the methods are described briefly as below by Steen et al. (2007):

Participatory design is about providing people who will be using a system a voice in the process of design, evaluations, and implementation of a system which they will be using. In this type of design, users are treated as experts, and it is attempted to bring their knowledge and skills into the development process. End users' knowledge is privileged in this method.

Ethnographic fieldwork is about designers and researcher going into the field and observe users' daily work. It provides a better understanding, and its main focus is on social and cultural aspects of communication and cooperation. It is a challenge for designers and researcher to look at a situation through users' eyes. They gather knowledge about end users and their current practice. The gathered knowledge of designers and researchers in the field is privileged in this method.

Contextual design is created by adding a complementary process to ethnographic approach. The gathered data from field is clustered along different perspectives and then transformed to product requirements. The knowledge of designers and researchers is privileged in this method.

Lead-user approach is about involving an innovative end user who are the leading edge of an important market trend and are experiencing needs that will be experienced by many users later. They experience a need that cannot be fulfilled with current product and create innovative solutions. Their knowledge and skill is privileged in this method.

Empathic design as its name is about empathizing with users, their experience and emotions. Empathic design is about attempts to find inspiration in the end-users' practice and to fuel creativity by empathising with end-users. In this method, the knowledge of designer is privileged.

Co-designing or co-creation is about users and designers sit together and jointly create. Ideas are articulate jointly and sketches are made and evaluated jointly by means of mock-ups and prototypes. Knowledge of users and designers are brought together to make a desirable solution. In this approach end-users and designers are provided with all sorts of material via which they can express themselves (Steen et al., 2007).

Kujala (2008) has suggested field study as a method of early user involvement in product development. Field study means that users and their tasks and environments are studied in their actual context by means of qualitative methods. She explains that the aim in this method is not to cover large samples of users, but to understand the needs of users in depth. It will contribute to gather more accurate user requirements, and needs can be reported better. By being close to users, developers can understand users' values and attitudes better. Field study approach is useful even in short time frame and has relatively low costs. It will improve the usability and increase customer satisfaction. However, it has some challenges such as large amount of data and difficulty in managing them. It is also time consuming and there can be a communication problem between fieldworkers and designers. It is also mentioned that people are often preoccupied with the current work situation and its inherent and are not concerned to deliver appropriate design demands. Analysing user needs and discovering relevant issues from a product development point of view is challenging (Kujala, 2008).

Lallimo (2014) has studied user involvement in a school building design via co-design method by involving the staff and students. He defines co-design as a way of mutual

learning for users and designers and argues that they can create their own designs and ideas and discuss to reach for a shared solution. It has been shown that involvement has led to visibility of the hidden user needs. The involvement has done in the reciprocal mode by means of documents and drawings.

It has been agreed that involving users early in the planning process, as well as later on, adds value to the construction projects. It is done by providing additional information about expectations and requirements and strengthen long-term relationships between users and owners (Eriksson et al., 2015).

The author has summarized the benefits and challenges of user involvement based on findings from literature review in Table 5.

Benefits	Gain knowledge and information	Kujala (2003) Fischer et al. (2020) Eriksson et al. (2015) Ahern et al. (2014)
	Common understanding and better insights to stakeholders' needs	Kujala (2003) Spiten et al. (2016) Storvang and Clarke (2014) Lefdal (2015) Jensen (2006) Støre-Valen (2021) Lallimo (2014) Eriksson et al. (2015) Majchrzak et al. (2005)
	Increase functionality	Kim et al. (2016) Jensen (2006) Støre-Valen (2021) Jensen (2006) Spiten et al. (2016) Kujala (2003)
	Positive effects on project success	Kujala (2003) Bano and Zowghi (2015) Hunt (2008)
	User satisfaction / user preparation	Kujala (2003) Kujala (2008) Jensen (2006) Jensen (2011)
	Reduce design flaws	Støre-Valen (2021) Spiten et al. (2016) Kujala (2003)
	Sense of ownership in users	Eriksson et al. (2015) Ives and Olson (1984) Fischer et al. (2020) Jensen (2006) Hunt (2008)

Challenges	Cost and time consuming	Kujala (2003)
		Kujala (2008)
	Difficulty in getting access to users	Kujala (2003)
		Bano and Zowghi (2015)
	Huge amount of data	Kujala (2003)
		Eriksson et al. (2015)
		Kujala (2008)
	Communication issues	Kujala (2003)
		Bano and Zowghi (2015)
		Eriksson et al. (2015)

Table 5: Summary of the benefits and challenges of user involvement in projects

3.4 Communication in projects

An important issue in managing complex projects is communication. One of the interview objects in Remington (2011) have used a metaphor "like water to a plant" to emphasize the importance of the communication. It is argued that it is needed for a project to grow, and if it is not there or it is wrong, the project will die like a plant. Communication has been mentioned as a central to leadership, and it is argued that effective communication is not easy to achieve. Communication effectiveness will be driven by needs for accuracy, timeline, and appropriateness of information through the layers of leadership. A project director has declared that "communication within leadership layers is all important; if you get that, so much else follows". Communication should fit the complexity level of the project, and the way complexity is managed in the project will affect the communication methods. In such situations, communication is always multi-layered and top-down approach is common to manage it. It is done via two methods of formal and informal communication network. Informal networks include advice, trust, work communication and power and influence communication network. Knowledge sharing is a significant output of communication (Remington, 2011).

Communication means "to make common", and when communicating, a common understanding is created. Communication is defined by Barrett (2008), as "the transmission of meaning from one person to another or many people, whether verbally or non-verbally". Communication is the process of acquiring all relevant information, interpreting them and effectively distributing it to the persons who might need it (Zulch, 2014).

Communication consists of three components: a transmitter/sender, a transmission channel/medium and a receiver. The success of communication is dependent on the sender's ability to speak, write, reason and listen completely. Feedback has a fundamental role in communication. The receiver of the message should confirm the understanding of the message to be sure that the communication is effective. Communicators need to constantly monitor and review the success of their communication process (Zulch, 2014). On the other hand, Ziek and Anderson (2015) believe that the goal of communication is to send clear, unambiguous and complete information. They discuss that communication is more than message exchange, and it is a way that project managers generate the grounds for a project.

Communication in projects is not just about transferring information. It has significant impact on the success or failure of the project and should be considered as a part of the managerial mission of the project leaders and their team (Streich and Brennholt, 2015).

Besides the quality of the information achieved via communication, the quantity of the information should be considered. Excessive communication and information hinder the project progress due to enormous effort invested into communication. The project team should always evaluate the actual added value of any communication for the both sides (Streich and Brennholt, 2015). When working in cross-cultural projects, effective communication can help to manage expectations, misconceptions, and misgivings on project teams (Ochieng and Price, 2010).

Turner and Müller (2004) have found that best project performance is obtained when there is high levels of collaboration between client and project manager and medium levels of structure. Best results can be achieved when two parties collaborate, and the project manager is empowered. This will lead to a good, trusting, working relationship between them. However, appropriate communication is necessary to deal with the client's concern and make the relationship work.

Streich and Brennholt (2015) have defined three levels of communication that a successful project needs to consider. They argue that strategy, structure and culture, are the three levels that a project manager should define and implement in a project (Figure 7). The key is to establish the right strategy and message for communication by implementing communication structure or processes that are set considering project's constrains. They will end in defining the communication culture and practices in the project. According to Streich and Brennholt (2015), in a successful project and communication management, strategies, and goals are reviewed and project assignments and objects are specified. Then, structure, processes and procedures are defined, and at the end, aspects of culture and behaviors of project personnel are addressed and discussed.
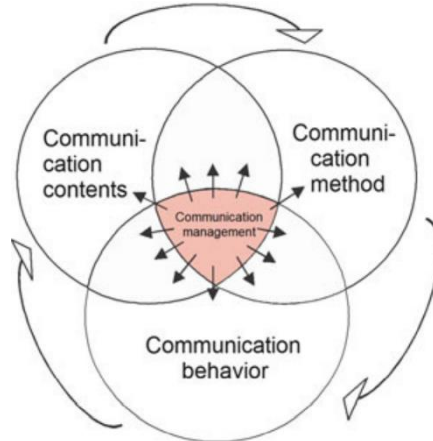
Figure 7: Systematic levels in communication management (Streich and Brennholt, 2015)

Zulch (2014) has discussed the effect and importance of communication on cornerstones of the project management, meaning cost, time, scope and quality. She has found that the project manager's communication skill has an impact on the cornerstone areas. Ziek and Anderson (2015) go further and consider communication as a means of creation. They argue that it shapes not only the scope of the project, but also its trajectory. They believe communication gives project managers another way of control. It provides them with another tool to design the predetermined goals, activities and resources of a project. They discuss that solutions or decisions can be constructed through the interaction of various stakeholders.

According to the surveys done by Carvalho (2008), existence of a "formal communication plan" facilitates the communication process. It is a formal document, which includes the overall plan for communication during the project lifetime. This is confirmed by 91% of respondents to the survey. Moreover, Muller and Turner (2002) have mentioned communication frequency, communication content, and communication media as three elements of communication in projects. They argue that relational norms, organizational structure, and project risk have impact on choices of each communication element. Zulch (2014) has also discussed that each project should have a communication plan, which address the following:

- Who (lines of communication – sender and receiver – responsibility and authority)
- What (scope of communication and format)
- When (schedule)
- Feedback (confirms message received and understood – document control)
- Filing (retrieval, storing, disaster recovery)
- How (email, document, telephone, meeting, presentation)

Turner and Müller (2004) have discussed that both formal and informal communication is necessary in the project and having their mixture leads to a better performance results. Formal communication is perceived as slow in speed and high in accuracy, while informal communication is high in speed and low in accuracy (Mullins, 2007). The focus of formal communication is more on the topic, while the focus of informal communication is rather on relationship than the topic (Mead and Andrews, 2009). Schneider et al. (2008) have also mentioned that even though many requirements and aspects are described in documents, many others are not. Informal communication including meetings, phone calls or emails assist in better information flow, and therefore more clear requirement description.

According to Turner and Müller (2004), best results are achieved in a project when there is a balance between formal and informal communication in addition to maintaining regular face-to-face meetings. Moreover, providing quantitative data to the client to analyze performance, can assist achieving the best results. This will lead to a mutually satisfying information exchange, which is fundamental in long-term business relationships.

Poor communication during projects affects the schedule, the cost, the safety of workers and the project quality. Improved communication by the project manager may lead to less failure, innovation and technical solutions, positively influencing the quality and leading to better decision making (Zulch, 2014).

Henderson (2004) has also mentioned encoding and decoding as two core competencies for a project manager. She has studied the effect of project manager's encoding and decoding capability on team members' satisfaction and productivity. She argues that the project managers' competency on decoding and encoding are associated with team members' satisfaction, while project managers' encoding is highly associated with team productivity.

In addition, Muller and Turner (2002) have distinguished between four communication modes. Personal project reviews, which are face-to-face meetings with deep discussions of all contents. Project analysis, which is mostly about information on quality metrics and project trends. Written status reports which include written information about current status and achievements, issues, changes, next steps and other items needing communication. Verbal updates, which are brief and timely verbal updates from the project manager on status and achievements, issues, changes and next steps.

Communication is linked at least to four emotions including trust, interest in the project, the perception of progress, and comfort and need for control. Communication can assist to build trust on the projects, while a failure in communication can lead to mistrust (Turner and Müller, 2004, Keys et al., 2017). According to study done by Ochieng and Price (2010), trust is fragile, intangible, and generally difficult to quantify. However, it is a primary factor in the success of teamwork. Good interpersonal skills and mutual respect can assist to cultivate trust. Its importance is more significant in multicultural project teams. In order to have integrity in such teams, all members need to trust and understand each other.

In the literature review done by Carvalho (2014), four primary barriers have been distinguished with regard to communication. Trust, priorities, semantics and mental model, and environment are the four main identified barriers. Trust is essential in every communication. It helps people to ask for help, speak openly and honestly, take risks, accept new challenges, and perform their activities with less anxiety and stress. Priorities differ from stakeholder to stakeholder, and each of them can have their specific objectives, which might be in conflict with others. Project team utilize their own semantics whereas management team use the semantics of management. It is important to reconcile these views and make a common language. Moreover, many barriers can arise from several sources, which include environmental factors.

In addition, the most important communication barriers found in the survey done by Carvalho (2008) have been the difference in language between system and business, difference in perception, and lack of project communication plan. It is good to mention that the study is done in IT area and by system and business; she means the professionals from the systems area and the professionals of the business area.

Efficient communication is subject to a multitude of barriers. Streich and Brennholt (2015) have mentioned some possible barriers as filter mechanisms, selective perception, information overload, and defense mechanisms.

Filter mechanisms are when the sender is manipulating a message, for instance to cover negative content by qualifying it. The more hierarchical level there is in an organization, the more filtering will take place in communication.

Selective perception happens when the recipients see, hear and read "selective" messages that correspond to their needs, motives, or expectations.

Information overload often happens in projects. The project will need substantial amount of information. However, people have limited ability to process it. The result will be to select, prioritize, or even ignore some parts of information to stay capable of action (Streich and Brennholt, 2015).

Defense mechanisms happen in reaction to external sources of stress, as well as to internal sources. It results in keeping unacceptable thoughts and feelings out of awareness by keeping them underground, and therefore the reality is not perceived as it is (Cramer, 2006).

3.4.1 Communication in construction projects

Multiculturalism is an increasingly prominent feature of the construction industry. It results in many managerial challenges including ensuring the effectiveness of the communication between various cultural groups (Loosemore and Lee, 2002, Loosemore and Muslmani, 1999). Due to several interfaces, complicated network and diversified team members of a

large construction projects, communication and coordination efficiency among team members is vital to the project's success. In addition, due to long period of the project, coordination between various members of the construction team is necessary for smooth project execution (Cheng et al., 2003).

According to surveys done by Zulch (2014), written communication has the highest importance in construction projects, following by, electronic, oral, visual and nonverbal communication in a descending order. On the other hand, electronic communication has the highest effectiveness, following by written, oral, visual and nonverbal communication in a descending order. She has found that the effective project communication by a project manager, as the leader of the project, will influence all other areas positively and will contribute to the effective management of the whole project. Martin et al. (2014) have also discussed that contracts and written communication can provide a framework for communication on construction projects. However, contracts will not provide the means for effective communication. This should be done by removing barriers with clear, concise and well-planned communications.

Zulch (2014) argues that the successful execution of a construction project is heavily dependent on the construction project manager's ability as communicator to lead the team and manage the project successfully. She proposes a communication foundation model, in which, communication is the function that integrates cost, scope and time. This can assist achieving a quality product and may be seen as having a "cornerstone function" (Figure 8).
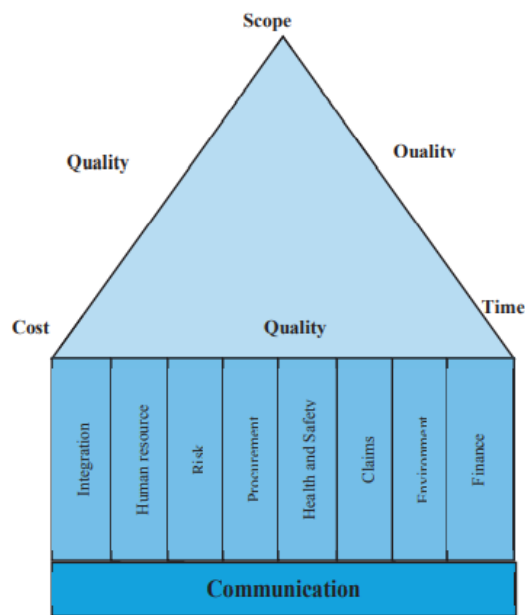
Figure 8: Communication foundation model (Zulch, 2014)

Moreover, Loosemore and Lee (2002) have studied the importance of language in communication in construction sites. They have argued that there is a language barrier between operational workers, who do not speak English fluently, and their managers. In such situations, it is common in construction sites to have some individuals who can speak both languages well, as "cultural gatekeepers". However, this issue can itself result in some problems, since people are not trained for it. It is mentioned that even with professional translators, it is estimated that 40% of the intended meaning can be lost. Use of cultural

gatekeepers can end in misunderstanding and misinterpretation. This can cause rework and might need close follow up of the site managers repeatedly. There can also be another issue with gatekeepers. In some occasions, the group that they are translating for does not approve them. This will cause some internal issues. For example, if a person who can speak both languages is younger than others with less experience, he/she will not be acceptable to the group.

It is argued by Loosemore and Lee (2002) that language barrier between managers and workers can cause some problems. It is meant that early warning of foreseeable problems would not be appeared, and operators would be more likely to ignore problems or solving them independently without consulting managers. It has been mentioned that some mangers consider lack of a common language as a significant source of frustration, which reduces their effectiveness. Senaratne and Ruwanpura (2016) have noted complexity, tensions, less availability of drawings, inexperienced site agents, poor writing, listening and recording, and lack of details as some of the barriers that hamper effective communication in construction projects.

Cultural differences can cause some communication problems during working in multicultural construction projects. Loosemore and Muslmani (1999) have studied the various parameters arising from cultural issues between western and Arabic countries around Persian Gulf region. They argue that verbal and non-verbal languages, technology and uncertainty, time, and values are some of the issues, which are treated differently in those cultures. They discuss that many communicational behaviours related to mentioned issues have various meanings for each party, and even in some cases, they have opposite meanings. They mention, silence or eye contact as an example. Avoiding eye contact is a sign of humility in Arabic culture, while it might seem impolite in western culture. They believe that the key to overcoming the problem of intercultural communication is to develop sensitivity to cultural diversity. They also suggest having a process of cultural negotiation in international construction projects. Participants from various cultural background should adapt certain aspects of their cultural behaviour to better fit with the other side during this process (Loosemore and Muslmani, 1999).

Furthermore, Ochieng and Price (2010) have conducted 20 interviews with senior project managers in construction projects with focus on cross-cultural communication challenges in multicultural project teams. The results have shown that effective communication within multicultural project environment can happen when the project manager shows an awareness of cultural variation. The interviewees have mentioned the main challenge in forming multicultural project teams is "the creation and development of cross cultural collectivism, trust, communication and empathy in leadership". Their study has revealed that the early establishment of clear lines of responsibility and clear robust procedures of resolving conflicts within the integrated team can assist to achieve effective communication. They have mentioned that communication has a significant role in the successful completion of heavy construction engineering projects. There needs to be a well inter-connected communication system in place between clients, project manager, and the project team to have an effective structure of multicultural teamwork.

Loosemore (1998) has studied the influence of communication structure on crisis management efficiency in construction projects. It is revealed that the communication structure that emerges in response to a crisis, affects reaction efficiency by determining the efficiency of information flow. The focus was on speed of information transfer and its distortion and reduction through filtering. Efficient information flow has significant effect

on reduction of uncertainty, which will result in reduction of misunderstanding, disagreement, frustration, tension and ultimately conflict. Efficient information flow is also important to the speed and suitability of response to a crisis. However, the issue is more complicated. The nature of transactional content, and interests and abilities of the involved people can affect the relation between communication structure and crisis management. It can have both positive and negative influences on efficiency (Loosemore, 1998).

Moreover, Martin et al. (2014) have investigated various types of construction project structure with focus on their centrality and its relation to communication difficulties. They have argued that the project structure utilized in projects, significantly affects the way individuals interact and communicate. They have shown that decentralized structures have a better structure for communication. Limited financial sources available in such structures forces implementation of proactive risk reduction measures, which will assist to improve project performance. Their results have revealed that smooth, clear and efficient communications can be achieved using the flattest organizational structure. The decentralized organizational structures have less communication resistance than those are centralized (Martin et al., 2014). Suitable project organizational structure will improve the efficiency of communication between various groups of project members. Therefor it is a key element for successful execution of a huge construction project (Cheng et al., 2003).

Cheng et al. (2003) have also tried to find a quantitative modeling for the evaluation of a project's communication efficiency under different organizational structure. Based on their model's results, the organizational structure with fewer layers or hierarchical levels is very close to the optimal organizational structure and the coordination efficiency among the team members can be enhanced. However, they have shown that the most optimal structure is not necessarily the flattest. The most suitable layer relationship should be derived from the mutual reliance relationship on the project network.

The summary of the finding in literature with regard to communication in projects is collected in Table 6.

Transmission of meaning / data / information	Barrett (2008) Barrett (2008) Zulch (2014) Ziek and Anderson (2015)
Effective communication	Ochieng and Price (2010) Streich and Brennholt (2015) Ziek and Anderson (2015) Loosemore and Lee (2002) Loosemore and Muslmani (1999) Loosemore (1998) Cheng et al. (2003)
Good communication plan	Streich and Brennholt (2015) Carvalho (2008) Muller and Turner (2002) Zulch (2014) Martin et al. (2014) Loosemore (1998) Cheng et al. (2003)

Impact on success	Streich and Brennholt (2015)
	Remington (2011)
	Turner and Müller (2004)
	Zulch (2014)
	Anderson (2015)
	Henderson (2004)
	Cheng et al. (2003)
Formal and informal communication in place	Turner and Müller (2004)
	Mullins (2007)
	Mead and Andrews (2009)
	Schneider et al. (2008)
Communication and trust	Turner and Müller (2004)
	Keys et al. (2017)
	Carvalho (2014)

Table 6: Summary of communication in projects

3.4.2 Communication in user involvement

Clear and open communication between users and project team is vital for project success. The goal of user involvement is to have an interactive communication and share information between two sides of the project (Limpornpugdee et al., 2009). The communication should be interactive, and not a sequential integration, where one-way communication is required (Amoako-Gyampah and White, 1997). User involvement is a communication process, which enables exchange of information between two sides of the project. It also assists the project team to be aware of user needs and potential solutions to problems (Gales and Mansour-Cole, 1995). Indeed, the role and importance of communication has been more emphasized recently, since the users are viewed as partners, and the importance of teamwork and collaboration has been emphasized more. Communication is considered as a dimension of user participation (Hartwick and Barki, 2001).

User involvement should be deliberately managed and not left to chance. Two-way communication needs telling the users that their input is valued and will be sought constantly (Amoako-Gyampah and White, 1997). Frequency of interaction, and the number of potential users interacted are two main points that should be considered in user involvement. Frequent interaction with users can lead to development of shared norms, values, languages, frames of references, and expectations. Such interaction can end in reciprocal communication, which is significant in reducing misunderstanding or disagreements in the project (Gales and Mansour-Cole, 1995). Communicating using the same terminology, translating client value into understandable design criteria, and creating a common understanding are important for successful end-user involvement (Spiten et al., 2016). Users have emphasized the significance of understanding the language used and the impact of their decisions (Keys et al., 2017).

According to Amoako-Gyampah and White (1997), adequate user involvement and satisfaction needs to include:

- An interactive process based on the project manager's visibility.
- Identification of the right of users.
- Providing timely feedback to users on their suggestions and inputs.
- Minimizing semantic barriers between developers and other project participants.

- Keeping people informed of project changes.
- Making sure that project participants trust each other.
- Ensuring effective communication.
- Providing for the clarification of roles and expectations.

Although, in many researches and cases, user involvement is resulted in more success in the projects, Gallivan and Keil (2003) have criticized this assumption. They have studied a case in which they have realized that regardless of high amount of user participation, the project resulted in fail. They have found out if user participation is not properly managed to ensure open and honest communication, then the solution made by the project may not fit users' needs and may be rejected or under-utilized. They have established a four-stage model and suggested projects to use it in order to be sure that the effective communication is in place. The four stages of process are:

- Users become conscious of messages to communicate to project team.
- Users transmit messages to project team through one or more communication channels.
- Project team receive and interpret messages from users.
- Project team set priorities and take action, based on their interpretation of messages.

The studied case by Gallivan and Keil (2003) was in the field of information system development. They have analyzed the case based on their model and realized that the most critical feedback that users needed to transmitted to developers, users' negative evaluation of the system and the reason they found the system not supporting them in their work, never reached the developer. Weak signals from users, in combination with substantial "noise" which was addressing the secondary problem, in addition to selective perception of developers led to failure of the projects. Therefore, the stages of the model was not performed properly resulting in lack of success.

Moreover, De Brabander and Thiers (1984) have shown that "semantic gap" and "asymmetry in secondary power" between users an project team can act as a barrier to have an effective communication. They have studied that such "sanctionary power" over users, would make users reluctant to use the developed solutions. It will end in a situation that users might agree to use the solution during the user participation process, while their future action would be different, and they would be less inclined to use. They also add that presence of an "active question elicitor" third party can help to remove this barrier. The third party can help the weaker power to ask for more arguments whenever the superior party is tending to make a proposition. Newman and Noble (1990) argue that user involvement should be a process of reciprocal and mutual learning. Both sides of the project including users and designers should discover and resolve their differences and learning should be a two-sided process. This learning process can be seen as a way of reducing the semantic gap. Learning is not just about cognitive information regarding task and designs, but it should encompass an organizational awareness of both sides which influences the choices of each side.

In addition, Newman and Noble (1990) discuss if good strategies have been embedded in the user involvement process, a learning process which is based on negotiation and mutual agreement will take place. During such process, designers can learn about users' requirements, and users instead will learn about the results of the project. This learning can reduce the resistance of users towards the new system, which is mostly due to fear and unfamiliarity.

While discussing communication between users and project team, both types of formal and informal communication should be considered. Kraut and Streeter (1995) have done a survey and concluded that the informal coordination and communication in the system development projects contributes to a better knowledge sharing and therefore more success in the projects. They have shown that projects with denser cross-boundary networks were better informed and coordinated. Personal networks are more beneficial in uncertain projects, since they contribute to a better information sharing. However, they have also emphasized on the importance of formal coordination. Due to the fading nature of informal communication in addition to its excessive transaction costs, each project needs to have a certain amount of formal communication. They argue that formal procedures are particularly beneficial for senior managers, since it gives them the power to control and gain feedback.

Limpornpugdee et al. (2009) argue that not only the communication skills of project team has effect of project success, but also communication competence of users has impact of the quality of shared information, and therefore project results. By communication competence, they refer to the definition made by Spitzberg and Cupach (2012), which is a combination of the knowing what to say and the knowing how to communicate, in combination with motivation to communicate. They discuss that if the users cannot communicate their knowledge with the project team thoroughly, important information for developing a successful solution may be missing. It can have effects on the final quality of the project. The more users share their knowledge with the project team, the more the project team is aware of their requirements, and consequently the better the results are. However, knowledge and information sharing cannot take place without some kind of communications between two sides of the project.

Moreover, Hartwick and Barki (1994) have emphasized on the impact of overall responsibility on user participation. They argue, "It is the meaningful participation that has the greatest effect on involvement, attitude and use". By meaningful participation, they refer to a type of involvement, which includes personal autonomy, control, making important decisions, and performing significant tasks.

Hunton and Beeler (1997) have studied the effect of users' voice during user participation process on their involvement, attitude and performance. They have concluded that users who had instrumental voice have the highest user involvement and attitude, compared to the users who had non-instrumental voice or no voice. They also had a better performance in comparison with the two other groups. They have also shown that users with non-instrumental voice had higher involvement and attitude compared to the one who had no voice, while there was no significant difference in their performance. As a result, users who had influence throughout the design process were more satisfied than the ones who were participated, but could not have influence.

The summary of the findings in this part can be found in Table 7.

Interactive communication / Be aware of needs	Limpornpugdee et al. (2009)
	Amoako-Gyampah and White (1997)
	Gallivan and Keil (2003)
	Newman and Noble (1990)
	Gales and Mansour-Cole (1995)
	Hartwick and Barki (2001)

Semantic gap	(Spiten et al., 2016)
	Keys et al. (2017)
	De Brabander and Thiers (1984)
	Newman and Noble (1990)
Proper plan / involvement	Amoako-Gyampah and White (1997)
	Gallivan and Keil (2003)
	Newman and Noble (1990)
	Kraut and Streeter (1995)
	Limpornpugdee et al. (2009)
	Spitzberg and Cupach (2012)
	Hartwick and Barki (1994)
	Hunton and Beeler (1997)

Table 7: Summary of communication and user involvement

3.4.3 Communication tools

Recognizing the effects of using a particular communication mechanism within a situational and cultural context is a communication skill (Mead, 1990). Maintaining open, regular and accurate channels of communication with all levels of project staff and stakeholders is vital to ensure the smooth flow of information between project stakeholders (Buehring, 2009). Proper selection of tools provides opportunities for effective exchange of valuable information among project stakeholders. It will result in clear presentation, and improve the chance of accuracy of decision-making. It can also enhance the creativity and innovation in the project (Manole and Grabara, 2016).

Mead (1990) has divided communication channels into three main categories and introduced several modes within each channel (Table 8).

Spoken	Written	Pictorial
One-to-one (face-to-face)	Letter	Slides
	Telex/cable	Film
Small-groups meetings	Memo	TV/Video
	Large-circulation publication	Overhead projection
Presentations		Photographs, graphs, charts, drawings
Film	Small-circulation report	
TV/Video		Media used in conjunction with written modes
Telephone (one-to-one, group link up)	Fax	
	Advertising	Quantitative data
Radio	Computer	
Video conferences	Quantitative data	
	Electronic mail	

Table 8: Various channels and modes of communication (Mead, 1990)

He argues that these modes can be used in combination. For example "a written report used as input to a large group meeting, in which the speaker illustrates his points with slides, and takes questions on a one-to-one basis from members of the audience". Both cultural and non-cultural factors should be considered while selecting a proper mode. Cultural factors are related to values associated with the production and effect of the message. Non-cultural factors include:

- Number of receivers,

- Needs of receivers,
- Relationship with receiver,
- Complexity of the message function,
- Importance of the message and need for impact,
- Complexity of the language used,
- Functions of the message (to persuade, buy/sell, etc),
- Quality of the message,
- Distance, geographical location,
- Need for speed/urgency,
- Need for accuracy,
- Need for legal protection,
- Need for receiver feedback,
- Availability of the communication technology,
- Cost,
- Precedent (Mead, 1990).

In addition, Samáková et al. (2017) has discussed that a communication channel includes 4 main elements. Communication method, communication tool, communication frequency and support of communication. They have categorized each element according to Table 9.

Synchronous and asynchronous communication methods	Communication tools	Support of project communication

Synchronous – straight
 - Meeting
 - Personal interview
 - Phone call
 - Workshop
 - Conference
 - Social activities
 Synchronous – virtual
 - E-conference
   teleconferencing
   videoconferencing
   tele-videoconferencing
 - Internet forum
 Asynchronous
 - Newsletter
 - Project documents
 - Letter
 - Board
 - Website
	- Email
	 - Telephone
	 - Presentation
	 - Video call
	 - Fax
	 - Paper
	 - Unified communication
	 - Chat
	 - Internal chat
	 - Social network
	 - Video recording
		- Microsoft Outlook
		 - Microsoft Net Meeting
		 - Calendar from company Google
		 - Microsoft Office Communicator

Table 9: Categorizing methods, tools and support of communication (Samáková et al., 2017)

According to their survey, meeting and personal interview prevailed as the most important method, and email, phone call and presentation were the most widely used tools during projects.

Even though non-verbal communication might not look like a tool, but it can affect the communication. It can become a barrier or remove barriers to effective communication. Researchers have discussed the importance of non-verbal communication, and have

mentioned if there is any conflict between verbal and non-verbal communication, people tend to rely on non-verbal clues as a means to interpret the true meaning of a communication. Non-verbal communication includes aesthetic communication that occurs through creative expression, physical communication such as a smile or frown, etc., signs that are more mechanical kind like signal flags or lights, etc., and symbols of communication which are used to build self-esteem such as clothing, jewelry, etc. (Phutela, 2015). Günhan et al. (2012) have also emphasized the importance of non-verbal communication in construction projects. They have argued that due to the highly diverse population in the industry, face-to-face communication is necessary to overcome the challenges arisen from diverse backgrounds. Face-to-face communication allows practicing non-verbal communication.

Moreover, Alreshidi et al. (2018) have demonstrated that emails are the most common communication tool, followed by face-to-face meetings in construction projects in UK. According to their study, next popular tool is phone calls, while teleconferencing and online meeting tools have lower rank compared to the earlier technologies and tools (Alreshidi et al., 2018). Many companies are also using social media recently as a communication tool especially for advertisement (Biradar and Girisha, 2013).

Ahmed et al. (2021) have done a survey to analyze communication modes used for information sharing in construction projects in Pakistan. Results have revealed that emails, drawings (CAD), phone calls, WhatsApp and site meetings were the most common tools utilized in the projects. However, written documentation and report, stakeholder meetings, drawings (CAD), site meetings and phone calls have been the most effective communication tools. El-Saboni et al. (2009) have also emphasized on the effect of electronic communication systems on construction project success. They have studied two cases, and it is revealed that implementing electronic communication management systems has led to an organizational transform trend, from functional, towards matrix and project structure. Aforementioned transformation has enhanced the chances of project success. Benefits gained from utilizing electronic communication management system was positive effects on schedule, transparency and availability of information whenever needed. It was also resulted in better monitoring, control and documentations for project managers.

Thissen et al. (2007) have suggested allowing teams to choose their own communication tools from a variety of options. They also add that it should be insisted on frequent communication among all members, including some synchronous interactions like telephone, chat, web-conferencing, etc. It is also mentioned that shared file storage can facilitate team interaction. Moreover, they discuss that communication tools do not have steep learning curve and employees can adapt quickly, especially if they have had the option to choose. Moreover, Kapogiannis and Sherratt (2018) have shown the use of integrated collaborative technologies can improve the collaborative culture throughout a project. It is due to access to information by stakeholder from anywhere at any time. This will result in common understanding about the project, which can enhance team collaboration. It can also assist to develop trust among stakeholders and improves control of all stages.

3.4.4 Communication via visualization techniques

Several tools have developed to help project stakeholders visualize and communicate information. Traditional methods focused on 2D drawings, while the advancement in information technology has shifted them more towards 3D and modeling including building

information modeling (BIM) (Tayeh and Issa, 2020). Complex projects such as the design of urban environments involve many stakeholder groups. In order to have a collaborative building design, a shared understanding is required between all of the involved parties. 3D visualization models can facilitate reaching to a shared knowledge in such complex projects (Bouchlaghem et al., 2005).

Park et al. (2016) has developed an illustration called "cone of experience" (Figure 9). The illustration is adapted from Dale's cone of experience (Dale, 1969) and correlates the level of remembrance with level of involvement. It shows that while one doing or practicing in a real experience, the highest level of learning and remembering can happen, compared to the abstract methods like reading or listening which has the lowest efficiency. Concrete experience can contributes to higher understating and learning (Park et al., 2016). 3D models and more advanced visualization methods can assist the users to place on the lower part of the cone and so on understanding better. However, due to high costs and unavailability of these methods on every situation, a combination of methods should be used.
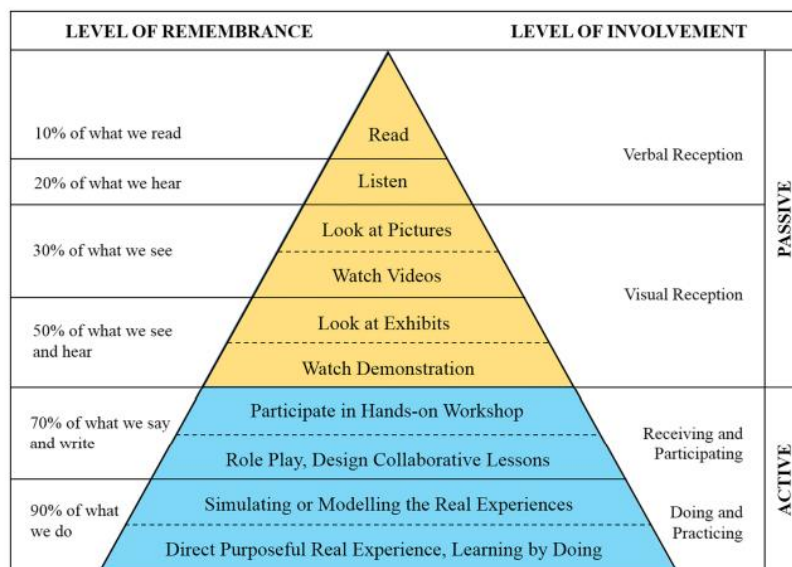
Figure 9: Cone of experience (Park et al., 2016)

Keys et al. (2017) has emphasized on use of mock-ups in construction projects. They argue that mock-ups are a critical communication tools that allows users to understand the space better. Architects has discussed the benefits of a full-size mock-up in the project. One has mentioned, "Actually standing in the space offers much more value than looking at a drawing or a simulation." Construction and project managers noted the benefits of even simple mock-ups to help users understand how equipment would fit into the space, while designing for example a clinical room.

BIM is a modeling technology, which allows for more detailed and realistic 3D virtual environments embedded with properties of different building systems (Tayeh and Issa, 2020). BIM contributes to stakeholders' collaboration at different stages of the building lifecycle. It gives the opportunity to insert, extract, update, or modify information during the process. It can be considered as a new way of managing information flow during the lifecycle of the construction project (Motamedi and Hammad, 2009).

There has been some discussions about how important learning BIM is in the future. Companies expect their employees, even the fresh graduated ones, to have the knowledge

of BIM. This emphasized the significance of integrating BIM into construction management education. Studies have shown that students also desire to learn the tool and utilize it in their future career (Clevenger et al., 2010).

Moreover, Sulankivi et al. (2010) have suggested the use of BIM technology as a starting point for safety planning and management. They argue that the use of 4d-BIM technology can result in improved occupational safety by connecting the safety issues more closely to the construction planning. It will then provide more illustrative site layouts and safety plans, in addition to providing methods for managing and visualization up-to-date plans and site status information. It will also support safety communication in various situations. They also discuss such BIM technology can assist in education and training, analysis and anticipation of unsafe condition, monitoring of condition, and communication and collaboration.

However, adapting BIM to the construction industry has faced some barriers, as well. Alreshidi et al. (2018) have categorized them into socio-organizational, legal, financial, and technical aspects. Socio-organizational barriers include among others, team resistance to change, generational gap in BIM skills and understanding between junior and senior employees, and barriers to collaboration e.g. trust within a team. Legal barriers concerned among other with lack of defined liability for wrong or incomplete information input, lack of intellectual properties right for electronic information, and lack of clear regulations. Financial barriers includes among others, training costs, and cost of initial software setup. Technical barriers include among others, lack of technical training, lack of compatibility between various standards-based products across the lifecycle and supply chain, and lack of compatibility in software and data integration between stakeholders during the lifecycle.

Moreover, Oraee et al. (2019) have done a systematic literature review on collaboration barriers in BIM-based construction network. They have categorized barriers into 5 main groups. Process barriers, which consist of barriers related to tools, barriers arising from information and technology communication, and training. Context barriers, which are categorized based on three sub-factors including environmental, organizational and cultural barriers. Actor barriers, which are concerned with areas associated with members' knowledge, skills and abilities. Team barriers, which are related to challenges to collaboration in the form of the composition of BIM-based networks, relationship among the members in the network, and knowledge sharing inter- and intra-network. At the end, task barriers which are concerned with demand and structure. The summary of their findings is illustrated in Figure 10.
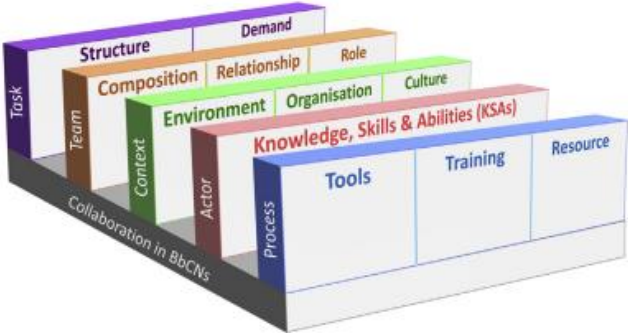

Figure 10: Summary of barriers in collaboration in BIM-based construction networks (Oraee et al., 2019)

Building information models can be visualized on flat screens, or recently using virtual reality (VR) and augmented reality (AR) technologies. These techniques are often associated by a head-mounted device that help the user to immerse in the virtual world. VR can assist the users to observe virtual site environment, while AR augments the users knowledge by overlaying virtual information on top of actual options (Tayeh and Issa, 2020). VR provides an opportunity for architects to visualize their design and have a much clearer understanding of both the qualitative and quantitative nature of the space they are designing (Bouchlaghem et al., 2005). On the other hand, visualization techniques can be considered as a communication tool between designers and clients. However, one should match the visualization techniques to the client understanding. Researches has discussed that the client is the most important category to benefit from the visualization process (Ormerod and Aouad, 1997).

Wang et al. (2018) have conducted a critical review on the use of VR in construction engineering education and training. They have found five major categories including desktop-based VR, immersive VR, 3D game-based VR, BIM-enabled VR, and AR. In desktop-based VR, a simple computer monitor is used as the platform for accommodating virtual activities. They display a 3D virtual model on a screen and relies on the users' spatial and perception abilities to evaluate the area. In immersive VR, some special hardware such as the head-mounted device and sensor gloves is used to withdraw users from the physical world and provide an immersive environment. User is surrounded with images, sounds and other virtual scenarios, which makes the virtual world more "real". 3D-game technology enhances user interaction through integrating visual, interactive, network, and multi-user operating technologies- It can assist to more collaboration and interaction among users and provides more close to real-life operations. BIM-enabled VR provides users an immersive visualization environment, which is based on BIM-model. In this media, users can analyze factors like cost and material type to develop effective building design in real life. AR uses sensory technology to provide a direct or indirect view of a physical environment with augmented virtual information. It can provide sound, video or graphics and enables users to interact with object. Users can modify scale, positions and other properties to make them fit the environment perfectly. AR allows for more interaction and active participation (Wang et al., 2018).

Bouchlaghem et al. (2005) have studied three cases in which VR has used in various steps of the construction project. The result have declared that using visualization in the conceptual design phase can assist the designers to work collaboratively and communicate ideas more effectively. In housing development, it can improve marketing with use of models to communicate with clients or for planning consultation with planners. It can also design team in developing new ideas. In the last case, they have found that visualization can assist to exchange of information for buildability problems and result in bridging the gap between designers and site teams.

Moreover, Getuli et al. (2020) has suggested the use of VR in training site personnel with regard to health and safety issues . They have argues that it can reduce site accidents as well as increase the site productivity. They provide a training protocol that can be implemented via smartphones. In this case, portability is improved compared to PC-based VR solutions. Li et al. (2018) have also done a critical review of VR/AR applications in construction safety. Their study shows that many VR/AR systems had been proved as efficient, usable, applicable and accurate approaches in hazard identification, safety training and education, and safety inspection and introduction. However, they have also revealed some challenges using VR/AR, including lack of information required for VR/AR,

lack of detailed investigation on the immediate reaction and response of workers when safety incidents happen, lack of multi-role for achieving a complete project-level human-computer interaction environment, lack of real-time safety work package to give more detail task-based safety information, etc.

Abbas et al. (2019) have studied effectiveness of communication immersive VR methods. They have compared traditional face-to-face discussions based on BIM models displayed on a monitor screen against immersive VR-based communication with BIM embedded in the immersive environment. The results have not shown any distinct difference in terms of discussion quality meaning level of effectiveness and satisfaction experienced, communication richness meaning detailed responses and vivid messages, and openness, which is about enjoyableness and open-mindedness. However, accuracy of the communication with regards to transformation of information correctly and understanding it properly, face-to-face communications had better results due to higher human-human interaction. Moreover, communication appropriateness, which is about behavioural acts and social norms, was worse in immersed VR. The reason can be related to missing non-verbal communication cues like facial expressions, body postures, and eye contact.

Another visualization technique that is new to the construction industry is holography. Tayeh and Issa (2020) have studied development of an interactive hologram to visualize construction projects. They argue that holograms can improve user's spatial understanding and problem-solving skills. In addition, multiple users can utilize it at the same time and interact with it by use of hand gestures and/or voice commands. Results have proven that holograms are user-friendly and easy to use, in addition to being an intuitive tool.

Digital twin has been used recently as a visualization method in many industries including construction. Digital twin is a replica of the real world, which provides a means of simulation, anticipation and optimizing the real systems and processes (Lu et al., 2020). Digital twin allows for data synchronization between real object and its virtual replica (Tchana et al., 2019). It can go beyond BIM and by use of internet of things provide a "up-to-current" modeling which allows for automatically updated as-built BIM. It can also be used to evaluate various scenarios to find out potential solutions against arisen issues. It also provides an effective monitoring and data analytic method and an accountable data communication in construction projects (Lee et al., 2021).

The summary of the visualization tools used in projects can be found in Table 7.

3D drawings and modeling including building information modeling (BIM)	Tayeh and Issa (2020) Bouchlaghem et al. (2005) Park et al. (2016) Motamedi and Hammad (2009) Clevenger et al. (2010) Sulankivi et al. (2010) Alreshidi et al. (2018)
Virtual reality (VR) / Augmented reality (AR)	Tayeh and Issa (2020) Bouchlaghem et al. (2005) Ormerod and Aouad (1997) Wang et al. (2018) Getuli et al. (2020) Li et al. (2018) Abbas et al. (2019)

Other methods (mock-ups, holograms, digital twins)	Keys et al. (2017)
	Tayeh and Issa (2020)
	Lu et al. (2020)
	Tchana et al. (2019)
	Lee et al. (2021)

Table 10: Summary of the visualization tools used in projects

4 Results, Analysis and Discussions

In this chapter, results are presented, and analyses have done on the finding from both literatures and interviews. Discussions are carried out with findings from empirical data and linked them to the theory presented in chapter 3. The chapter is divided into five parts discussing the main topics of *User involvement; its benefits and challenges*, *the process of user involvement*, *communication* as an important tool in user involvement, and *coordination* as a significant activity needed in both sides of the project to have an efficient and effective user involvement process. At the end, a summary as the *big picture* seen in the study is presented (Figure 15). The figure is presented here, as well to give an overview and show the roadmap to readers.
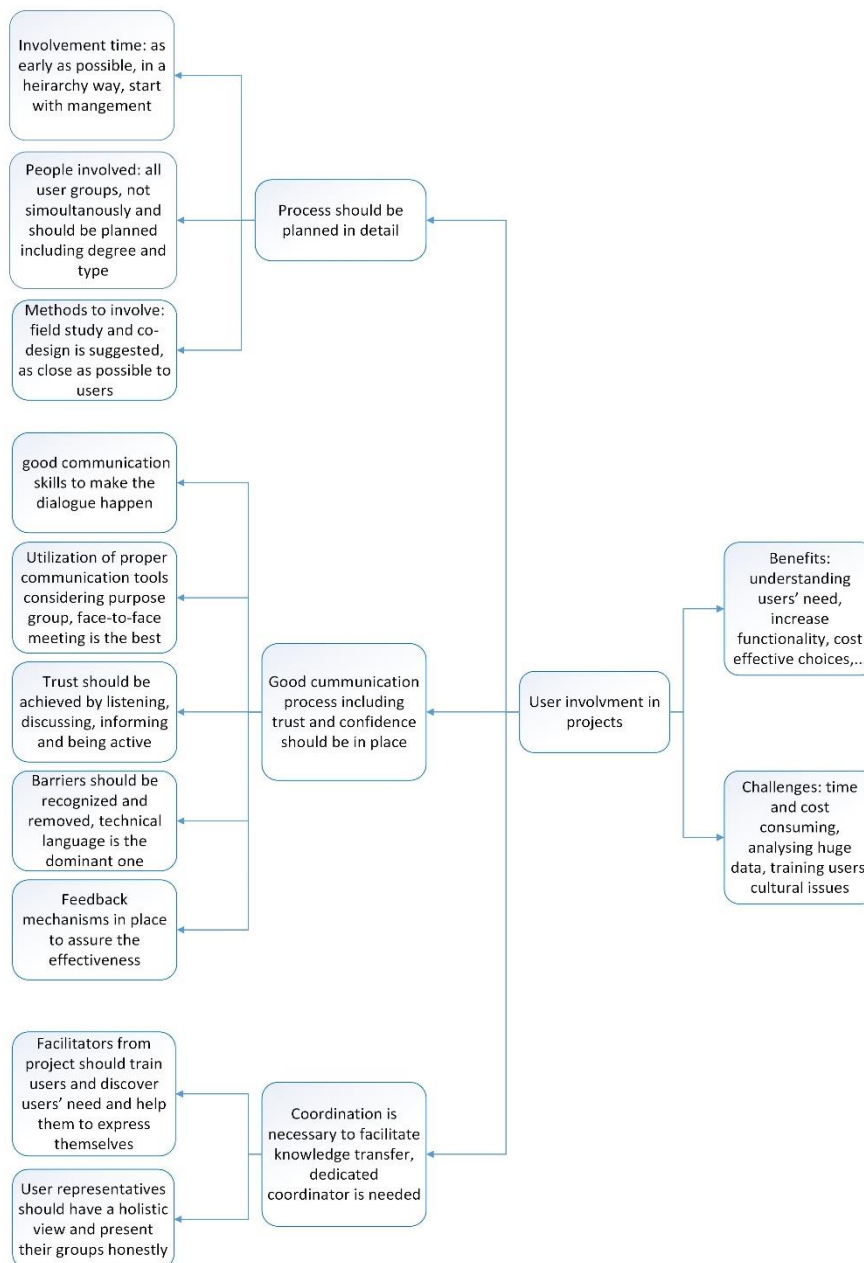
4.1 User involvement, benefits and challenges

User involvement has both benefits and challenges. The importance of user involvement has emphasized by PS1, and it is argued that it can lead to understand users' needs. No matter of the size of the projects, it is vital to know users and understand their requirements. PS2 has also admitted that there is no doubt that user involvement is vital to the project. It will contribute to understand the users and learn about their needs. SS1 from secondary interviews has also emphasized on the importance of understanding users' needs. It is considered as the hard part of the user involvement process and mentioned that it needs to be prioritized. PS4 has also added that a good collaboration with users in a way that everybody is agree with the building project until end, can act as a good basis for the project. Moreover, PA1 has stated that involving the users and listening to them will give a purpose to the project. The project team can understand what the important things that should be solved are, and what should be prioritized. They can also realize which things will have big consequences if one wants to take them away. The importance of understanding users and their needs has been argued in literature, as well. Kujala (2003) has mentioned it as one of the benefits of user involvement in the project. The importance of gained information from users and the way it can help to adjust design have been argued in several literatures (Kujala, 2003, Fischer et al., 2020, Eriksson et al., 2015, Ahern et al., 2014). Cicmil and Marshall (2005) have also mentioned the significance of collective learning and shared understanding of collaborative work.

Involving users in the construction projects will assist the project team to find the best solutions. According to the interview results, if the project does not understand users, they will make a wrong solution. For example, PS1 emphasized on the value of involvement of service personnel in material selection. It was mentioned that fail material selection has big consequences and can cost a lot. Another example was ergonomic challenges including logistics. It was explained that the construction project should make the best solution to go from point A to B. In some cases, users need the fastest and shortest way to out of the building, like emergency routes or routes in police stations or hospitals. To be able to make the best decision, the project team needs to know the users' daily work and their routines. PA1 has also agreed on the importance of user involvement on reducing maintenance cost. One can avoid consequential mistakes, which might result in a very costly building regarding maintenance, like warming up more areas than needed. It will help to have everything correct. Støre-Valen (2021) has also argued the benefits of user involvement regarding technical solutions and material choices in construction industry. She has also discussed that it will result in reducing design flaws and making cost-effective solutions. Jensen (2011) has also mentioned that the most important outcome of user involvement is the sense of ownership and building that suits the needs of users. PS4 has also declared that even though the user involvement process is time consuming, it will end in having more royal users.

User involvement has not just benefits regarding cost and correct building, but also makes good feelings in humans. PA1 has mentioned this and discussed user involvement can make the feeling of being listened, belonged and understood in the users. It can also prepare them for entering a new situation. Moreover, the involvement process will assist them to understand the project and provide realistic expectations. Hunton and Beeler (1997) have shown that users who had influenced the project were more satisfied than the ones who were participated, but could not influence. Jensen (2011) has also discussed that involving users in a construction project will prepare them for strategic changes that will happen with moving.

SS4 from secondary interviews looks at the topic from different angle. SS4 has mentioned that with the increasing demand on being sustainable and effective, there is no room to make dead spaces in the building. If there will be spent money, time, and space on a building, it should have a good functionality. Thinking about climate and environment, this issue becomes more and more important. PA1 has also added that the construction projects cost a lot of money. Both building and renovating costs a lot. Therefore, building fail has big consequences. It will result in hanging on to something that may not work. Kim et al. (2016) have also argued that the goal of user involvement is to increase the usability of the building and develop a sustainable product with high functionality. SS4 has also added that buildings should not be built for the sake of building. They should add value to the users. They need to be attractive, change users' routine, and be qualified. For example, there has been a university building that the students left the building at 4pm every day, while the construction organization was thinking how there could be some changes in order to make it more attractive for students, so they stay later in the building instead of going home, to a cafe or other places. SS4 has emphasized that these are issues that construction organization should think about them.

One of the challenges mentioned by PS1 was that people from user organization has often a fulltime job and cannot spend time on the project. While both sides of the project need to spend enough time together to be able to understand each other's perspective. Knowing each other will help them to come to a common solution in a specific problem. PN2 and PN4 from user groups have also mentioned the time limit, and the fact that they cannot spend so much time since they already have a fulltime job. Kujala (2003) has also discussed that difficulty in getting access to users, is one of the challenges in user involvement process. Dunović et al. (2014) have also mentioned the constraint in resources as an aspect of complexity. On the other hand, Hunt (2008) has shown that generous allocation of time from users has contributed to the success of the construction project.

Another challenge mentioned by PS1 and PS2, is the cost of user involvement for the user organization. They declared that user organization usually underestimate the required time for the involvement and think that the project will just have a little work, while it will demand many people from the organization, and key resources should be involved. It has expense for the organization, but if they put enough resources on that, they will achieve better results. PS1 also mentioned the cost of not being able to make decisions and stated that it will end in delays. Conflicts are also another source of cost. Regardless of its direct cost, it will make the working atmosphere unpleasant, and people who work in such situation might need a sick leave, which again will end in cost for the organization. Cost and time spent on user involvement have also mentioned as one of the challenges in literatures (Kujala, 2003, Kujala, 2008).

SS4 has also mentioned that users are usually too conservative. They hold on to what they have too much and cannot look ahead. It is the management job to tell them the story of "where we are going to be in the future". Otherwise, users will look at what they have today, and snice they are unsure about the future, they hold on to what they have. This issue is also admitted by PN1. According to SS4, there are always a few employees who are forward leaning, but their voice is rarely higher than the ones who oppose changes. SS4 has also added that the construction company have realized that those who are opponents and against are more heard or have raised their voice than those who are in favor. According to PA1, people might need to change the meaning of project success in near future. Success in a project should not be measured just by time and budget. Project

managers need to think of the lifelong of the building, as well. This requires to go deeper in the project to understand changes over time.

Moreover, SS4 has mentioned that the project should meet the users' need. There can be some situations that the construction organization finds a solution that thinks it is nice and flexible, and suits everyone. While it is not proper for the users. It can be assumed that the people in the project have not understood users, completely. For example, the idea of having flexible offices might be disturbing for a researcher who needs a full day concentration. It might not be a good idea for these users. The construction organization may not have had enough respect and insight into differentiating different users. There should be an ability to create something that suits the users within the framework of the project. The issue of landscape offices has been PN2's main motivation to involve in the process. PN2 from user groups belongs to those faculties who are supposed to move to the new campus. It is mentioned, "Being a historian and all this talks about open landscape offices is a bit provocative and threatening". It is also added, "My office has many functions. It is a place where I write, where I have meetings, where I teach, and it is also my laboratory because I need my books and sources to do research". PN2 pointed out to the bookshelves in the office, which were full of books. It is argued that going from something that works to something that may not work is a thread to their work condition. They will try to contribute to have the best possible working condition for the employees. They believe if they cannot make the proper condition, people will not come to work and will rather to stay home.

Furthermore, PN1 has mentioned the dilemma between concretizing and keeping the building flexible in the user involvement of a construction project. From the users' perspective, it is very important that the building is as flexible as possible. Because organization will change during the course of time takes to build it. So, their concern is that they have buildings which are essentially adopted for change from the beginning. So, for example, rule number one is not splitting offices with concrete walls, which cannot be changed when the organization has changed. When the building is finished, most likely the organization has changed several times. There may be more students or less students, and there may be more people who need offices or less. Maybe other different subjects, which are in the need, will change during the course of the process. So, they always try to pull towards plans that are as flexible as possible and be aware that there will be change. However, construction organization needs concrete solutions.

There is also one challenge that is specific to "campus project". There is decided by the government to cut the funding of the project (Adresseavisen, 2022), and it has happened in the middle of the process of writing this report. The reduction in funding has resulted some chaos an also ambiguities in the process. PN2 has mentioned that they do not know even the buildings will be built or not. However, they think that what they have done until now regarding to planning and programming can still be used in other context. According to information in their website, the user involvement process will not be affected (NTNU, 2022). Nevertheless, PN3 has mentioned the fund reduction has reduced the motivation. Moreover, it has caused some worries to the users, since decisions should be made very quickly and under time pressure. It is also mentioned that those worries have spread out among the people who are involved, as well. PN3 has stated that the project was already complicated, and the mentioned issue has added more complication.

Communication and challenges around it have also mentioned regularly in the interviews and literature as an important challenge in the involvement process. Since this is a big topic, the author has decided to explore it in a separate section (4.3.4).

User involvement is a necessary process in projects. Considering the importance of the infrastructure projects for the society, their functionality, sustainability, and compliance with users' need is significant. The way to achieve these goals is to communicate with users and understand them. However, there are some challenges in the process needs considerations and evaluation to gain the highest benefit of the process. The main issue is that the building should add value to the users and society. With high cost of construction projects and increasing demand on being sustainable, the project should be as effective as possible. This requires knowing users' needs properly and anticipate their future needs, as well.

4.1.1 User involvement in complex projects

Involving users in a complex project including an extended number of users, have some challenges. SS1 from secondary interviews has mentioned that people in the construction organization are sometimes afraid of involving more people in the project since they feel that they might lose control. However, it is more dangerous to involve less people than needed, compared to involving more and probability of losing control. It is clarified that if the involvement process happens within clear frameworks with proper tools, there is not any problem, and the project can meet the heterogeneity. However, by now it might be so demanding since the project is not completely equipped with the necessary tools. Difficulty in control has been mentioned in literature as an aspect of complexity (Vidal and Marle, 2008, Remington, 2011). On the other hand, it has been stated that traditional static methods of management may fail in complex environment. They are not capable of considering multiple feedback, non-linear relationship and dynamic environment of complex projects (San Cristóbal, 2017).

SS4 from secondary interviews has mentioned the importance of having framework in such big projects. And then within that framework, the construction organization and users will work on how to do things to succeed and reach the goals. It has been stated that it should be clear that who will take the decisions since it is not possible to have everyone in the decision-making process. There should be a goal hierarchy, as well. Things should be set against each other, and decisions should be made. Because in a project like "campus project", there is never enough money to do everything. So, there should be a hierarchy of goals and understanding the consequences of choices. People should be aware of what they are saying "yes" to and what saying "no" to. PS4 has also mentioned that users need to know the consequences of what they are saying.

One issue mentioned by SS4 in the secondary interviews was the problem of internal agreement in big projects. It is in a way that people in the user organization have not reached to an agreement about their next strategies. Uncertainty in the definition of goals is mentioned as an aspect of complexity (Turner and Cochrane, 1993, Geraldi et al., 2011). SS4 declared that it can affect the work of construction organization since they do not know what the strategies are, and how things will happen in the organization in the future. It is mentioned that UoH-sector (universitets- og høgskolesektoren) is perhaps the most challenging sector since there is a cultural issue in working with researchers. The culture of questioning things and discussion. These are also mentioned by PN2, who is from user groups at NTNU. PN2 has stated that they do not receive proper answers for their "whys"

and "hows". This makes it difficult to reach to an agreement. This is related to project context which is a driver of complexity (Vidal and Marle, 2008). Cultural complexity has been recognized as one of the highest ranked complexities in construction projects (He et al., 2015).

According to SS4, this might not be a big challenge in private sector since they can define the strategy and say that "this is our strategy" and "if someone is not agree, they can leave us". In public sector, this is not an option, and the construction organization relies on a consensus from users to be able to design the building. This looks like that the construction organization should assist the user organization to establish its strategies, while it is not their duty. It might look weird, but since the public construction organization tends to build an infrastructure, which will work for decades, it is necessary to understand the future strategy of the organization to make it useful for future users. They need to be able to think ahead when planning the buildings. It is like translating the strategic goals into behaviours, and then taking it from behaviours to physical solutions. It has been shown that information complexity and goal complexity have significant negative effects on project success (Luo et al., 2017).

Directional and temporal complexity, which are about ambiguous goals and uncertainty about future of the system, respectively, are the ones can be seen in the project. However, the organizational complexity, which is connected to the huge number of different interconnected tasks and activities, is also visible in the project. It should be added that the case project has some degrees of technical complexity, as well (Remington and Pollack, 2007). Socio-political complexity, which covers the support from stakeholders and fit with the organizational strategy (Geraldi et al., 2011) can also be detected in the case project.

Moreover, SS4 has stated that having a good dialogue with management is very important. It is essential to have the commitment of people who will make decisions. And the next level is middle management level. It is mentioned that it is the management team who communicates with the other part of the user team. The importance of management commitment has also emphasized by PS1 and PS2. It is also stated by PA1 that the role of leaders is so significant. They are the ones who create the atmosphere of the project. Remington (2011) has also emphasized on the role of leaders and the fact that the communication should go top-down in complex projects.

Furthermore, it is declared by SS4 that a mixture of top-down and bottom-up method should be used in involvement process. It is better to start with top-down to have the management in the project and create the overall framework, and then to work with bottom-up to come up with some alternatives. However, it can be done in a back-and-forth way, or better to say like a "wave", that goes up and done. It is in some way between details down in the bottom of the wave and deciding or big decisions up at the top of the wave. And then if the project is completely decided, it can be more bottom-up.

Recognizing the right level of the complexity early in the project can contribute to project success. It will assist the project team to define the required experience, select the right expertise, and have a better resource allocation (Remington, 2011, Baccarini, 1996). User involvement in complex projects has some other issues than normal projects. The varying nature of the project (Remington and Pollack, 2007) and differentiation (Baccarini, 1996) in the form of various groups of users, make it more challenging. The importance of having good frameworks and proper tools is mentioned both in literature and in interviews. Otherwise, the project might lose control or at least feel more problem than benefit from the process. Engaging management team of users from early days in the project has shown

to be vital. Since the complex projects have various aspects that should be considered, having people with holistic view is significant in the success of project. On the other hand, complex projects seem to have many idealistic desires to achieve in the project. However, no project can be successful in achieving all of them. It is primary to have a goal hierarchy to decide which goal to include in the project plan and which one to exclude for now. Considering various groups in complex projects, and hence different point of views, coming to an internal agreement seems to be challenging in complex projects. Having a questioning culture like the one mentioned in the universities, makes it even more demanding. This can be assumed to be more challenging in public sector than the private one. Involving both higher management and specialist in the complex projects have significance. It is the project team who should decide when to involve each group. The summary of the findings in part 4.1 can be found in Figure 11.
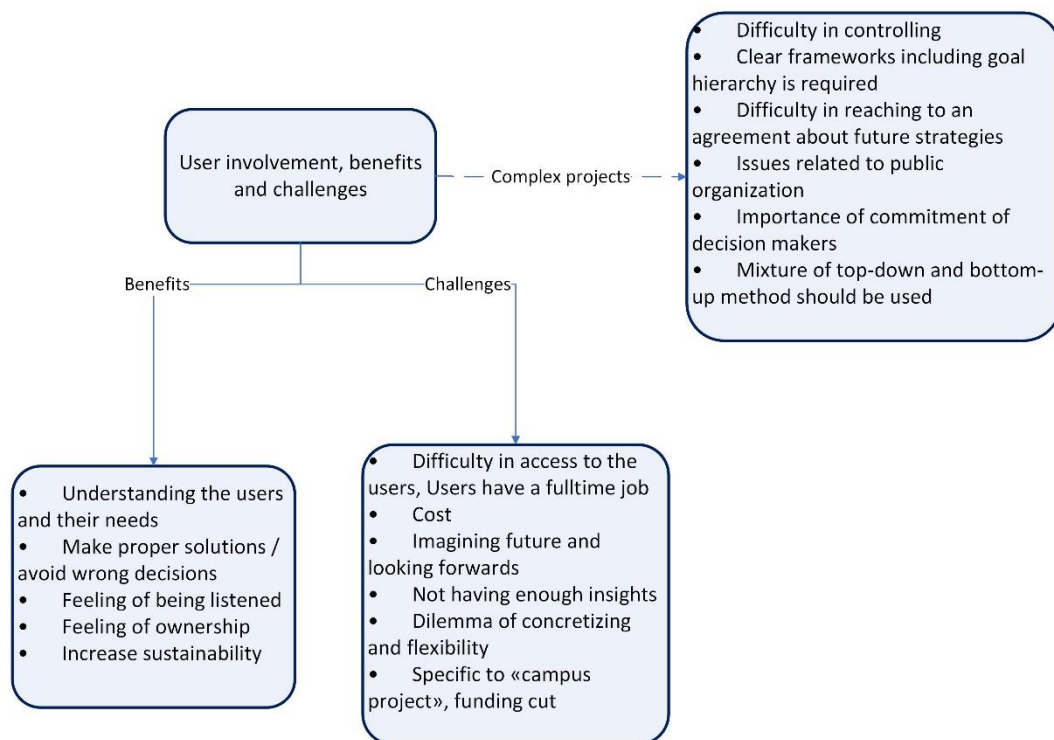
Figure 11: Summary of findings about user involvement, its benefits and challenges, with a glance at user involvement in complex projects

4.2 The process of involvement

It is argued by PS4 that since there are many groups involved in complex projects, there needs to have a common goal in the project. It can also assist people to understand the project. The goal should be an overall goal, which is about the bigger goal for the society, rather than an individual concern like whether one will get a better office. This should be communicated well, and the goal and frames of the project should be set in the beginning. Then individuals should put themselves in the bigger context. It is also discussed by Luo et al. (2017) that the goal complexity has significant negative effects on project success. PA1 has also mentioned that everyone should compromise in order to make the project successful. There can always be some in-between solutions that can cover to somehow the needs of different groups.

PS1 and PS2 have discussed that for better understanding the users and knowing their needs, it is suggested to go inside their organization and be familiar with their routines. It

will help the project team to know the work process in the organization and prioritize tasks according to their needs. They explained that it is important to spend time in different areas, which users spend time in, to see how they work, and learn their work process. It is important to know their needs to make a better design regarding both the building and its interior design.

They add that the construction team should be at users' workplace to see, to listen and to understand what is going on. They need to have insight and they can achieve it by going inside the organization. However, people should trust them and share information with them. PS2 has mentioned that they need to sneak gradually inside the organization to get the detail information. It was declared that it would be helpful if the project could have a place like a "bar" in the organization to sit and listen to people. It is so important to understand their culture. Meeting physically with users to make a relationship with them has emphasized in secondary interviews by SS1 and SS4, as well. Direct contact with users has been considered as a helping issue to designers. It will assist them to understand various context of use (Kujala, 2003). Mead and Andrews (2009) have also mentioned the importance of informal communication on making relationship in the project.

This is in alignment with the field-study suggestion by Kujala (2008). She argues that this type of user involvement will allow for deep understanding of users' needs and will give an accurate overview of users' requirements. She adds that field-studies improve the usability and contribute to customer satisfaction. In addition, Ives and Olson (1984) have suggested a user involvement model and discussed about who should be involved and if the involvement is beneficial or not. They also argue that the type and degree of involvement should be decided.

It looks like that understanding users should be done in a qualitative way, and the best method is to go inside their organization and look and listen to their daily tasks from project point of view. It is assumable that users have some needs and requirements, which they themselves are not even aware of them to be able to describe it for project team. While, by being close to them and having a curious glance at their tasks, project team can discover them and apply them to achieve more success.

4.2.1 When to involve

The time of involvement is another issue, which should be considered. PS1 has also emphasized on the time of involvement in the project. Users should be involved in the project from first days and the project team should assist them to mature during the project life. PS1 has also added that the involvement process should be done in a hierarchy way. The management group from user organization should be involved as soon as it is decided to start a project. The management commitment is needed from first days and through the whole project life. Then the involvement can go down to explore more generic issues and details. According to PS2 and PS1, strong involvement is necessary until the pre-project is completed. After that, there are less clarifications, and more details are needed.

PS1 has also added that involving users early will keep the company in the project and help to manage costs. It is possible to do rematch later, but it is more desired to have a common development process during the project life. PMBOK (2017) also emphasizes on early involvement of users in the project and mentions that a proper involvement process can lead to project success. Spiten et al. (2016) have also mentioned the importance of

common understanding between users and project team. They discuss that the involvement process should start early in the project and continue during the project.

The construction organization should have management's acceptance the whole time in the project, since it is the management who can see the entity of the project and can decide. It is also the management team who can help individuals if they have any issues. Management should act as a guide in the whole process.

In addition, SS4 from secondary interviews has emphasized on the timing of user involvement. It is mentioned that decisions should be made at the right time, which is a challenge in the construction industry. In order to have the users as a part of the team, they should have the necessary insights and the ability to make the qualified decisions at the right time. They need to assist users, so they start their maturing process earlier and become part of the team. It is declared that once the building process is started, it is like a train that starts to go. Users should be in the team when the train leaves. It is also added that involving the users in the planning phase, might lead to lose control and cause over-cost. PS3 has also mentioned that to achieve the prepared operation planning, the construction organization needs to involve users early in the project. Otherwise, they might face delay. Bertelsen (2003) has also discussed the time pressure in the construction projects and argued the importance of early start of cooperation.

Early involvement of users has been emphasized by both literature and interview objects. It can contribute to less cost of changes in the early stages. It can also give the users enough time to mature in the process and be ready to make decisions in the right time. However, the project team does not need to involve all the user groups from early days. It should be done in a hierarchy way. The first group requires to be involved is management team and then other groups can be included gradually in the project. Early involvement of management and having their commitment is important to help the project to decide about issues on time and avoid delays.

4.2.2 Who to involve

It is also important in the user involvement process, to decide who will be involved. PS2 stated that there are different groups of users in the project. For instance, in the campus project, there are lecturers, administrative people, maintenance and service people, students and other stakeholders. Each group has different needs and should be involved with different processes. Each group should be involved when the decisions need to be made, are relevant to their work area. PS1 has added that process of involvement should be planned all the time. The project team should recognize which group they need to involve at the time.

As mentioned in last parts, PS1 and PS2 believe in a hierarchical involvement. So, they argue strong user involvement is needed in the pre-project and the management should be involved from first days. It is significant to have the management involved, so the decisions can be made at the right time. It is also important to have people who can see the holistic picture of the project. This is aligned with PA1's opinion. It is mentioned that the best results have achieved when leaders have been involved and collaborated. They can provide a good atmosphere in addition to leading their employees' direction. They can also make some decisions internally, in case of any conflict in the group. Not every small decisions needs to be taken to the project, but some of the decisions can be made inside the organization.

PS1 and PS2 has continued that, by going further in the project, more detail is needed, and more specialists should be involved. For example, unions are not directly users of the project, but should be involved in some levels or work environment committees, who are responsible for health services in the user organization. They should be involved to help the project with ergonomic solutions from health point of view or cleaning and maintenance staff who will be responsible for changing filters and so on. The whole user groups should be considered. The involvement process should look at both the overall infrastructure and the details inside the building. It is also declared by PA1 that each group of people in the organization has different interests. So, it is important to have leaders in the process to take care of for example maintenance cost for the whole organization, and also individuals who are more interested in their own offices. SS1 from secondary interviews has also mentioned the importance of involvement of all user groups. According to Lefdal (2015), users have an expertise which is significant for the planning of the building's functionality. It is also shown that the diversity of the stakeholders can contribute to include different point of views in the project and even improve safety management (Peñaloza et al., 2020).

So, involvement of each group is important, but the time and degree of it should be decided in the project. Each group has valuable data that can contribute to project success. If the aim is to achieve more value, it should be considered in each level. People who have interest in each level should be involved and heard. However, it is the project team in collaboration with the user management who should decide about the degree and type of involvement of each group.

4.2.3 How to involve

Results from primary interviews (PS1, PS2, PS4, PN1, and PA1) show that the involvement process should be planned the whole time. The project team needs to have a plan to know when and who should be involved at any time. Eriksson et al. (2015) and Bano and Zowghi (2015) have also emphasized on the importance of good strategy and plan in the user involvement process. They argue that if the process is not managed correctly, it can cause more problems than benefit in the project. A wrong defined process can also harm the trust between project actors (Eriksson et al., 2015). If the communication process is not managed well, it will also weaken users' motivation (Bano and Zowghi, 2015). Fischer et al. (2020) emphasize that the designers should be specific about how, when and where users should be involved.

PN1 has referred to the developed framework by NTNU (NTNU, 2016), and described how they use the framework as a tool to plan the involvement process. The frameworks explains who should be involved in each stage of the project, and what questions need to be answered. PN1 has stated that for instance, leaders have a very great role in the beginning when defining the overall goals and knowledge. However, end-users are also reached-out, so the project can understand them as much as possible. In the framework, some methods are also suggested to be used in each stage. However, the most important part is the reasoning and "why" of each step. Zulch (2014) has also discussed that the project team should have a communication plan, which addresses the details of the process including who, what, when, and how.

Moreover, it is mentioned by SS1 in the secondary interviews that training of users can contribute to raise the knowledge of users. This can be done by means of lectures, courses, or workshops. PN1 has also mentioned that they try to train leaders of the user groups and provide them with good tools, so they can involve effectively in the process. PS4 has also

mentioned that in order to communicate goals of the project- and user- organization, they work together with people from NTNU to prepare users for the user involvement process. There is a kind of "onboarding" process of user groups. It is done via background objectives and overview to the professional decisions made by NTNU. This will create the frames of the project, and then one can carry out the process. Hunt (2008) and Storvang and Clarke (2014) have also shown the contribution of workshops including all parties to the project success.

SS1 has explained that various tools should be used to get a better insight of users' needs. Discovering the silent knowledge can contribute to create good solutions. Users are experts of their own lives and by involving them in the project, more detailed knowledge about their needs, wishes and requires can be discovered (Fischer et al., 2020). However, it seems that discovering this knowledge needs some effort from project team, as well. Communication tools is a broad topic, therefore the author has decided to discover it more in section 4.3.2.

Findings from literatures and interviews have shown the importance of not only the concept of user involvement, but also the way it is done. Empirical data shows that the involvement process should be planned, and it should be decided in the early phases. It can also be seen that the plan should be in detail. It should include when, who and how should be involved in the process, and what the goal of this specific involvement is. If the project has not a good plan for the whole process, the involvement of various people in the project will end in a chaos. The project team should always have the goal and purpose of the involvement in mind and plan for it. It is also important to consider involving all user groups to gain ideas and information from various users. However, the degree of involvement should be decided before the process. To achieve the best results out of involvement, the project team should train users and help them in explaining their needs and ideas. The whole aim of the involvement process is discovering knowledge. As it is mentioned, the management team of user organization should be involved strongly and during the whole life of the project, while the involvement of unions might be in some levels and to some degree. Summary of the findings in part 4.2 can be found in Figure 12.
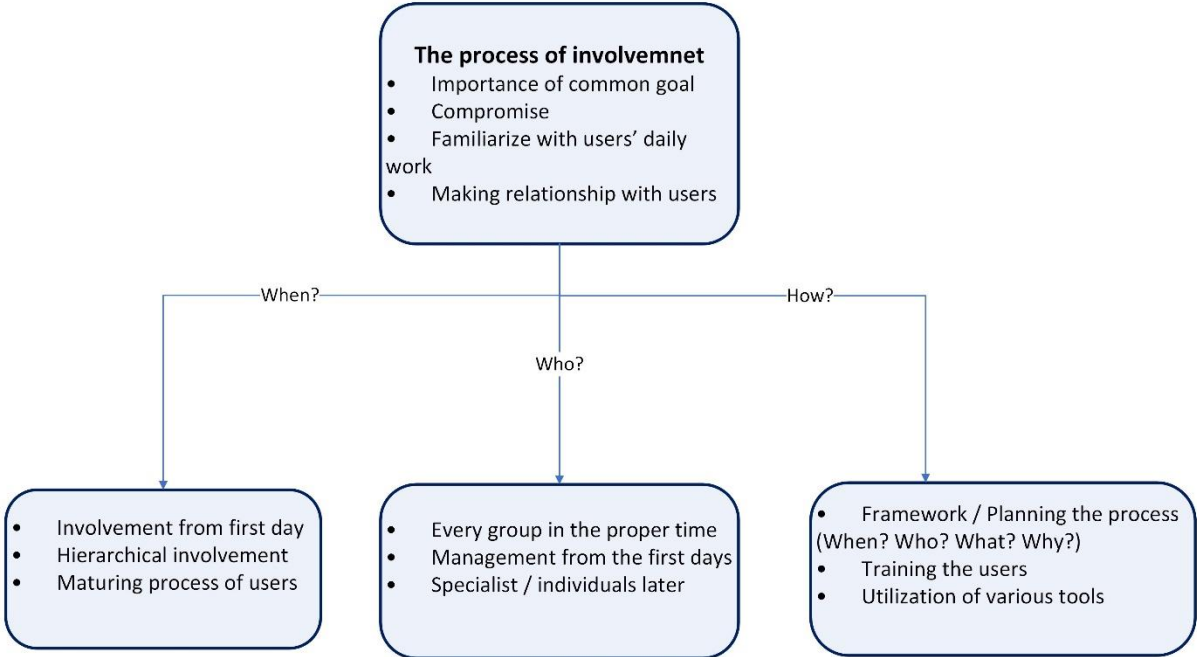
Figure 12: Summary of findings about the process of involvement

61

4.3 Communication

Communication is an important success factor in projects, especially in complex ones. It can be a big assistance to project actors to know each other and understand each other's perspective. It includes communication within project team, between teams, and across the firm or industry (Senescu et al., 2013). Remington (2011) has mentioned it as "water to a plant". Poor channels of communication, and poor generation and use of information have been ranked as the highest contributors of project complexity in construction industry (Wood and Ashton, 2009). Due to the importance of the topic in user involvement, the author has decided to look at communication in more detail.

PN1 has mentioned that communication should happen between project organization and users, which can be assumed as an extended project organization. In this context, communication is internally. However, there needs to be some levels of communication between the project and its external surrounding. PN3 has also mentioned that communication is both about the internal part, which is the way that they communicate inside their groups, and about how it is done between different groups, and also out to the organization broadly. Remington (2011) has also stated that communication is always multi-layer.

PN2 has declared that communication is about making other people understand what one is saying or trying to do. Communication is about meaning and understanding. PN3 has also added that the goal of communication is that everyone understands each other, and the tasks, terms, and frameworks are clear. It is also about understanding the project and knowing about everyone's role. PN4 has also added that communication is a way to reach out to others. Its goal in general is to convey the message and to provide transparency around what is going on in the project, and what will be done. So, it is important to communicate and convey what is the goal behind the whole project. Barrett (2008) has also mentioned that communication is the process of transmitting of meaning, and Zulch (2014) has described it as the process of acquiring, interpreting, and distributing the relevant information.

According to PN1, it is important to see the human mechanisms in change while doing projects like "campus project". Therefore, it is required to understand how to work with communication in these projects. Jensen (2011) has also mentioned that user involvement can assist the users to be prepared for the change.

During interview, PS1 mentioned that continuity is so important in big projects. There are many knowledge that one needs to handle, so having continuity in the key resources is so significant. Users and construction organization should work as a team and should gain each other's knowledge. It is mentioned that it is vulnerable if someone with knowledge sits across. It is vital to work with users as a team and spend time with them. It is also mentioned by Ahern et al. (2015) that dynamic organizational learning and continues learning can develop more capabilities in complex projects.

PS4 has argued that communication can take place with organizations outside of the project, as well. For example, for NTNU, it is so important to know what happens in other universities in Norway and in Scandinavia. They can be compared together and one might say, "they have done it like this". The whole idea is to be informed of what is going on and what different possible solutions are. If one sees many resemblances, then one can say they are in a same way. Then, it can be possible to go to that university, which will be very useful. Zulch (2014) argues that improved communication can lead to less failure, more

innovation, and better technical solutions. It can also improve the quality and end in better decision making.

Finding has shown that communication is an important success factor in projects, especially when the project is complex and may be considered as a change project. The project team and users should communicate with each other properly, in order to understand the overall goal of the project, in addition to gaining knowledge about each other. It is vital in complex projects, that each side knows the other side and their needs. Therefore, it is important that people see each other as a team. Not only the team members should communicate with each other, but also they should communicate with other teams. They also need to communicate with their surroundings that might not be part of the operation team in the project. Moreover, the project should be able to communicate with other resembling projects to find possible solutions. There can be some solutions that are used in the same context, and the project team can gain information by communication.

4.3.1 Communication skills

It is mentioned that project manager's communication skill has an impact on the cornerstone areas (Zulch, 2014). Moreover, Ziek and Anderson (2015) have discussed that communication not only shapes the scope of the project, but also its trajectory. It is also stated that not only the communication skills of project team affects the project success, but also users' communication competence have impact on the quality of shared information and therefore project success (Limpornpugdee et al., 2009).

PN1 has mentioned that they try to train leaders of the different user groups in the project. They supply them with good tools in the form of presentation material, so they can communicate. PN1 added they need to work a lot with translation of technical language to their people. Therefore, they work a lot on it. They also provide good information to the leaders and help them to find relevant stuff within the information, to be able to communicate well.

According to PS4, it is difficult to say that one needs special communication skills in the project. People can communicate in different ways. People have different personality and various professional ideas. But, the goal is to have good atmosphere and good chemistry to make the process more interesting. However, PN2 from user organization has declared that architects should have proper communication skills. They should be able to communicate to users what they are thinking to and how. They need to be able to translate it to a language that users can understand. They also need to frame the project; otherwise, the project cannot be done. PN2 has also added that users also need some levels of communication skills to be able to communicate their needs. If a user cannot do it well, he/she will be in a big trouble after the project is finished. PN2 has declared, "I need to understand what the architects are telling me, and I have to be able to visualize and understand. At the same time, I have to translate them to students and employees who have not spent as much time as me on this project. So I have to have several skills". Spitzberg and Cupach (2012) have also admitted the importance of users' communicating competence. PN2 has continued that it is the project team and architects who should relate to all the others. They have to be able to explain how they are thinking and why. Not the least, why they are arguing for those specific solutions. If they are not able to communicate the framing, the limitations, the possibilities, the opportunities, and everything, they are in trouble because then there is no trust. PN2 makes an example, "It is up to them. If you want to buy a new car, it is the car seller who had to tell you about this car and if he is not

able to tell you about this car, you are not going to buy the car?" Moreover, it is stated by Ochieng and Price (2010) that good interpersonal skills and mutual respect can help to build trust.

According to PN4, communication skills are very important in complex projects. Especially when there are some people, like students, who are not professional in the field and their input is required in the project. It is important that the ones who are professionals and experts in the topic can communicate well what will be done and explain it in a pedagogical method. It is very important to have communication skills in order to ensure good inputs. PN4 has stated, "Regarding my own communication skills, I represent students' opinions in this group, so I should be able to communicate well with others in the group what students need. Meanwhile, I have to communicate with student groups and ensure that I have good inputs from them regarding required areas and so on, as well."

PN4 also believes there are different levels of communication skills in the project. It is important for experts like architects to communicate well what they want to reach in the future and what they are actually aiming for. However, it is also important that leadership can communicate properly what they need in return, so it becomes a dialogue about what indeed one will reach in the future. In addition, it is important to communicate and convey towards everyone who is involved in the project, like neighborhood and society. There are various levels, which one needs to reach out. Remington (2011) has also emphasized on the importance of communication in leadership level.

PN3 has also added that since the relation is not symmetrical in the meetings, it is mostly about the project team's communication skills. They should be able to engage users and provide them with good information. PA1 has also declared, "Users are user". They do not need to have special communication skills. They just do this job for the sake of public. While the project team consists of professionals. It is clear that users should get permission to be themselves. Project team will not adjust them. Users will be allowed to be wrong, difficult, scold, frustrated and everything they want. They should be allowed to live their life. They can expect more, and it is the project team who should be professionals, «Now, I will make the whole world tidy».

As it is discussed communication is a significant success factor, and in order to make it as well as possible, people need communication skills. Everyone needs some levels of communication, however, some may need it more, and for some it might be a requirement. Project team must have proper and adequate communication skills to be able to inform others framings, limitations, goal of the project and not the least engage the users. It is the project team who should provide users good information and tools, to prepare them for giving good inputs. However, users need some levels of communication skills, as well. They need to be able to communicate with the project team, so dialogue happens. They also need to communicate with their groups and try to gain their inputs. It can be said that leaders of the groups may need more skills. Nevertheless, one should keep in mind that users are users, and it is their first and maybe last time to do the job. While the project team are professionals and it is their daily job.

4.3.2 Communication tools and methods

Communication tools can assist the project to ease the process of information sharing. Various tools and methods can be used in the project. PN4 has argued that it is important to utilize the available tools to reach out. For example, presentations, workshops, or technical digital tools can be helpful. Moreover, PN4 thinks it is important to consider the

purpose group. For example, if one wants to reach out students, it is better via good websites or social media, while reaching out to professors is easier via mail, Innsida or good articles.

PS4 has stated they use both written and oral communication in the projects, but the best results are achieved via face-to-face meetings. Kujala (2003) has also emphasized on the benefits of having direct contact with users. PS4 has explained that they communicate in many methods and use many sketches and drawings to discuss what they or users mean. It is also mentioned that PowerPoints and presentations are used a lot. In addition, they use text iterations and sketches. Even though sketched are very abstract, but they are very concrete. They often bring up discussion, which is the goal to understand each other. PS4 explained that they provide users some documents including text, numbers and diagrams, which may help them to visualize. They also draw sketch, which is a very non-binding tool. It does not look like a finished project, and it is a solid object, which is easy to use and discuss. These tools can help the users to understand the outcome of what they say. It is summarized by PS4 that the best option is physical meeting and discussions around a table, compared to digital meetings. However, it can also be sending and receiving text digitally afterwards. It is also mentioned in the literature that that the bests results can be achieved by use of a mixture of formal and informal methods of communication (Turner and Müller, 2004, Mullins, 2007, Schneider et al., 2008) .

NTNU has developed a program, which acts as a framework in the user involvement process of campus development (NTNU, 2016). According to PN1, this framework is used as a communication tool during the process. It says anything on an overall level, about which dilemmas and problems a building project or a change project will face in different phases. It is actually a lot about communication. They have divided the whole process into five basic phases including vision, define, design, build, and use. They use it as an overall framework, which talks about different stakeholder groups in each level should be involved, and what are their interests in the project, and also what the project means for them. In addition, it is mentioned what questions should be asked at each stage of the building process. For example, the first step is the overall goal and the vison for the whole thing. This phase has its own characteristics; however, many people will be wondering in this phase, "ok, what type of offices will I get?" And that is actually something that the project will not be able to answer before the building stage. They have used this as a communication tool during the process. So, when they are in the first phase, and people ask about what type of offices they will get, and how big they are, they use this as a tool to explain why they cannot answer that yet. But, what they can answer now and they use the framework to keep the discussions to what is possible to solve in different stages in the project.

PN1 has stated that since the campus project is complex, they focus of meetings and arenas for collaboration. This is their primary channel of communication, and they prefer to co-work. However, this will take a lot of resources, and they also need to reach out further with what happens in these meeting. So, they supplement it with information meetings. They prefer to provide and arena in which people work with dialogues and have a two-way communication. Because these things are so complex, so better to have a dialogue about it. It does not help just to inform. After these two levels, they have a third layer that is written communication. This includes digital channels, websites, social media, emails, and direct messaging. They have also an intranet that they update the information there. They use their website as a hub of information, and assist their users and leaders to find information there. Their goal is to have as much information as possible through

the website. So, they have three layers of communication, co-working meetings between people (physical or digital), information meetings, and outreaching via written media. This is in alignment with categorization of Muller and Turner (2002) regarding communication modes. They distinguish four phases including, personal project reviews that are discussion meetings, project analysis that is in line with information meetings, written status and verbal updates that both can cover the written communication.

PN3 has also declared that they have many meetings. Moreover, they have logistic meetings about how many meetings there will be. In addition to that, there are some public meetings, held by the leaders, that are open to public and everyone can attend. PN3 has added that they use mainly PowerPoints on those meetings. Users are also supposed to read some stuff and prepare themselves. PN4 has also declared that they use mostly PowerPoints and models. The importance of two-way and reciprocal communication is also emphasized in literature (Amoako-Gyampah and White, 1997, Gales and Mansour-Cole, 1995).

Different types of meetings can be utilized in user involvement process. According to PA1, there are three main types including information meeting, input meeting, and dialogue meeting. Information meetings are big meetings, where just the information is given and people can come up with questions. It is often in a way that one is in contact with big groups at once. In the input meetings, one listens, and discussion and dialogue meetings are facilitated more creatively. It is important to use all the three types in the process. Project team should have a good plan in advance, and informs it to the users. PA1 has mentioned that they try to give some information about different steps to the users, "Ok, now we are meeting and these are the things that we need to make decision about». «Then we come next autumn and discuss these things» and then « the year after, we will discuss furniture» and to somehow give them information about the process and some degree of predictability of what type of meeting they have joined. It is also mentioned in literature that having a good communication plan can facilitate the communication process (Carvalho, 2008, Zulch, 2014). Turner and Müller (2004) have discussed the best results are achieved when there is a balance of formal and informal communication, in addition to regular face-to-face meetings.

According to PN2, users are provided with documentations that they need to read through. However, because they have full time job and documents are enormous, they do not have enough time to go through all of them. PN2 has declared that there need to be a good visualization tool that users can be able to relate to them. Many of used tools are so abstract. They have been given many tasks in groups to say how they want to frame things, or what kind of functions they want to put in each space. PN3 has also mentioned that they use drawings and circles as a tool. For example, one circle is workplace, another circle is library and so on. They should discuss about which things should be close together, and which should be far. There is no building in the process, and everything is so abstract according to PN3's opinion. PN4 has also added that there is a lot of drawings on paper and models, and boxes and bubbles. It is not so much about the building itself, but more about how things will be placed relative to each other.

PN3 has mentioned that they have visited all the campuses and departments with all special rooms to have an idea of the actual rooms that they should write function description for. It is also mentioned by PA1 that inspection and visit is a very important tool. There is a method called "silent visit" that PA1 has found it very very good. In this method each user should plan to reflect alone. They take the users to a building that is

built and includes some of things that they are willing to get. They let them go and take notes for themselves, and they are not allowed to talk with each other. They have time at the end to reflect alone and then together, and it is a visualization tool. It can be used in the early phases of programming. It gives users a very good overview and helps them to learn about things that are talked about. So, the best way is to show them what they will get tomorrow. It is very effective to take them and show. It is also demonstrated in "cone of experience" that doing and practicing in real world has highest learning efficiency (Park et al., 2016). Keys et al. (2017) have also emphasized on the use of mock-ups in projects. It can give a better understanding to users. Moreover, it is stated by PA1 that architects draw everything now in 3D, and one can make video together with the drawings. Utilization of new 3D models like BIM has also discussed in literature (Clevenger et al., 2010, Sulankivi et al., 2010). However, some barriers have also mentioned while using these technologies (Alreshidi et al., 2018, Oraee et al., 2019).

SS1 has explained that there are also some tools, which have been used by the construction organization. It is like a drawing tool with many options and even words that can be chosen. The organization has asked the users to draw their offices or their working days. It has ended in uncovering some important needs for users and find out why some areas in the buildings are not used. This has been of help, even in rearranging of existing buildings, and has let the architectures to redesign existing areas to useful ones. They can get a good insight and get the description of needs that is important for architectures to know.

In addition, PA1 has mentioned there are other tools like 3D-glasses for visualization, drawings, and principle sketches. They has also worked in a project that they have used VR-glasses. PA1 guess it will be a tool in future. The benefits of using AR/VR-glasses has discussed in literature extensively (Bouchlaghem et al., 2005, Li et al., 2018). However, they are expensive methods and one of their drawbacks, is missing non-verbal cues and human-human interface (Abbas et al., 2019).

Some applications and software can also be used in the project. PN3 has mentioned "Miro Board" as one of those, which is used by their group as a communication tool. It is a medium to make virtual post-it notes. It is made to make users active and give them the opportunity to go back and check. However, PN3 has found it very abstract and declared it needs time to get used to it.

In addition to communication skills that can help to have a better communication in the project, communication tools can assist the project team to gain knowledge and share it. There can be various tools in different arenas, which are of help to visualize and discuss about various features of the project. However, one needs to select a proper method for each group. It had been mentioned that some methods, which are common for architects seem a bit abstract for users. The project team need also pay attention to the purpose group. For example, some tools are better for reaching out to professors, while other are better to communicate with students. It is also declared that meetings, especially face-to-face ones, have the best effect. They can provide a medium for co-working and dialogues. However, various types of meeting can be used in the process. Some can be more dialogue-base and discussing about topics, while others can have more focus on sharing information. The project team should try to utilize the combination of tools and methods and make a framework. It is also helpful to inform the framework to users in order to create some levels of anticipation. Selection of proper visualization tool can help both users and project team to understand the project and communicate their needs and goals.

4.3.3 Communication and trust

Trust has been mentioned as one of the most important issues during interviews. Trust is a primary factor in the success of teamwork (Ochieng and Price, 2010). Communication can assist to build trust, while a failure in communication can lead to mistrust (Keys et al., 2017). PS1 declared that users should trust the project team and be sure that they are there for the sake of users. It is stated that the project culture is also so important, and it should be paid attention from the first days in the project. PS1 has added that people should feel safe and confident in the project, and that is not something that can be bought or ordered from a consultant. Moreover, users are sometimes vulnerable to share information. They are worried about if that will make any problem for them, or if it means they have done something wrong. It is important that they understand the fact that both sides are with each other. It needs trust, so they can be sure that the project is aiming for the best for them. The project team should work on that and make the atmosphere safe and confident for people. The issue of trust and its importance has also mentioned in the literatures. Lack of trust is considered as one of the aspects of complexity. Both internal and external trust is necessary (Bosch-Rekveldt et al., 2011, Remington, 2011). Project team should be aware of the fact that an ill-managed user involvement can damage trust (Eriksson et al., 2015). Communication process should include some degrees of informality to improve the relationship between parties (Mead and Andrews, 2009).

Leaders have an important role in making a trustworthy atmosphere in the projects. According to PA1, both leaders of the project team and user organization are responsible to make an atmosphere that people are allowed to talk freely. It is up to them whether it is forbidden to say stupid things or being in disagreement with leaders. People should be allowed to say what they want and leaders should also consider their opinion. It will avoid "talking in the corridors" and makes trust.

In addition, PS4 has mentioned that communication will help to take all the inputs of users serious, which leads to make trust. It is very significant that users feel that they are listened. It should not be like that if one does not like something, does it in his/her own way. One should write and take notes of all the inputs. However, people should discuss about them and be prepared for some resistances. One cannot just order what he/she want. When it comes to money, there are some frames. One the other hand, PN2 has mentioned that due to language issue in the project, users got a feeling of not being listened, and this has become a matter of trust. Users are wondering whose interests the building team is defending. Whether they are defending the interests of architects who want to make a monument or something, or they are defending the interests of all the people who are going to work in that conditions in those spaces. Carvalho (2014) has also mentioned that stakeholders might have different priorities and specific objectives, which can be in conflict with others. According to PN2, the builders had started the discussion with "You are not going to get all the offices that you want", and they have not been successful in answering the users' question regarding their efforts to get users as many offices as possible. This has led to lack of trust between them. PN2 admits that trust has been an issue in the project. Even though compared to the beginning, it is better now, but it is still an issue. PN3 from user groups also admits that. Even though leaders try to listen more to the users and reassure them to gain trust, but it is still an issue.

PN4 argues that there is absolutely a relation between communication and trust. It is about how project people communicate about the inputs. Moreover, their body language shows if they are interested in what users say, if they write it down, if they ask questions, and if

they want to be active to somehow to take the input or they just lie back on their chairs. Whether they follow up the discussion or they just do something. It is something like internal communication, which influences people's trust. The importance of non-verbal communication and its power even on verbal communication has also discussed by Phutela (2015).

PS4 stated that trust is something that one should make himself/herself deserve it. People can build trust by being, by listening to what users say, and treat them in a proper way. Then one can gain appropriate trust that is important. Trust should be between all stakeholders. One should also accept that people have different interests and various visions, and that one must not agree on everything. However, people need to be confident that others say what they mean to somehow. PN2 have also argued that trust cannot be given. It is something that one have to get through examples and showing that he/she understand others or makes an effort for it. It is also important to try to understand what others say. It is a two-way process. PN2 has stated, "If I want to trust you, you have to give something back to me, telling me that you understand and that you're taking my concerns seriously." In addition, PN3 has agreed that trust has to do with listening. One can gain people's trust, when taking their inputs seriously and keeping them in the project. It is also to be informed. Trust is achieved when people are sure of being kept informed about changes. It is also important to handle what can be handled and handle it well. Amoako-Gyampah and White (1997) have also mentioned keeping people informed of changes as a prompter in the process.

PS4 has mentioned, to make trust, it is very important to provide an atmosphere where it is allowed to say stupid things. And then one can admit that "yes, maybe it was a bit stupid." However, it is allowed to try it without considering it as a failure. To take all inputs seriously provides trust. It is also added by PA1 that all the stakeholders should be confident in being able to say even stupid things, things that might not fit, and things that might not make sense. It is so important in making trust. Carvalho (2014) has argued that trust helps people to speak to ask for help and speak openly and honestly.

Another issue that affects trust is transparency. PN3 has declared that all the information should be transparent and available to people. All the summaries of the meeting should be public, so people can go and check, in case they need it. It causes trust. It is also mentioned by Kapogiannis and Sherratt (2018) that access to information by stakeholders can develop trust.

PN1 has stated that there is obviously a relation between communication and trust. Trust is difficult to achieve when people do not understand each other. There are many dilemmas in "campus project" that mean a lot for people. So, one have to consider human factors here. PN1 mentioned, "When we work with communication, we always talk about that communication is about, head, heart and stomach". There is always certain degrees of feeling in communication. Workplace is a very good example. It is the closest environment where people spend most of their time and it is a great deal for people. In case, one does not have a good environment at work, it is obviously a lot of frustration and people are not able to do their job. So, there are many feelings related to the discussions about people's closest work environment. The controversy there is obviously individual office versus landscapes. And there need to be rational arguments regarding why, what you need and what you do not need. However, the discussion is always mixed with the emotional aspects of it. So, it can be very difficult to sort out what is logical argument, and what is emotional. And then obviously, if one gets rational arguments against him/her on something that one

does not consider it as rational, because there are other reasoning around it, it is very quick that one can mistrust the other person. And vice versa. It is also mentioned by Turner and Müller (2004) that communication is linked to emotions including trust.

PN1 has added if one puts the users versus builders, the builders need to ensure that it is possible to plan a future work environment within cost and frames of building. There is only a certain amount of space available and there are some physical rules, which implicate what one is actually able to build as offices. On the other hand, people from user organization feel that the available space is too small, compared to how things are organized today. That makes them mistrust each other, because users think that they get too little space, and builders think they want more space. Ochieng and Price (2010) has mentioned that trust is a fragile thing, and when it comes to multicultural projects, its significance is even more.

PN1 suggests that the clue is to be able to get the discussion to be about, "ok, we have so much space available. How can we optimize the use of it?" However, it is extremely difficult to get to that point of discussion that one actually discuss the optimization of the use. Because there is so much distrust in that discussion. It is basically about feelings and things that mean very much for the individuals. It needs to be planned out from a community. These are in line with what PN2 has mentioned from the process and why trust is still an issue in the project. Some ways of doing things have not looked logical for users. User description manual is a document that describes what users need, how they will use them, and everything that one needs to consider in the project. It has been set that users describe them to the builders, and they write the final document. However, this has looked strange for users and affected their feelings about the project. PN2 has argued, "The question is who is building for what needs, and who is going to decide which needs?" This is something that is not clear for them. Ochieng and Price (2010) have discovered that early establishment of clear lines of responsibility can assist to improve communication and cultivate trust in multicultural projects. It needs a well inter-connected communication system in place between stakeholders.

Trust is a primary factor in user involvement. All the interviewees has admitted that trust has strong relationship with communication. Trust is something that people should deserve it. It cannot be given or bought. It should be built by treating people properly. If people can communicate honestly and freely, trust can be achieved. Leaders of both project and user organization have an important role on making the atmosphere in a way that people can trust each other. If they provide a situation in which people feel safe and confident to be themselves, and it is allowed to speak frankly and even say stupid things, trust is easier to achieve. In addition listening carefully, taking inputs serious, informing people about changes, and discussing issues honestly can affect trust. There are always some degree of feeling and emotions involved in communicating. If people find discussions irrational or disturbing their emotions, mistrust is easy to happen. In addition, it is important to see whose interests are followed in the project. If users feel that the project team do not listen to them and follow their interests, trust can be affected. One should also consider that people's body language can show their interests in discussions. If one's body language demonstrates that the topic is not interesting, it is easy that the other side feel mistrust. Finally, to gain trust, the best solution is to lead discussions towards optimization and solutions that can cover each groups interests partly.

4.3.4 Communication barriers

There are always some barriers with regard to have an effective communication. Many issues related to humans' nature, cultural issues and technical problems can hinder the process. Carvalho (2014) has distinguished four primary barriers in the communication process including trust, priorities, semantic and mental model, and environment. Difference in perception, lack of project communication plan, filtration, information overload, and defense mechanisms have also mentioned as other barriers in the process (Carvalho, 2008, Streich and Brennholt, 2015). Although contracts and written documents might provide some frameworks, effective communication should be carried out by removing barriers. Clear, concise, and well-planned communications can assist (Martin et al., 2014). It is also mentioned use of informal coordination and communication contributes to a better knowledge sharing and more success in the project. However, both formal and informal communication is required (Kraut and Streeter, 1995).

Spiten et al. (2016) has emphasized on using the same terminology during user involvement and creating a common understanding. From empirical findings, PS1 and PS2 discussed about how important it is to understand users and know them. They also mentioned the importance of having the same terminologies. They stated that there are some words and expressions, which are totally common for project people to use, while users do not understand them. They also added that users do not understand their drawings and models, and they need to clarify them to help users to understand the plan. On the other hand, the project team also needs to know users' terminology to be able to know what their needs are. Users should take time to explain them, so a good solution can be found. PS1 mentioned nano-lab as an example and explained that by nano, the project team might only know 10^{-9}, while it means much wider for users who work in that lab. Both sides need to clarify their language to the other party to let the communication happens in the same level of understanding. It is a principal to have the same understanding. People in the project should understand each other's perspective. To achieve that, human resources on both project- and user-side is needed. PA1 has also referred to the language barrier as the biggest barrier in the process. People have different backgrounds that causes technical language barrier. "As an architect, I can read drawings. I can look at a drawing, and see the room is 20m^2, this width, and so on." An architect's experience and education have given her/him enough skills to know how the room will look like including its all detail. However, it is not that easy for a user. Another barrier is to understand this issue and realize what it means in the context. It is important to understand what things mean for each stakeholder.

PN1 from user groups has also mentioned language as a barrier. It is not about Norwegian-English. It is about technical language (fagspråk in Norwegian). Architects have a different language than engineers who again have a very different language than social studies or humanities. So, they work a lot with translation. The building language is complex, and they need to translate it to a language, which is understandable for people who do not work with it every day. PN3 has also referred to the language issues in the process. There are many special words and shortening of words used by project people, which is not familiar for users. PN3 has said it takes time to get use to the admin language specialized for the process, and it is a communication issue. It also affects whatever goes with language, like the overview. People cannot get the proper overview of the project. PN4 has also agreed that the technical language is a barrier. It is difficult for a student to understand what it is that they are actually working with, if it is not conveyed in a proper way from the ones who own the project. PN4 wants to give good inputs, but to be able to

do so, one must have a good factual basis and a skill that should be given in an easy way. The issue of language barrier has also stated in literature. It is mentioned that project team use various language than users. It is important to reconcile these views and make a common language (Carvalho, 2014, Carvalho, 2008). Lack of the common language has been stated as a significant source of frustration, which reduces communication effectiveness (Loosemore and Lee, 2002). It is also mentioned that semantic gaps act as a barrier to have an effective communication and should be minimized to have a proper user involvement (Amoako-Gyampah and White, 1997, De Brabander and Thiers, 1984).

PN2 has also added that one of the big issues in the campus project is the diversity of the disciplines who should communicate together. In addition, the project is driven by Statsbygg, which is dominated by architects who think in visual, pictures, abstracts, etc. They have their way of communication, and that is not the way the rest of the university is communication. Architects are used to use architectural languages and thinking like an architect, and from PN2's point of view, that is not the way that the world works. Users want to know how many offices and how many functions they will get. PN2 continued, "I don't want to be given a big circle example. A big paper with a big circle and lots of circles. One circle is one office. And then to be asked about how I want to put this circle into this other circle?" This method is quite abstract for users. For example, most people think of buildings as squares, not circles. The way architects think is very different. PN2 has concluded the lack of communication skills from the architects has led to some problems in the project. They are used to their methods and they insist on doing it like an architect. However, this method cannot answer "how" and "why" questions from users. Loosemore and Muslmani (1999) have suggested a process of cultural negotiation in international projects, to let the participants adapt their behaviour to better fit with the other site. This can also be used in smaller scale in projects in which people with various background has involved. Ochieng and Price (2010) have discussed that the best results can achieve when the project manager shows awareness of cultural variations.

Both PN2 and PN3 have mentioned the word "abstract", while talking about architectures' technical language. All the drawings including circles looks so abstract for them and takes time to understand. According to PN3's statement, there are many steps from people with concrete needs to the abstract circles. "Cone of experience" has also admitted that abstract methods like reading or listening has lower efficiency (Park et al., 2016).

Interview objects' statements reveal that the way communication is proceeded is not in accordance with what Zulch (2014) describes as the communication process. Senders should be able to speak, reason and listen completely, and feedback should be received from receiver to confirm understanding the message. Ziek and Anderson (2015) has also confirmed that the goal of communication is to send clear and unambiguous messages. However, in the case of "campus project", communicated information by architects is still unclear and "abstract" for users.

Moreover, PN3 has referred to the complication of rules and formalities around this type of projects, and explained that it is not easy for a person who is not an experienced architect, to grasp what these formalities mean in practice. PN3 is sure that more could have been done to explain these to the users.

PN2 has added that there are already many various groups at NTNU, and each group have different needs. It is challenging to translate between what architects say and what users say. PN3 has also discussed the diversity of the disciplines involved in the project. For example, one of the buildings called KAMD (art, architecture, music and design) will include

many disciplines with various needs. This makes the process a bit challenging. It is complicated to keep the information flowing both ways. There are various groups inside each building, and then there are different building, and then their relation with the general campus, and Statsbygg, and there are also some special groups, and so on. There are many different groups who need to communicate with each other. Moving information between those groups and also taking care of the information is an issue. Loosemore (1998) has also emphasized on the importance of information transfer. It is mentioned an efficient information flow can reduce uncertainty and therefore misunderstanding, disagreement, frustration, and conflict.

However, according to PN3, users are mostly recipient more than giving information, since the meetings are governed from top. They are in a way that Statsbygg is leading and users are reacting to that. It is not much like that users are communicating, it is mostly in a way that they are commenting and responding. Meetings are driven by Statsbygg and users are acting to them. Even though they can react and insist on things, the communication is not symmetrical. However, the importance of two-sided learning process has been mentioned by Newman and Noble (1990). It is argued that the process should be reciprocal and mutual learning should take place to reduce the semantic gap.

In addition, PN2 has argued that people in "campus project" are all educated. They have grown up in their traditions. Thinking like a historian is different from thinking like an architect, or economic, or other professions. PN2 has stated, "We are children of our disciplines." For example, a historian treats a problem different from an engineer. Historians are trained to describe and figure out why and how things happened. They are not interested in solutions, since that belongs to the future. However, an engineer is basically looking for solutions. They have different mindsets.

Moreover, seniority has recognized as a barrier by PN2. People with senior position are used to get things done in their own way, and it can hinder the communication at some points. This is also aligned with what PN3 argues about people who have worked in one field a lot. In this project, the ones who lead the project from Statsbygg know so much more and then it is easy to take in granted others know the same, while they do not. Interestingly, PA1 admits that kids and children are the most open and easiest with regard to facing new things. They are mostly creative and like to work with things.

Utilizing some new applications or software may cause some complexity for users. PN3 has mentioned the use of "Miro Board" which is a virtual post-it. It is supposed to facilitate the process; however, it takes time to get used to it and makes the process at some points more complicated.

Lack of motivation due to various reasons can also act as a barrier. PN3 has mentioned the fund reduction in "campus project" as a reason of losing motivation. Having doubts regarding whether the given inputs will be useful at some points, can affect the motivation. Interest in the project and the perception of progress are two emotions that can be linked to communication (Turner and Müller, 2004). Users' lack of motivation and attitude has been mentioned as the top challenge hindering effective involvement (Bano and Zowghi, 2015). On the other hand, Ives and Olson (1984) have argued that the motivational factors can improve project acceptance, sense of ownership, and resilience to change.

PS1 mentioned that users are not as experienced as the project team, so people in the project should understand them and give them some time to improve and mature in the process. It is crucial to have both sides on the journey. Both PS4 and SS4 have also

mentioned this point in secondary interviews and declared that this maturing process takes time. Eriksson et al. (2015) have also explained this problem and mentioned that users are expert in their own field, while have not much expertise in the project. Moreover, Kujala (2003) has disclosed the communication problem between users and project team. She has argued that users might not be able to communicate their requirements precisely, while know them. This is also mentioned by SS1 in secondary interviews that users have some solutions in mind, while it might not be the best solution for their needs. Project team should try to dig into their needs to help them to discover the real need and find solution for that. Bano and Zowghi (2015) go further and consider communication problem and misunderstanding between users and project team as the most prominent problem.

According to PS4, one of the barriers to have an effective communication is when one has an underlying agenda. One says something, while he/she has another meaning on the background who does not want to say. It is called substitute arguments (vikarierende argumenter in Norwegian), and it is in a way having some politics. To have a hidden agenda is a barrier. To remove this, people should try to make trust between them. Trust will make it easier to open up and say what you really mean. Streich and Brennholt (2015) have mentioned this issue as filter mechanism. They describe it as a situation when sender is manipulating a message to cover some issues.

Another barrier mentioned by interview objects was the amount of information in complex projects. PN1 has mentioned that there is quite a large amount of information in the project. It makes it hard for people to orient themselves and find relevant stuff. PN2 has also mentioned the large amount of information as a challenge. It is hard for people to find out what is important and what is not. Since users have already a full-time job, it makes it harder for them to be able to read the documentation and understand what they are telling. PN3 has also referred to the amount and complication of information, which makes it difficult to understand. PN3 has stated, "There is a lot of wrap your head around". Moreover, due to the huge amount of information, applying trade-off is needed while transferring information between groups and levels. This can be challenging, since the information should be simplified in a way that people can understand it. On the other hand, one needs to give enough details to people who will need the information. Moreover, there are many changes all the time. It is so challenging to keep everyone informed about all the changes. Streich and Brennholt (2015) have also mentioned information overload, as a barrier and discussed that the excessive amount of information in the project might hinder the project progress. They emphasize that any given information should add value. Ochieng and Price (2010) have also mentioned the importance of effective communication.

PN4 has also mentioned that they need to spend a lot of time to read about what they will give input about, and it is a big barrier, since it is not something that a student has time for. "We have already used a lot of our study time, compared to employees who are involved, while it is part of their working time."

PN4 has also declared that students are underrepresented. In all of input-groups, there are many employees involved, while there are just two students. So, it is very easy to evaluate things unimportant when they come from students' side, compared to what comes from employees. There is a lot conversation about working place for employees. So, PN4 has to spend a lot of time to get across what is meant compared to a wise person might say that. It is a big barrier for them. PN4 has continued that "I experience a little feeling of that we are not fully prioritized. In a simple way, people are paid for sitting there, while for example, I have spent four hours on a meeting this week, and it is almost four hours

every week. If you count it, it will be many hours in one year that I should spend in these meeting without being paid, in comparison to others who are paid for sitting there." Issues like this has showed less prioritizing of students. Even though they are working on it and they will make them to be paid, but it is upset that budget has not belonged to it already. In fact, students spend the same amount of time as employees, and that makes a feeling of students are placed further down the rest. De Brabander and Thiers (1984) have also stated that asymmetry in power can act as a barrier to have an effective communication.

There is also a barrier regarding understanding the questions and answering them in a way that can give knowledge to the builders. PN1 mentioned that it is important for users to understand what they are answering. They need to ask users in a way that they understand what they have been asked about and why, and how this will be used. The user organization's main concern is to give the builders enough knowledge about their needs, and the way that they are going to use the arenas in the future. And this process can be quite difficult at some points.

PN1 has also mentioned that the user organization tries to keep the building flexible since there might be some changes during the building time in organization's strategies and operational methods, while builders need concrete answers to their questions. They have limited time and budget, and need to plan the building within certain cost. There is a dilemma between concretizing the building and keep it open.

One barrier that is specific to "campus project" is the role of Statsbygg. It has been chosen as the contractor and there is no competition. According to PN2, when the government is going to build something, users cannot choose the main contractor. Since there is to somehow monopoly in the project, builders do not feel the need to convince users and cover their needs. PN2 has stated it makes them reluctant to listen to the users. Statsbygg has come to the user organization and said that they are going to build the project and it will be like this and that. It has given a feeling to the users that they are not basically listening to them and do not put enough effort on understanding their needs. PN2 has discussed that, "if I want to renovate my house and I got a feeling that contractors and architects will not listen to what I want, I would fire them. However, it is not the option in this project, and Statsbygg will build it anyway". This has also affected the trust between parties. The issues related to trust is discussed in a separate section.

Another issue is the difficulty of imagining the future. PN1 has also stated that it is difficult for users to put themselves in the future situation on behalf of someone who will be here in 10 years. They are used to their current surroundings, and it is challenging for them to answer "how are we going to teach in 10 years?" It can be a great risk to plan the building based on today's needs, while it should be planned after tomorrow's needs. It can be a challenge for builders to distinguish if users are talking about now-situation or future needs. So, they have to ask in the right way, and also understand what they are told. PA1 has also mentioned this point and declared that since the user involvement process happens in a given time and mostly early in the project, and also projects take time to be finished, there is a difference between today's needs and delivery-day's needs. For example, a school might say that they will need an archive room, and then after four years that the school is ready, technology has developed and no one sees paper anymore. This is a barrier in the process. It is also added by PA1 that users usually relate themselves to what they have today, and it is difficult for them to relate themselves to what they will get in the future.

Furthermore, PS1 has added that users are often vulnerable to ask about things they do not understand. This is also a barrier in the process. They usually have high professions, which makes it difficult for them to declare that they have not understood something. People in the project use some expressions, which have been used for a long time in their work area. While, for users, it might not be easy to understand. It is mostly hard for them to ask and say for example, they have not understood one drawing or one expression. "To dare to ask" is a barrier.

PA1 has mentioned any issue that can hinder communication in general can act as a barrier in user involvement, as well. To misunderstand, to be hungry, to be irritated, or not to dare to say anything since your boss is sitting there. It is also added by PA1 that the perspective of project team and user organization is different. Project team is made for taking quick decisions, and progress, and it is like a quick train, which just thunders across the way. While, an organization has very long lines. These different perspectives makes a barrier in a way that they cannot understand each other. It is also stated by PA1 that due to the time limit in the project, many decisions need to be taken at once, that might be challenging to handle.

Communication in general is a complicated issue and it can face barriers due to various reasons. Some issues are related to general nature of humans, and some are specific to the projects. The main and most-referred barrier is technical language. Users and project people have different language regarding their professions that can hinder the process. It is mentioned by all on interview objects, regardless of their role, that language is a big barrier. Architects are used to their drawings and sketches that seem very abstract and difficult to catch for the users. Diversity of disciplines and backgrounds in the project have also increased the complication of the issue. People with various background who are mainly educated and have different perspectives, are difficult to be able to convince each other. On the other hand, there is a huge amount of information in a complex project that one needs to handle. Moreover, users have already a full-time duty that makes it difficult to find time. It is a challenge to have balance between enough details and easy to handle information. One needs to take care of the information flow both upwards and downwards. Moreover, when there is not a symmetrical communication process in place, people might lose trust and motivation, which can act as a hamper. Another hindering issue is the feeling of not being prioritized. It was mentioned by a group of users that they feel they are underrepresented.

Lack of competition in the construction organization may cause some reluctance in builders with regard to listening to users. Other issues like seniority, not daring to ask, having underlying agenda, misunderstanding, and mistrust can also disturb the communication process.

4.3.5 Ensuring effectiveness of communication process

Regardless of everyone's try to utilize communication skills and tools to have an effective communication, there can be some misunderstandings in the process due to many reasons. It is important to have some measurements in place to ensure the effectiveness of the process. PN1 has declared that they do continuously stakeholder surveys and try to adapt their communication to answers. PN1 also added that prioritizing the meetings and co-working arena is to be sure that two sides of the conversation understand each other well. They have people from building organization sitting in their user groups and facilitating them. In this case, builders can directly ask questions from users and get the first-hand

knowledge from them. PN1 says that the clue is that there has to be a dialogue by putting people in the same room, and not just sending information between two sides. In addition, there needs to document the process to be able to go back and see if there has been any misunderstandings. In this case, one can ask the users again, what they may have misunderstood. The key is to have a dialogue and ensure that the structure is in a good way.

It is mentioned by PS4 there needs to set an overall goal in the project. Goals and frames of the project should be set in the beginning, and people, regardless of their personal opinion, should put themselves within that picture. In order to ensure understanding each other, some maturing process should happen during programming and project development. It will take time and should go some rounds in an iterative process. It is obvious that some things might be misunderstood. Streich and Brennholt (2015) have also admitted that three levels of communication including strategy, structure and culture should be defined in every project. However, PS4 has stated during mentioned rounds, it will be possible that at some point one realizes that there is a misunderstanding. Then, one can go back and fix it. It is very important to understand early in the project that there is a misunderstanding. Since professionals have worked a lot in this area, they already know many of them. Users who come from different businesses, they know their careers. So, it is very important to communicate with them in a way that they become aware of consequences of what they say. People in the project team should help them.

PN3 has stated that they try to be sure of the information flow to reduce misunderstanding in the process. It is also mentioned that leaders of each group try to visit other groups to ensure the information flow works properly both ways. There are also different meetings between leaders of the group. In addition, leaders try to make sure that regardless of technical language issue, the information is flowing.

PN4 is still in doubt if their message is conveyed properly, and the project has understood them well. "I am not sure if they understand what I want". The ones, who sit in the meeting, have completely different background and they are responsible for taking the minutes of the meetings. PN4 has stated that although all of the minutes are saved, PN4 struggles to have access to the SharePoint. So, they should trust that the inputs are taken in the minutes. On the other hand, ensuring should happen when one wants to convey a message. When they want to deliver description that is their group's mandate, PN4 has to do double check the whole report and take care of if it will mean the same as what they want. And this is the method to be sure, and if the inputs are not taken, one can refer back to the report.

According to PA1's statement, drawings are a good option for taking feedback, rather than just words. Even though they user writing and summarizing very often, but PA1 believes that receiving feedbacks on drawings can give them the opportunity to discuss. PA1 has worked a lot with workplace improvement, and mostly people want closed rooms. However, having all the rooms closed will result in long dark corridors. So, they try to come up with drawings and show alternatives to users and ask "Is it really what you wanted?"

In order to have a proper communication, one needs to be sure of effectiveness of the process. There can always be some misunderstandings and difficulties in getting other's message. Surveys can help the project to evaluate the process. Some solutions can also act as preventative of misunderstanding. It is recommended to set goals and make frameworks based on that. Moreover, physical meetings and co-working can contribute to better understanding. It can also be beneficial to train users for the project, so they are

aware of the process. Good documentation and archiving, proper information flow and double check can also help people to increase the effectiveness. One of the interview objects has recommended using drawings as a base for taking feedback. It can help to raise discussions and give an overall view about the subject.

4.3.6 Communication and project success

The overall objective of user involvement and communicating with users is to increase project success. Streich and Brennholt (2015) have discussed the significance of communication on project success and referred to it as "mission of the project leaders and their team". Interview objects have also admitted it. According to PN1, there is definitely a relation between communication and project success. Communication is a main success criterion in any project. PN1 has mentioned that in their organization, it is more about reducing risk via communication. They try to remove the barriers that might reduce the quality of the project, or may risk reaching to that quality within the given time, or there might be risks that will lead to more costs. For example, misunderstanding can lead to more cost, because one have to change things later during building, which is more expensive and costs more. If one cannot make a good order of what is needed, it will end in increasing risk. And all this is about communication. If people can understand each other well in the early phases, have a clear common goal, and understand which factors of the project they need to work with in the process, it will reduce the risk, or even flip it and result is success. That will end in a good building, which is well-adapted to the future organization. Kujala (2003) has also mentioned the importance of early involvement of users to avoid later change cost.

PN3 also believes that communication will definitely affect the project success. If one does not listen to the needs, solutions made will not serve the purpose. However, there are always different opinions and there needs to be a trade-off. According to PN3, what is particular in "campus project" is that NTNU is quite actively involved, more than any other projects in Statsbygg, and they hope it will help to get results that work. There has been some examples of buildings that people are not satisfied. For example, there is too much glass and people feel exposed, or having open landscape offices, and people get headache every day. However, it is super hard due to the complexity and easy to loose people's agreement. Gallivan and Keil (2003) have also found out if the involvement process is not managed properly, the solutions made may not fit users' needs and may be rejected or under-utilized afterwards.

Another issue improving the construction project success is considering its universality. PN3 has stated that the buildings need to be universal to be able to give access to as many people as possible. For example, there should be an easy access for someone with wheelchair. These issues are solved by challenging the building functionally. These are also communicated in the process to make the best option.

PN4 has also admitted that there is absolutely a relation between communication and project success. In order to have success, the project should be accepted and approved by the ones who will use it. Therefore, users should be communicated well enough in advance, about what the project will be and what they will do.

Results have shown that there is definitely a retail between communication and project success. If adequate and proper communication process is in place, people will have a good understanding of the project and also each other. It can result in better understanding of the needs and therefore make solutions, which serve the purpose. It can also result in

reducing the risks and increasing the project quality. Communication can also assist to achieve universal solutions that can include as many as possible users.

Communication is the most important way to discover the knowledge in the project. If the communication process is not managed well, the project cannot have access to users' knowledge and explore their ideas. Communication is in itself a big topic that needs the help of many socialist and psychologist to discover all aspects of it, which is not in the scope of this study. But its relevance to the user involvement should be paid enough attention. There needs to be trust between project actors including users and construction organization to let the good flow of information. Lack of trust can hinder communication, and without communication, no information is transferred. In the new world and modern society, projects cannot be successful without adding value to the users, and to reach this goal, they need to understand users and their needs. And having a good communication is not something that can be fixed without having communication skills and proper use of communication tools. The whole project people need to make the atmosphere safe for the other party to express their questions and ideas. This needs time and effort. There also needs to have some measuring systems in place to evaluate the process and ensure of its effectiveness. Summary of the findings with regard to communication is illustrated in Figure 13

Communication
- Important success factor (especially in change projects)
- The goal is to understand the project and each other
- Working as a team
- Internal and external context
- Be informed of other solutions

Communication skills
- Everyone needs it, leaders need more
- Project team MUST have it
- Project team is responsible for communicating framings, goals, engagement
- It should be a dialogue
- Users are users

Communication tools and methods
- Best method is face to face meeting / Co-working
- Various tools like presentations, drawings (2D/3D), documentation, sketches, text, diagrams, VR-glasses, video, software (Miro Board)
- Various arenas like meetings, visiting buildings (silent visit) workshops, digital channels, websites, social media, emails, and direct messaging
- Various levels including dialogue meeting / information meeting / written media
- Utilizing combination of methods with considering the purpose group
- Developing a framework as a tool / informing people about the plan
- Selection of proper visualization tools

Communication and trust
- A primary factor in user involvement
- Strong relation between communication and trust
- One should deserve it!
- Leaders (project team / user organization) make the atmosphere
- Feeling safe and confident to be yourself, Say the stupid things!
- Listening, taking inputs serious, informing, and discussing honestly / openly
- Importance of body language
- Emotions in discussions / irrationality affects the emotions
- Whose interests is followed?
- Optimization should be focused

Communication barriers
- Technical language
- Diversity of disciplines and backgrounds / diversity of perspectives
- Abstract methods used by architects
- Complicated rules and formalities
- Information flow both upwards and downwards
- Asymmetrical communication
- Seniority and getting used to some methods
- New software
- Lack of motivation
- Having underlying agenda
- Huge amount of information
- Lack of time (related to users)
- Feeling of not being prioritized
- Dilemma of concretizing versus flexibility of the building
- Monopoly of the building organization
- Difficulty of imagining the future
- Not daring to ask
- Anything hindering communication in general including misunderstanding, being hungry, being irritated, being afraid

Ensuring effectiveness of communication process
- Stakeholder surveys
- Prioritizing meeting and co-working
- Documentation and archiving
- Setting goals
- Training users
- Proper information flow
- Double check
- Use of drawings to take feedback

Communication and project success
- Definite relation between communication and project success
- Reducing the risk and increasing the quality
- Understanding the needs / solutions which serve the purpose
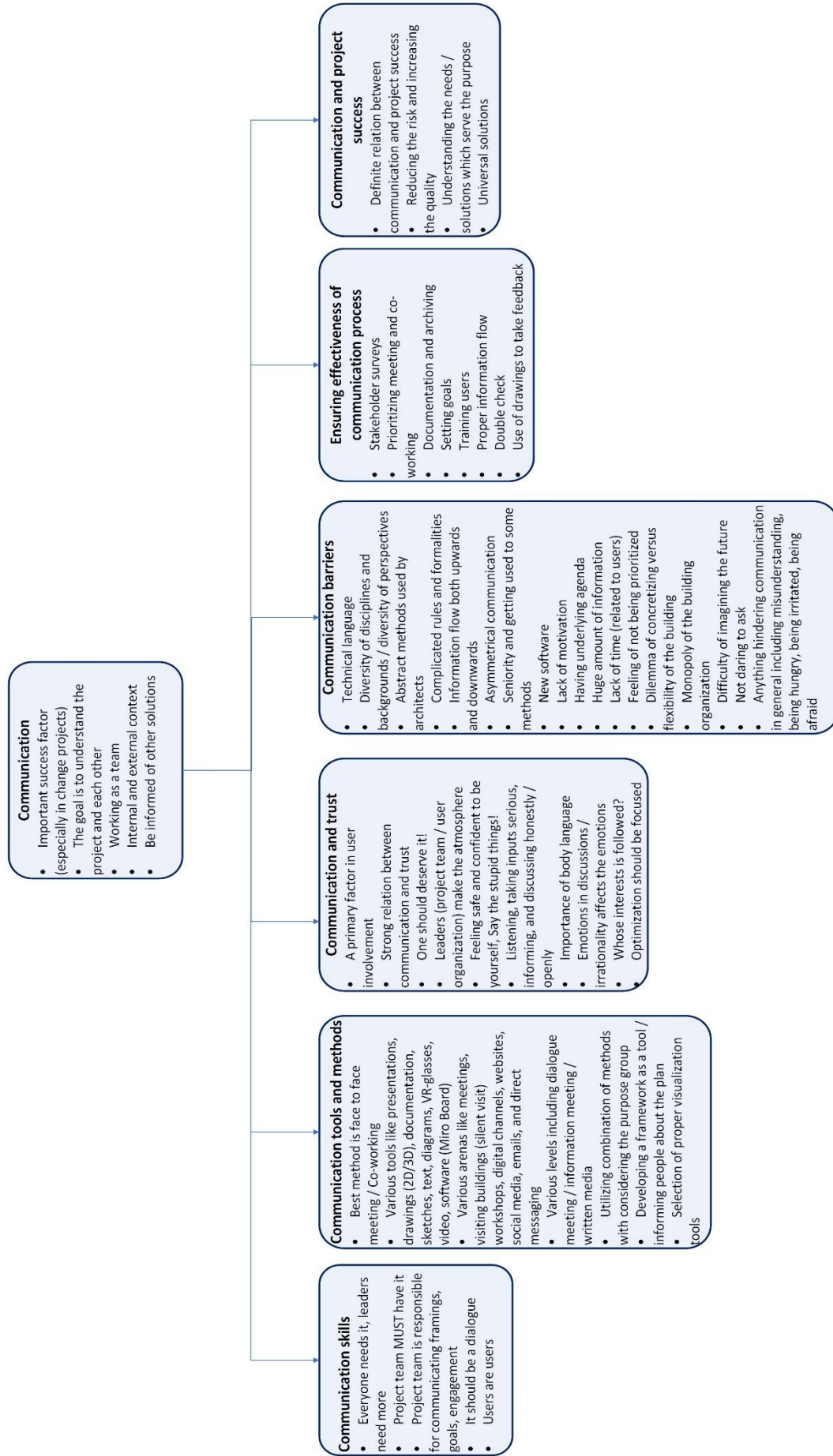- Universal solutions

Figure 13: Summary of the finding related to communication

4.4 Coordination

Coordination between various members of a complex project team is necessary for smooth project execution (Cheng et al., 2003). Hunt (2008) has shown that having a dedicated coordinator helps to project success. This is also aligned with empirical information from the interviews. PS2 mentioned that it is important in projects to have a dedicated full-time coordinator in addition to some part-time ones. The coordinators should participate in the project and have ability to manage to be good in so many fields. It is mentioned that complex construction projects need a lot of collaboration and communication, and since user personnel have already some duties, they might not be able to put enough time and effort on coordination. While by having a representative who is only responsible for coordination between project actors, the project can achieve more success. Ahern et al. (2014) have discussed that emergent knowledge is one of the characteristics of the complex projects. It is necessary to have a good coordination to gain all the knowledge in the project.

Jensen (2006) has mentioned that the client organization has a crucial role in creating synchronized coordination and integration of the business process and building process between users and construction team. Spiten et al. (2016) have also emphasized on the role of coordinator and have discussed that it is crucial that the user coordinator has some experiences of construction processes and design possibilities. Technical competency of the coordinator will ease the communication and interaction. Having people with experience can reduce the project complexity (Geraldi et al., 2011, Bosch-Rekveldt et al., 2011).

Good coordination is necessary to transfer knowledge between users and construction organization. Coordination acts as an important tool to facilitate communication and provides a good information flow. It should be done in a proper way from both sides to manage the relationships and information. There need to be some dedicated people who has the duty of coordination. It should not be overlooked in the projects.

4.4.1 Facilitators' role

Facilitators have an important role in projects. PS1 has mentioned that the aim of the project is to make solutions for users' needs. To achieve this goal, the project team should ask good questions from users and push them to think to the future rather than to their history. This is a barrier in the process since people are so familiar with what they have had until now, and it is challenging for them to say anything about the future. Users do not see the need to think about some issues early in the project, while due to their experience, the project team know that some decisions should be taken in order to have the project finished within the deadlines.

PS1 has also declared that facilitators should make the users to think about how the organization will look like in the future. For example, how the learning and research situation will be, how people will work, they will sit together in shared offices or in private areas. PS1 has added that the way that people study now, is not the same as the way none of them did, even though they might be graduated recently. These are the challenges that the user organization should think about. SS4 has also mentioned this point in the secondary interviews. It has been stated that construction organization and users should make a good connection, and try to think about future, not past since the building will be built for the future.

PS1 has discussed about the competence of the facilitators in asking proper questions. It is important that they dare to raise some questions regarding doing things in another way. However, there need to be a good interaction between users and project team based on trust. People should also dare to show off and discuss. In the meantime, it should be the construction organization who should decode, find, or make a solution, give examples, or maybe even make mocks. Henderson (2004) has also referred to encoding and decoding as two core competencies that a project manager will need. It is argued that encoding can improve the tea members' satisfaction, and decoding can improve productivity. Storvang and Clarke (2014) have also emphasized on the role of facilitators in making a good communication. They argue that facilitators should provide the right methods during the discussions to achieve information, and uncover and identify user needs.

The use of digitalization in the project to contribute to visualization is also mentioned by SS1 in the secondary interviews. It has been declared that these models can help the users to visualize the building and see their requirements precisely. It will let them to have better insights of the building and so on provides detail information for construction organization. However, they cannot be the only option, and the project team and users should meet face to face regularly to build trust. Luo et al. (2017) have also suggested the use of technology and visualization tool to improve the communication.

Another issue mentioned by PS1 is that the time of decisions should be considered. It should be done in right level and the project team should not rush into them. They should consider if it is the right time for decision making or it can be postponed. It is the construction organization who should decide when the best time for finalizing decision is.

PS3 has declared that the construction organization has different challenges than users, since they have shorter time horizons compared to them. There are different people involved from user organization. It is important that the decisions are raised to the right level and process of decision making is clear. It is very crucial that the construction organization manages and runs the project in accordance with the operational planning.

It is important for the construction organization to treat people with respect and try to move them to a higher position, so they can see things different. The construction organization should act like an agency between different users.

Another issue mentioned by SS1 in secondary interviews was that facilitators should try to create trust in the users. They need to be transparent, open, and also dare to be empathic with users. They should try to step back from expert role of "I have all the answers" when questions come up, and work on bringing out what the users actually say and dig into that. "It is like digging for the treasure, and that is often hidden far behind and takes some effort to find out". If digging in does not happen, regardless of doing everything right, users will be unsatisfied. It will end it doing things right, but not meeting the needs. Facilitators should let the users act like experts in the dialogue. Indeed, they are experts in their fields, and they know their needs better. This is also mentioned by Fischer et al. (2020) in the literature. Construction organization just know the solutions.

Moreover, it is mentioned by SS4 in the secondary interviews that construction organization knows the process, and people in this industry are grounded in linear processes. As soon as one opens some Excel-sheets and forms and progress plan, everyone in the construction organization jumps in the direction. Project people are so used to this type of work. However, users who are from various organizations are not familiar with such processes. Facilitators should make a relationship with them and try to

find out a way to achieve a good dialogue with them. It needs time, and some curiosity about what is actually going on.

Facilitators have an important role in triggering users to express themselves. As the role name shows, they should facilitate the involvement process and try to find some tools and techniques to ease the communication. They need to understand users and suggest proper tools according to the situation of each users group. It can be assumable that the way of involvement of professors is not same as the involvement of service people. Each group has different language and different ways of communication. Trust should be built by facilitators. They should dig into users' dialogues to find the real needs and assist them to think to the future. It can be said that it is the facilitator who should discover the important information for the project and discover the unnecessary ones from the involvement process.

4.4.2 User-respresantatives' role

During the process of user involvement in huge projects, it is natural that the project cannot involve every single user. It is common to select some representatives from each group.

PS1 has mentioned that in the campus project, NTNU will look at the various areas as one learning area, regardless of different majors and study fields. User representatives should be able to see the project as an entity ("helhet" in Norwegian). It shows the importance of involvement of dedicated and right persons who can see the project in a holistic way and do not have personal opinions. It is important to have people who can drive down to the individual subjects. It is also necessary that the representatives can make decisions in case any changes are needed in the process. It should not be in a way that they involve just in discussions and final decisions are pointed out to the management. It is vital to have the right person in the right place. PS1 has also added that users should pay attention to how big the organization they come from is. They need to take care of all the questions a mega-, giga-project needs to have answer for. However, this is often a mismatch.

It is mentioned that user organization should select representatives who can see the overall view. It is like involving politicians in big politic decisions. It cannot happen with just local politicians who care more about local issues. It should be people who can see the entity. However, people are different regardless of their career and positions. There can be some conflicts between representatives, as well. People from different positions and majors have various experiences and opinions. Thy need to sit together and discuss issues. It is nice to have discussions, but it is important to consider that the purpose of the discussion is "having a better every day than it is now".

Another issue discovered form secondary interviews regarding representatives was that it is difficult to uncover real needs. SS1 has mentioned that the project team needs to differentiate between needs and desires. However, it requires digging further in the dialogue with the person who own the need, to uncover the real needs. While, when representatives are present in the dialogue, they do not have room to maneuver. They have almost a mandate from their group, and the group has mentioned that "this is so important to us". In this situation, the conversation cannot be interactive and innovative. Inadequate information is mentioned as a characteristic of complex projects (Pich et al., 2002). The availability of the information and its ambiguity is also mentioned as an aspect of complexity (Geraldi et al., 2011). It seems that the nature of having representatives in the project, can affect the availability of the real information.

SS4 from secondary interviews has also mentioned to somehow the same issue when having unions as representatives of users in the dialogue. SS4 has stated that there are some situations that people from unions has come to them after meetings and declared that "Sorry, I don't really represent this view, but I have to represent it. I have to forward the messages that I get from my people".

Representatives have significant role in conveying users need to the project. It is important that they can see the overall view and not be personal in representing their group. The user organization should select proper representatives and give them authority to decide. Otherwise, it will cause more bureaucracy to refer all the decisions to the management. On the other hand, it has been discussed that representatives might make the dialogue less innovative and interactive since they do not have enough freedom from their group. It makes the work of project team harder to uncover real needs. In addition, the conflicts between different representatives can also make the process more challenging. These are the issues that the project team should be prepared for. Summary of the findings regarding coordination can be found in Figure 14.
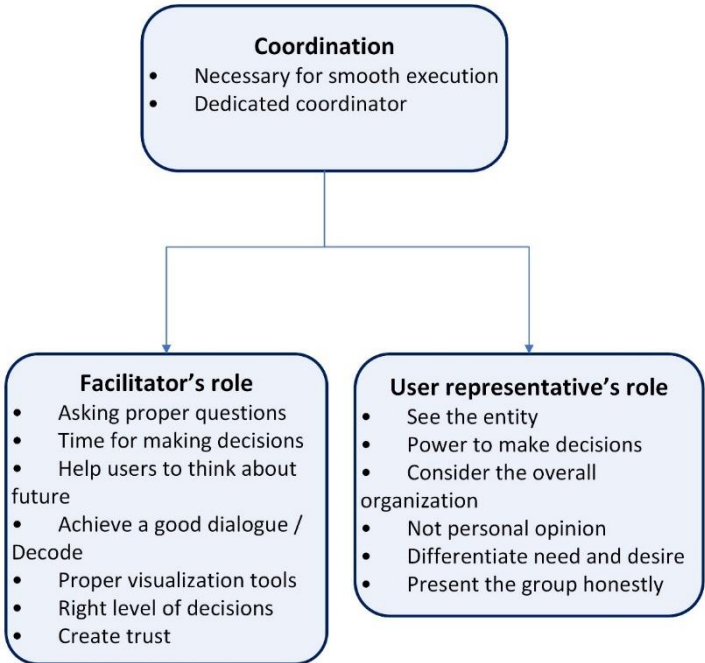
Figure 14: Summary of findings regarding coordination

4.5 Big picture

It is mentioned in the interviews that project culture, trust, common goals, and understanding each other, are important issues in the involvement process. It is also declared that the construction organization should treat users with respect and try to raise them to a higher position to see the overall picture and anticipate the future. In the rapid changing world, it is important to have a looking-ahead attitude than sticking to the history. Construction organization should assist users to make their future strategy clear, so they can provide the project team through information about their needs and requirement. This requires a proper framework and plan for user involvement process. In addition, proper and adequate communication and using suitable tools and techniques can help two sides of the project to understand each other better. Project team should dig into real needs of the users and try to translate them to different aspects of buildings.

In summary, user involvement is a vital process which is necessary to meet and understand users' needs and requirements. It has even more importance in infrastructural projects which aim to add value to the users' present and future life. The final goal of user involvement in construction projects is to improve project success by end-user satisfaction and increase building's functionality by knowing current needs and anticipate future needs of users. User involvement will add value to the construction project by providing additional information about the needs and requirements of users (Eriksson et al., 2015). Although the process is of high significance, it has some challenges. Extracted from empirical data and literature, it is time and cost-consuming and the project team need to deal with a huge data. They also need to train the users to prepare them for the process.

The way of involving users has high importance. Findings show that the process should be completely planned and managed with regard to the time of involvement, people who should be involved and the method used for involvement. Findings from literature encourages the early user involvement that is in compliance with findings from empirical. However, since the complex projects was the focus of interviews, it cannot be possible to involve all user groups of the project at the same time. There need to be a hierarchy with the emphasize on as early as possible involvement and engagement of management team. More detailed information can be collected step-by-step by involving specialists later in the project. Regarding the method of involvement, both literature and empirical findings point up the closeness to the users to be able to make a good relationship with them and understand their culture. Interview objects suggested field study and co-design methods which were pointed out in literature as practical methods, as well. There should be considered that collected information from each user group has value for the project. Therefore, the project team should involve all the groups, but the degree and type of involvement should be decided.

Despite looking like an easy process, understanding users and discovering their real needs can be so challenging, if there is not a safe atmosphere is in the project environment. Communication acts an important role in making good connection between two sides and providing that safety and confidence. Trust is mentioned as a primary factor in the process that allows the people to talk frankly, and ask and answer without barriers. In such a transparent situation, the reals needs can be expressed and discovered. Leaders act an important role in making atmosphere in a way that everyone feels confident to be himself/ herself. Good communication methods can facilitate the knowledge transfer process. Even though there looks to be some barriers in achieving proper communication process, the project team can be successful by improving their communication skills and utilizing proper tools. In addition, setting proper feedback measures in the process can assure the team of effectiveness of the communication process. If the project team and users can make a good communication, they can understand each other, and therefore the project can end in success.

In addition, coordination is necessary in complex projects. Both literature and empirical data has discussed the effect of competent coordinator in the ease of information transformation. Both sides of the project need to put enough effort on that. Facilitators from project side and representatives from user side act an important role in effective coordination and communication. Facilitators should assist users to be mature in the project and make them ready for decisions. Representatives, on the other hand, need to have a holistic point of view and try to both forward their groups concerns and be innovative.

All in all, user involvement is aimed to be a win-win situation which can help both sides to achieve their goals. It should help the users to have a better future and help the construction organization to have an efficient and effective project with higher success and better reputation. However, good planning and management is a significant requirement.

To have a better overview on the findings of this chapter, the author has summarized the main points in Figure 15.

Involvement time: as early as possible, in a heirarchy way, start with mangement

People involved: all user groups, not simoultanously and should be planned including degree and type

Methods to involve: field study and co-design is suggested, as close as possible to users

Process should be planned in detail

good communication skills to make the dialogue happen

Utilization of proper communication tools considering purpose group, face-to-face meeting is the best

Trust should be achieved by listening, discussing, informing and being active

Barriers should be recognized and removed, technical language is the dominant one

Feedback mechanisms in place to assure the effectiveness

Good cummunication process including trust and confidence should be in place

User involvment in projects

Benefits: understanding users' need, increase functionality, cost effective choices,...

Challenges: time and cost consuming, analysing huge data, training users, cultural issues

Facilitators from project should train users and discover users' need and help them to express themselves

User representatives should have a holistic view and present their groups honestly

Coordination is necessary to facilitate knowledge transfer, dedicated coordinator is needed
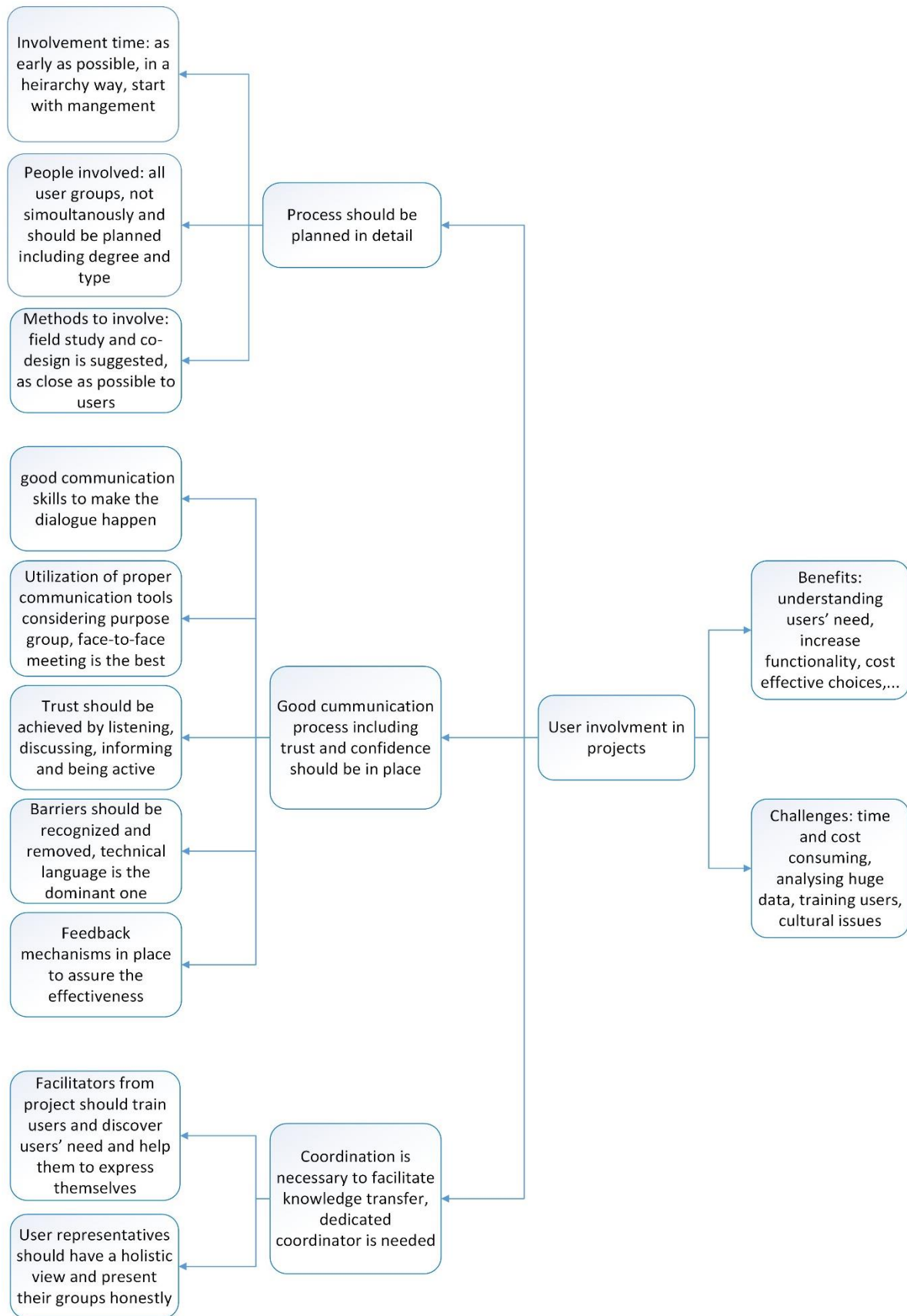
Figure 15: Overview of the main topics in user involvement found based on literature review and interviews

5 Conclusion

In this chapter, the overall conclusion of the study is presented. The author has tried to answer research question based on literature review and interview findings.

5.1 Answer to the reserch questions

RQ1: What are the benefits and challenges of user involvement in complex construction projects?

With the current demand of democracy in the modern countries and increasing emphasize on public projects being successful, user involvement seems to be a vital process in projects, especially in the complex ones with an extended number of stakeholders. It is also emphasized on both literature and interviews. It can help the project team have a close conversation with users, understand their needs and requirements and discover real needs which might be hidden. It is discussed that there are some needs which users know, but do not know how to express them or make dialogue about them with project team. With having an open, trustful, and confident atmosphere, the project team can do discovery of real needs. Good communication by means of proper methods and techniques can assist in this way. Coordination is also required to facilitate the process. Facilitators from project side and representatives from user side should make their best to ease the communication and let the project gain more benefits. Facilitators should train the users and help them to express themselves while they are discovering and decoding. In addition, representatives need to have a holistic overview, be honest and represent their groups properly. Moreover, knowing users' needs means increasing the functionality of the buildings, improving users' sense of ownership and hence more project success. It can also hinder design flaws and wrong choice of material, and therefore increase cost efficiency of the project.

However, user involvement process is not as easy as it might look like. There are some challenges, which the project needs to recognize them before starting the process. The first issue is time and cost consumption. Moreover, the process provides a huge amount of data that the project needs to deal with. It requires so much time, so many people should work on that, and many data analysis should be done later, which are all time and cost demanding. Another issue is communicational and cultural issues. Communicational issues will make the project more complex and if it is not solved, it will add more challenge to the project than improving it. Cultural issues, including organizational culture, can also hinder the process. The project team needs to know it and try to consider it while planning the process.

All in all, user involvement process should be conducted step by step by means of a complete and detail plan. It is emphasized that the whole process should be organized thoroughly, and the planning needs to be done early in the project. The main questions of "when, who and how to involve", should be answered in the plan. The emphasize was on early involvement of users. However, in complex projects, this is translated into early involvement of management team and then involvement of all groups based on the project's need in the right time. Regarding the involvement methods, there was suggestion

of field-study or co-design. However, it should be decided based on project context. The main purpose is to be as close as possible to users.

RQ2: How can early user involvement contribute to project success?

Earlier involvement of the users, especially the management team has been highlighted in both literature and interviews. It will allow the project team to make better relationship with users and give both sides the chance to progress together in the project. It will provide more time slot for project team to help the users to be mature in the process and be prepared for the decision-making points. Users are not as experienced as the project team, and they will need more time and effort to understand the project context. Meanwhile, project people will get the chance to learn more about the user organization culture while exploring their needs. The earlier involvement of the users will let both sides grow together, learn each other's perspectives, and make trust, which is an important issue in the whole project.

As mentioned, by early involvement in complex project, it cannot be assumed to involve all groups of the user organization at the same time and as soon as start of the project. This will lead in more chaos than benefit. However, it can be said that it needs to be done in the earliest time of the right time to involve each group, with the focus on having the management commitment as soon as possible.

However, it is good to have in mind that early involvement of the users might have the danger of increasing their expectations from the project. In addition, involving them too early can make the project lose control and get a lot of unnecessary data. It needs to be negotiated in the project to find the optimum time.

RQ3: What is the role of communication in user involvement in complex projects? And how can it contribute to more success?

Communication is an important success factor in complex projects, especially when the project is considered as a change project. User involvement cannot be possible without proper use of communication. Indeed, communication is the basic for user involvement process, and if project actors including project team and users cannot communicate with each other, no knowledge will be shared. Therefore, it is important that the projects will be aware of its importance and provide a good plan for it. People working in the project should work as a team. They need to not only to communicate between each other, but also with projects' surroundings. Considering the case project, "campus project", there are many levels of communication that needs to be in place to make the project achieve success.

Every member of the project will need certain levels of communication skills. However, leaders and most importantly project team need to have good levels of communication skills. They are professionals, and they should be able to communicate project's goal, its limitation, its framing, its plan and many other details with users and try to engage them as more as possible. Users on the other side also need to be able to conduct their messages including theirs needs properly to the project. Dialogue should happen in the process to let people gain knowledge about each other. However, communication is not as easy as it looks. People need some levels of trust in the process in order to be able to communicate openly and discuss their needs and plans easily within the team. Leaders have an important role in making a proper atmosphere in the project to build trust. Listening, taking inputs serious, informing and discussing openly are some prompters of trust.

In addition, some tools and method can be used in the process to help the users visualize and be able to give good inputs. It can also assist the project team to discuss users' needs with them and discover if it is a real need or there is some underlying ones. However, one should consider the purpose group and try to select a proper method based on their needs and interests. It is mentioned that many sketches used by architect seem too abstract for users and it is difficult to grasp. One should pay attention to the reason of using tools. They need to be useful and easy to understand to let people communicate simply. While some tools convert to a challenge to people rather than a helpful tool. The most important method is meeting face-to-face to eliminate some degrees of misunderstanding.

There are many barriers in the communication process, which act also as a barrier in user involvement process. The most-mentioned one is technical language, which is a big barrier between project team and users. There needs to be some trainings and compromising in place in order to make a common language. Without such an aspect, people cannot communicate with each other, and trust is easy to lose. There are also other barriers in the process like diversity of backgrounds, huge amount of information, asymmetrical communication, under-prioritizing some groups, lack of motivation, difficulty of imagining the future, and also monopoly of the construction organization. There has been found a large list of barriers in the communication process in this report. Project team need to study the present barrier in their team and try to remove it. Moreover, the project team can have some feedback systems in place to assure the quality and effectiveness of the communication process. Doing surveys, meetings, archiving, ensuring information flow, and double check can be some of the practices, which can help to have a proper communication process.

In summary, communication acts an important role in the project success. People need to talk and communicate with other to discover needs and find the best solutions for those needs. Everyone in the project needs to do his/her best to achieve this goal. However, project team are leaders and responsible for the process.

5.2 Practical recommendations

The important of good plan for the involvement process was emphasized during interviews. It is also in accordance with the findings from literature. Since the user involvement is a vital process in managing complex projects, it is recommended to make a model based on the industry to help the organizations to plan the process. It can be general model with capability of being special based on the projects in the organization. It needs a broad overview on the organization's context, its projects, and its experience on the topic. The plan needs to have some success criteria in various steps to evaluate if it goes well.

It is also recommended that organizations make reports of their user involvement experiences and analyse it based on benefits and challenges. It can be a great help for future projects. The organization can try to have more analytical investigation on the benefits and challenges to find the main source or reason. The next step will be improving the beneficial part and try to eliminate challenges.

Findings show that the importance of communication is not recognized thoroughly for projects. It is recommended that projects pay more attention to this topic and try to practice it more in the projects. Informal communication is not mentioned in any of interviews. However, the author believes that informal communication can help people make a good relationship with each other, build trust and hence speak openly. The main goal of communication is conveying the message. Informal communication can be a good

help. Moreover, the use of communication tools is underestimated in the projects, especially public section. Proper visualization techniques can ease the process of communication, and therefore help people gain knowledge.

5.3 Recommendations for future research

Early user involvement in complex projects can be investigated more to find the optimum time. The topic has more potential to be investigated both from literature review point of view, and its empirical aspects. It is suggested to study the topic in different type of complex projects (not only construction, not only public), or even examine it in simple projects and if possible, compare the effect of complexity on the topic. More detail interviews with focus on the topic can open new insights. It is also recommended to make a model to find the optimum time based on findings.

Interview objects provided a huge list of communication barriers. It is a sign that this topic still needs to be studied, and more examinations can be done on it. The topic of communication in user involvement specifically needs to be studied more, and it would be more interesting if phycologists and social scientists would also assist.

6 References

ABBAS, A., CHOI, M., SEO, J., CHA, S. H. & LI, H. 2019. Effectiveness of immersive virtual reality-based communication for construction projects. *KSCE journal of civil engineering,* 23**,** 4972-4983.

ADAMI, V. S. & VERSCHOORE, J. R. 2018. Implications of network relations for the governance of complex projects. *Project Management Journal,* 49**,** 71-88.

ADRESSEAVISEN. 2022. *Krisemøter på NTNU etter Borten Moes krav om milliardkutt* [Online]. Available: https://www.adressa.no/pluss/nyheter/2022/03/28/Krisem%C3%B8ter-p%C3%A5-NTNU-etter-Borten-Moes-krav-om-milliardkutt-25358457.ece [Accessed].

AHERN, T., BYRNE, P. & LEAVY, B. 2015. Developing complex-project capability through dynamic organizational learning. *International Journal of Managing Projects in Business*.

AHERN, T., LEAVY, B. & BYRNE, P. 2014. Complex project management as complex problem solving: A distributed knowledge management perspective. *International journal of project management,* 32**,** 1371-1381.

AHMED, N., MEMON, A. H. & MEMON, N. A. 2021. Communication Modes Used for Information Sharing in Construction Projects of Pakistan. *International Journal,* 9.

ALRESHIDI, E., MOURSHED, M. & REZGUI, Y. 2018. Requirements for cloud-based BIM governance solutions to facilitate team collaboration in construction projects. *Requirements engineering,* 23**,** 1-31.

AMOAKO-GYAMPAH, K. & WHITE, K. B. 1997. When is user involvement not user involvement? *Information Strategy: The Executive's Journal,* 13**,** 40-45.

ARGE, K. 2005. Adaptable office buildings: theory and practice. *Facilities*.

ARGE, K. 2008. Tverrfaglighet og fagkompetanse i prosjekters tidligfase. *SINTEF Byggforsk CONCEPT Project report nr. 28.*

ATKIN, B. & SKITMORE, M. 2008. Stakeholder management in construction. *Construction Management and Economics,* 26**,** 549-552.

BACCARINI, D. 1996. The concept of project complexity—a review. *International journal of project management,* 14**,** 201-204.

BAKHSHI, J., IRELAND, V. & GOROD, A. 2016. Clarifying the project complexity construct: Past, present and future. *International journal of project management,* 34**,** 1199-1213.

BANO, M. & ZOWGHI, D. 2015. A systematic review on the relationship between user involvement and system success. *Information and software technology,* 58**,** 148-169.

BARBOSA, F., WOETZEL, J. & MISCHKE, J. 2017. Reinventing Construction: A Route of Higher Productivity. McKinsey Global Institute.

BARRETT, D. 2008. *Leadership communication*, McGraw-Hill/Irwin New York.

BERTELSEN, S. 2003. Complexity–Construction in a new Perspective. *IGLC-11, Blacksburg, Virginia*.

BIRADAR, N. V. & GIRISHA, H. 2013. Application of Wireless Communication Tools in Managing Construction Projects. *International Journal of Computer Applications,* 73.

BOSCH-REKVELDT, M., BAKKER, H. & HERTOGH, M. 2018. Comparing project complexity across different industry sectors. *Complexity,* 2018.

BOSCH-REKVELDT, M., JONGKIND, Y., MOOI, H., BAKKER, H. & VERBRAECK, A. 2011. Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and Environmental) framework. *International Journal of Project Management,* 29**,** 728-739.

BOSLAUGH, S. 2007. An introduction to secondary data analysis. *Secondary data sources for public health: A practical guide***,** 2-10.

BOUCHLAGHEM, D., SHANG, H., WHYTE, J. & GANAH, A. 2005. Visualisation in architecture, engineering and construction (AEC). *Automation in construction,* 14**,** 287-295.

BRANNEN, J. & CORAM, T. 1992. *Mixing methods: Qualitative and quantitative research*, Ashgate Publishing.

BUEHRING, S. 2009. *The Importance of Communication in Project Management* [Online]. [Accessed].

CARVALHO, M. M. Communication issues in projects management. PICMET'08-2008 Portland International Conference on Management of Engineering & Technology, 2008. IEEE, 1280-1284.

CARVALHO, M. M. 2014. An investigation of the role of communication in IT projects. *International Journal of Operations & Production Management*.

CAULFIELD, J. 2020. *A quick guide to textual analysis* [Online]. scribbr. Available: https://www.scribbr.com/methodology/textual-analysis/ [Accessed].

CAULFIELD, J. 2021. *How to do thematic analysis* [Online]. scribbr. Available: https://www.scribbr.com/methodology/thematic-analysis/ [Accessed].

CHAN, A. P., SCOTT, D. & CHAN, A. P. 2004. Factors affecting the success of a construction project. *Journal of construction engineering and management,* 130**,** 153-155.

CHENG, M.-Y., SU, C.-W. & YOU, H.-Y. 2003. Optimal project organizational structure for construction management. *Journal of Construction Engineering and Management,* 129**,** 70-79.

CICMIL, S. & MARSHALL, D. 2005. Insights into collaboration at the project level: complexity, social interaction and procurement mechanisms. *Building research & information,* 33**,** 523-535.

CLEVENGER, C. M., OZBEK, M., GLICK, S. & PORTER, D. Integrating BIM into construction management education. EcoBuild Proceedings of the BIM-Related Academic Workshop, 2010.

CRAMER, P. 2006. *Protecting the self: Defense mechanisms in action*, Guilford Press.

DALE, E. 1969. Audiovisual methods in teaching.

DAVIES, A., DODGSON, M. & GANN, D. 2016. Dynamic capabilities in complex projects: The case of London Heathrow Terminal 5. *Project management journal,* 47**,** 26-46.

DE BRABANDER, B. & THIERS, G. 1984. Successful information system development in relation to situational factors which affect effective communication between MIS-users and EDP-specialists. *Management Science,* 30**,** 137-155.

DUNOVIĆ, I. B., RADUJKOVIĆ, M. & ŠKREB, K. A. 2014. Towards a new model of complexity–The case of large infrastructure projects. *Procedia-Social and Behavioral Sciences,* 119**,** 730-738.

EL-SABONI, M., AOUAD, G. & SABOUNI, A. 2009. Electronic communication systems effects on the success of construction projects in United Arab Emirates. *Advanced Engineering Informatics,* 23**,** 130-138.

ERIKSSON, J., GLAD, W. & JOHANSSON, M. 2015. User involvement in Swedish residential building projects: a stakeholder perspective. *Journal of Housing and the Built Environment,* 30**,** 313-329.

FISCHER, B., PEINE, A. & ÖSTLUND, B. 2020. The importance of user involvement: a systematic review of involving older users in technology design. *The Gerontologist,* 60**,** e513-e523.

GALES, L. & MANSOUR-COLE, D. 1995. User involvement in innovation projects: Toward an information processing model. *Journal of engineering and technology management,* 12**,** 77-109.

GALLIVAN, M. J. & KEIL, M. 2003. The user–developer communication process: a critical case study. *Information Systems Journal,* 13**,** 37-68.

GERALDI, J., MAYLOR, H. & WILLIAMS, T. 2011. Now, let's make it really complex (complicated): A systematic review of the complexities of projects. *International journal of operations & production management*.

GETULI, V., CAPONE, P. & BRUTTINI, A. 2020. Planning, management and administration of HS contents with BIM and VR in construction: an implementation protocol. *Engineering, Construction and Architectural Management*.

GÜNHAN, S., ŞENOL, G. & DOĞAN, S. Z. Non-verbal cues: improving communication in construction projects. 2012 ASEE annual conference program: final conference program and proceedings, 2012. American Society for Engineering Education.

HARTWICK, J. & BARKI, H. 1994. Explaining the role of user participation in information system use. *Management science,* 40**,** 440-465.

HARTWICK, J. & BARKI, H. 2001. Communication as a dimension of user participation. *IEEE transactions on professional communication,* 44**,** 21-36.

HAUSER, J. R. 1993. How Puritan-Bennett used the house of quality. *Sloan Management Review,* 34**,** 61-70.

HE, Q., LUO, L., HU, Y. & CHAN, A. P. 2015. Measuring the complexity of mega construction projects in China—A fuzzy analytic network process analysis. *International journal of project management,* 33**,** 549-563.

HENDERSON, L. S. 2004. Encoding and decoding communication competencies in project management–an exploratory study. *International Journal of Project Management,* 22**,** 469-476.

HOX, J. J. & BOEIJE, H. R. 2005. Data collection, primary versus secondary.

HUNT, M. 2008. User involvement in the Open University library building project. *New library world*.

HUNTON, J. E. & BEELER, J. D. 1997. Effects of user participation in systems development: a longitudinal field experiment. *Mis Quarterly***,** 359-388.

IPMA 2016. IPMA International Certification Requlations for the Assessment of Individuals in Projects, Programme and Portfolio Management. 4.0 ed.: The International Project Management Association.

IVES, B. & OLSON, M. H. 1984. User involvement and MIS success: A review of research. *Management science,* 30**,** 586-603.

JENSEN, P. A. Continuous briefing and user participation in building projects. Adaptables 2006, International Conference on Adaptability in Design and Construction, 2006.

JENSEN, P. A. 2011. Inclusive briefing and user involvement: case study of a media centre in Denmark. *Architectural engineering and design management,* 7**,** 38-49.

KAPOGIANNIS, G. & SHERRATT, F. 2018. Impact of integrated collaborative technologies to form a collaborative culture in construction projects. *Built Environment Project and Asset Management*.

KEYS, Y., SILVERMAN, S. R. & EVANS, J. 2017. Identification of tools and techniques to enhance interdisciplinary collaboration during design and construction projects. *HERD: Health Environments Research & Design Journal,* 10**,** 28-38.

KIM, T. W., CHA, S. H. & KIM, Y. 2016. A framework for evaluating user involvement methods in architectural, engineering, and construction projects. *Architectural Science Review,* 59**,** 136-147.

KRAUT, R. E. & STREETER, L. A. 1995. Coordination in software development. *Communications of the ACM,* 38**,** 69-82.

KUJALA, S. 2003. User involvement: a review of the benefits and challenges. *Behaviour & information technology,* 22**,** 1-16.

KUJALA, S. 2008. Effective user involvement in product development by improving the analysis of user needs. *Behaviour & Information Technology,* 27**,** 457-473.

LALLIMO, J. From pedagogical ideas to a school building: Analysis of user involvement in building design. Proceedings 30th Annual ARCOM Conference, 2014. Citeseer, 1-3.

LEE, D., LEE, S. H., MASOUD, N., KRISHNAN, M. & LI, V. C. 2021. Integrated digital twin and blockchain framework to support accountable information sharing in construction projects. *Automation in construction,* 127**,** 103688.

LEFDAL, E. M. 2015. Verdsetting av brukermedvirkning ved utforming av skoleanlegg. *Acta Diadactica Norge,* 9.

LEUNG, L. 2015. Validity, reliability, and generalizability in qualitative research. *Journal of family medicine and primary care,* 4**,** 324.

LI, X., YI, W., CHI, H.-L., WANG, X. & CHAN, A. P. 2018. A critical review of virtual and augmented reality (VR/AR) applications in construction safety. *Automation in Construction,* 86**,** 150-162.

LIMPORNPUGDEE, W., JANZ, B. D. & RICHARDSON, S. M. 2009. Communication competence factors as moderators to the relationship between user participation and information quality. *Journal of Information Technology Management,* 20**,** 1-21.

LINDAHL, G. & RYD, N. 2007. Clients' goals and the construction project management process. *Facilities*.

LOOSEMORE, M. 1998. The influence of communication structure upon management efficiency. *Construction Management & Economics,* 16**,** 661-671.

LOOSEMORE, M. & LEE, P. 2002. Communication problems with ethnic minorities in the construction industry. *International Journal of Project Management,* 20**,** 517-524.

LOOSEMORE, M. & MUSLMANI, H. A. 1999. Construction project management in the Persian Gulf: inter-cultural communication. *International Journal of Project Management,* 17**,** 95-100.

LU, Y., LIU, C., KEVIN, I., WANG, K., HUANG, H. & XU, X. 2020. Digital Twin-driven smart manufacturing: Connotation, reference model, applications and research issues. *Robotics and Computer-Integrated Manufacturing,* 61**,** 101837.

LUO, A. 2020. *What is discourse analysis?* [Online]. scribbr. Available: https://www.scribbr.com/methodology/discourse-analysis/ [Accessed].

LUO, A. 2021. *What is content analysis and how can you use it in your research?* [Online]. scribbr. Available: https://www.scribbr.com/methodology/content-analysis/ [Accessed].

LUO, L., HE, Q., XIE, J., YANG, D. & WU, G. 2017. Investigating the relationship between project complexity and success in complex construction projects. *Journal of Management in Engineering,* 33**,** 04016036.

MAJCHRZAK, A., BEATH, C. M., LIM, R. A. & CHIN, W. W. 2005. Managing client dialogues during information systems design to facilitate client learning. *MIS quarterly***,** 653-672.

MANOLE, A. L. & GRABARA, I. 2016. Methodologies and visualization tools of effective project management. *Polish Journal of Management Studies,* 14**,** 137--149.

MARIQUE, Y. 2013. Cooperation and competition in complex construction projects: Implementation of EU procurement rules in England and Belgium. *International journal of law in the built environment*.

MARTIN, H., LEWIS, T. M. & FIFI, J. 2014. Centralized versus decentralized construction project structure–Easing communication difficulties. *International Journal of Construction Management,* 14**,** 156-170.

MARTINS, A. & ASPINWALL, E. M. 2001. Quality function deployment: an empirical study in the UK. *Total quality management,* 12**,** 575-588.

MEAD, R. 1990. *Cross-cultural management communication*, Wiley.

MEAD, R. & ANDREWS, T. G. 2009. *International management*, John Wiley & Sons.

MIKKELSEN, M. F. 2020. Perceived project complexity: a survey among practitioners of project management. *International Journal of Managing Projects in Business*.

MILLS, A. 2001. A systematic approach to risk management for construction. *Structural survey*.

MOTAMEDI, A. & HAMMAD, A. RFID-assisted lifecycle management of building components using BIM data. Proceedings of the 26th international symposium on automation and robotics in construction, 2009. 109-116.

MULLER, R. & TURNER, J. Communication between IT project manager and project sponsor in a buyer–seller relationship. PMI research conference, Seattle, USA, 2002.

MULLINS, L. J. 2007. *Management and organisational behaviour*, Pearson education.

MUMFORD, E. 1979. Consensus systems design: An evaluation of this approach. *Design and Implementation of computer based information systems*.

NEWMAN, M. & NOBLE, F. 1990. User involvement as an interaction process: A case study. *Information systems research,* 1**,** 89-113.

NTNU. 2016. *NTNU program for involvering* [Online]. Available: https://www.ntnu.no/documents/1268425101/1269933790/NTNU+Program+for+

involvering_utskriftsversjon.pdf/6b215cd6-7e56-4e3a-9ff5-38bfa07486ee [Accessed].

NTNU. 2021. *NTNU homepage.* Available: https://www.ntnu.edu/campusdevelopment/unified-campus [Accessed].

NTNU. 2022. *Campussamling redefineres* [Online]. Available: https://www.ntnu.no/campusutvikling/redefinering-av-campussamling [Accessed].

OCHIENG, E. G. & PRICE, A. D. 2010. Managing cross-cultural communication in multicultural construction project teams: The case of Kenya and UK. *International Journal of Project Management,* 28**,** 449-460.

ORAEE, M., HOSSEINI, M. R., EDWARDS, D. J., LI, H., PAPADONIKOLAKI, E. & CAO, D. 2019. Collaboration barriers in BIM-based construction networks: A conceptual model. *International Journal of Project Management,* 37**,** 839-854.

ORMEROD, M. & AOUAD, G. The need for matching visualisation techniques to client understanding in the UK construction industry. Proceedings. 1997 ieee conference on information visualization (cat. no. 97tb100165), 1997. IEEE, 322-328.

PARK, C. S., LE, Q. T., PEDRO, A. & LIM, C. R. 2016. Interactive building anatomy modeling for experiential building construction education. *Journal of Professional Issues in Engineering Education and Practice,* 142**,** 04015019.

PENA, W. M. & PARSHALL, S. A. 2012. *Problem seeking: An architectural programming primer*, John Wiley & Sons.

PEÑALOZA, G. A., SAURIN, T. A. & FORMOSO, C. T. 2020. Monitoring complexity and resilience in construction projects: The contribution of safety performance measurement systems. *Applied ergonomics,* 82**,** 102978.

PENNANEN, A., WHELTON, M. & BALLARD, G. 2005. Managing stakeholder expectations in facility management using workplace planning and commitment making techniques. *Facilities*.

PHUTELA, D. 2015. The importance of non-verbal communication. *IUP Journal of Soft Skills,* 9**,** 43.

PICH, M. T., LOCH, C. H. & MEYER, A. D. 2002. On uncertainty, ambiguity, and complexity in project management. *Management science,* 48**,** 1008-1023.

PMBOK 2017. A guide to the project management body of knowledge (PMBOK guide). *PMBOK guide.* 6th ed. ed. Newtown Square, PA: Project Management Institute.

POVEDA-BAUTISTA, R., DIEGO-MAS, J.-A. & LEON-MEDINA, D. 2018. Measuring the project management complexity: the case of information technology projects. *Complexity,* 2018.

PREISER, W. F., WHITE, E. & RABINOWITZ, H. 2015. *Post-Occupancy Evaluation (Routledge Revivals)*, Routledge.

PYBURN, J. 2017. Architectural programming and the adaptation of historic modern era buildings for new uses. *Journal of Architectural Conservation,* 23**,** 12-26.

RABIANSKI, J. S. 2003. Primary and secondary data: Concepts, concerns, errors, and issues. *The Appraisal Journal,* 71**,** 43.

REDSTRÖM, J. 2006. Towards user design? On the shift from object to user as the subject of design. *Design studies,* 27**,** 123-139.

REMIJN, S. Integrating ergonomics into the architectural design processes: tools for user participation in hospital design. Proceedings of the International Ergonomics Association 16th world congress on ergonomics, 2006. Citeseer, e14.

REMINGTON, K. 2011. *Leading complex projects*, Gower Publishing Limited.

REMINGTON, K. & POLLACK, J. 2007. *Tools for complex projects,* England, Gower Publishing Limited.

ROTHER, E. T. 2007. Systematic literature review X narrative review. SciELO Brasil.

SAILER, K., BUDGEN, A., LONSDALE, N., TURNER, A. & PENN, A. 2008. Evidence-based design: Theoretical and practical reflections of an emerging approach in office architecture.

SAMÁKOVÁ, J., BABČANOVÁ, D., HRABLIKCHOVANOVÁ, H., MESÁROŠOVÁ, J. & ŠUJANOVÁ, J. 2017. Using the communication methods, tools and support during management of project communication in industrial manufacturing enterprises.

Vedecké Práce Materiálovotechnologickej Fakulty Slovenskej Technickej Univerzity v Bratislave so Sídlom v Trnave, 25**,** 51-62.

SAN CRISTÓBAL, J. R. 2017. Complexity in project management. *Procedia Computer Science,* 121**,** 762-766.

SAUNDERS, M., LEWIS, P. & THORNHILL, A. 2009. *Research methods for business students*, Pearson education.

SCHNEIDER, K., STAPEL, K. & KNAUSS, E. Beyond documents: visualizing informal communication. 2008 Requirements Engineering Visualization, 2008. IEEE, 31-40.

SCRIBBR.COM. 2021. *A step-by-step guide to statistical analysis* [Online]. scribbr. Available: https://www.scribbr.com/category/statistics/ [Accessed].

SENARATNE, S. & RUWANPURA, M. 2016. Communication in construction: a management perspective through case studies in Sri Lanka. *Architectural Engineering and Design Management,* 12**,** 3-18.

SENESCU, R. R., ARANDA-MENA, G. & HAYMAKER, J. R. 2013. Relationships between project complexity and communication. *Journal of Management in Engineering,* 29**,** 183-197.

SPITEN, T. K., HADDADI, A., STØRE-VALEN, M. & LOHNE, J. Enhancing value for end users: a case study of end-user involvement. ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION, 2016.

SPITZBERG, B. H. & CUPACH, W. R. 2012. *Handbook of interpersonal competence research*, Springer Science & Business Media.

STEEN, M., KUIJT-EVERS, L. & KLOK, J. 2007. Early user involvement in research and design projects – A review of methods and practices. *23rd EGOS colloquium.*

STØRE-VALEN, M. 2021. FM and clinical employees' involvement in the design of eight Norwegian hospital projects. *Facilities*.

STORVANG, P. & CLARKE, A. H. 2014. How to create a space for stakeholders' involvement in construction. *Construction Management and Economics,* 32**,** 1166-1182.

STREEFKERK, R. 2019. *Inductive vs. deductive reasoning* [Online]. scribbr. Available: https://www.scribbr.com/methodology/inductive-deductive-reasoning/ [Accessed].

STREEFKERK, R. 2021. *Qualitative vs. quantitative research* [Online]. scribbr. Available: https://www.scribbr.com/methodology/qualitative-quantitative-research/ [Accessed].

STREICH, R. & BRENNHOLT, J. 2015. Communication in projects. *Applied Psychology for Project Managers.* Springer.

SULANKIVI, K., KÄHKÖNEN, K., MÄKELÄ, T. & KIVINIEMI, M. 4D-BIM for construction safety planning. Proceedings of W099-special track 18th CIB world building congress, 2010. 117-128.

TAYEH, R. & ISSA, R. R. 2020. Interactive holograms for construction coordination and quantification. *Journal of Management in Engineering,* 36**,** 04020079.

TCHANA, Y., DUCELLIER, G. & REMY, S. 2019. Designing a unique Digital Twin for linear infrastructures lifecycle management. *Procedia CIRP,* 84**,** 545-549.

THISSEN, M. R., PAGE, J. M., BHARATHI, M. C. & AUSTIN, T. L. Communication tools for distributed software development teams. Proceedings of the 2007 ACM SIGMIS CPR conference on Computer personnel research: The global information technology workforce, 2007. 28-35.

TURNER, J. R. & COCHRANE, R. A. 1993. Goals-and-methods matrix: coping with projects with ill defined goals and/or methods of achieving them. *International Journal of project management,* 11**,** 93-102.

TURNER, J. R. & MÜLLER, R. 2004. Communication and co-operation on projects between the project owner as principal and the project manager as agent. *European management journal,* 22**,** 327-336.

UPEN. 2018. *Difference Between Descriptive and Experimental Research* [Online]. PEDIAA. Available: https://pediaa.com/difference-between-descriptive-and-experimental-research/ [Accessed].

VAZ-SERRA, P., EDWARDS, P. & ARANDA-MENA, G. 2021. An early-stage project complexity assessment tool for the AEC industry. *Construction Innovation*.

VIDAL, L. A. & MARLE, F. 2008. Understanding project complexity: implications on project management. *Kybernetes*.

VOXCO. 2021. *What is Descriptive Research?* [Online]. VOXCO. Available: https://www.voxco.com/blog/descriptive-vs-experimental-research/ [Accessed].

WANG, P., WU, P., WANG, J., CHI, H.-L. & WANG, X. 2018. A critical review of the use of virtual reality in construction engineering education and training. *International journal of environmental research and public health,* 15**,** 1204.

WILLIAMS, T. M. 1999. The need for new paradigms for complex projects. *International journal of project management,* 17**,** 269-273.

WOICESHYN, J. & DAELLENBACH, U. 2018. Evaluating inductive vs deductive research in management studies: Implications for authors, editors, and reviewers. *Qualitative Research in Organizations and Management: An International Journal*.

WOOD, H. & ASHTON, P. Factors of complexity in construction projects. Procs 25th Annual ARCOM Conference, 2009. 857-866.

XIA, B. & CHAN, A. P. 2012. Measuring complexity for building projects: a Delphi study. *Engineering, Construction and Architectural Management*.

XIAO, Y. & WATSON, M. 2019. Guidance on conducting a systematic literature review. *Journal of Planning Education and Research,* 39**,** 93-112.

ZIEK, P. & ANDERSON, J. D. 2015. Communication, dialogue and project management. *International Journal of Managing Projects in Business*.

ZIMMERMAN, A. & MARTIN, M. 2001. Post-occupancy evaluation: benefits and barriers. *Building research & information,* 29**,** 168-174.

ZULCH, B. 2014. Communication: The foundation of project management. *Procedia Technology,* 16**,** 1000-1009.

7 Appendices

7.1 TOE framework

TOE framework (50 elements in total).

TOE	Sub-ordering	ID	Source L/E/B[1]	Elements defined	Explanation
T	Goals	TG1	L	Number of goals	What is the number of strategic project goals?
T	Goals	TG2	B	Goal alignment	Are the project goals aligned?
T	Goals	TG3	B	Clarity of goals	Are the project goals clear amongst the project team?
T	Scope	TS1	B	Scope largeness	What is the largeness of the scope, e.g. the number of official deliverables involved in the project?
T	Scope	TS2	B	Uncertainties in scope	Are there uncertainties in the scope?
T	Scope	TS3	E	Quality requirements	Are there strict quality requirements regarding the project deliverables?
T	Tasks	TT1	B	Number of tasks	What is the number of tasks involved?
T	Tasks	TT2	B	Variety of tasks	Does the project have a variety of tasks (e.g. different types of tasks)?
T	Tasks	TT3	B	Dependencies between tasks	What is the number and nature of dependencies between the tasks?
T	Tasks	TT4	B	Uncertainty in methods	Are there uncertainties in the technical methods to be applied?
T	Tasks	TT5	B	Interrelations between technical Processes	To what extent do technical processes in this project have interrelations with existing processes?
T	Tasks	TT6	B	Conflicting norms and standards	Are there conflicting design standards and country specific norms involved in the project?
T	Experience	TE1	B	Newness of technology (world-wide)	Did the project make use of new technology, e.g. non-proven technology (technology which is new in the world, not only new to the company!)?
T	Experience	TE2	B	Experience with technology	Do the involved parties have experience with the technology involved?
T	Risk	TR1	B	Technical risks	Do you consider the project being high risk (number, probability and/or impact of) in terms of technical risks?
O	Size	OS1	L	Project duration	What is the planned duration of the project?
O	Size	OS2	B	Compatibility of different project management methods and tools	Do you expect compatibility issues regarding project management methodology or project management tools?
O	Size	OS3	B	Size in CAPEX	What is the estimated CAPEX of the project?
O	Size	OS4	B	Size in Engineering hours	What is the (expected) amount of engineering hours in the project?
O	Size	OS5	B	Size of project team	How many persons are within the project team?
O	Size	OS6	E	Size of site area	What is the size of the site area in square meters?
O	Size	OS7	B	Number of locations	How many site locations are involved in the project, including contractor sites?
O	Resources	ORE1		B	Project drive Is there strong project drive (cost, quality, schedule)?
O	Resources	ORE2	B	Resource and skills availability	Are the resources (materials, personnel) and skills required in the project, available?
O	Resources	ORE3	B	Experience with parties involved	Do you have experience with the parties involved in the project (JV partner, contractor, supplier, etc.)?
O	Resources	ORE4	E	HSSE awareness	Are involved parties aware of health, safety, security and environment (HSSE) importance?
O	Resources	ORE5	B	Interfaces between different disciplines	Are there interfaces between different disciplines involved in the project (mechanical, electrical, chemical, civil, finance, legal, communication, accounting, etc.) that could lead to interface problems?
O	Resources	ORE6	B	Number of financial resources	How many financial resources does the project have (e.g. own investment, bank investment, JV-parties, subsidies, etc.)?
O	Resources	ORE7	B	Contract types	Are there different main contract types involved?
O	Project team	OP1	B	Number of different nationalities	What is the number of different nationalities involved in the project team?
O	Project team	OP2	B	Number of different languages	How many different languages were used in the project for work or work related communication?
O	Project team	OP3	B	Cooperation JV partner	Do you cooperate with a JV partner in the project?
O	Project team	OP4	B	Overlapping office hours	How many overlapping office hours does the project have because of different time zones involved?
O	Trust	OT1	B	Trust in project team	Do you trust the project team members (incl JV partner if applicable)
O	Trust	OT2	B	Trust in contractor	Do you trust the contractor(s)?
O	Risk	OR1	B	Organizational risks	Do you consider the project being high risk (number, probability and/or impact of) in terms of organizational risks?
E	Stakeholders	ES1	B	Number of stakeholders	What is the number of stakeholders (all parties (internal and external) around the table, pm=1, project team=1, NGOs, suppliers, contractors, governments)?
E	Stakeholders	ES2	B	Variety of stakeholders' perspectives	Do different stakeholders have different perspectives?
E	Stakeholders	ES3	B	Dependencies on other stakeholders	What is the number and nature of dependencies on other stakeholders?
E	Stakeholders	ES4	B	Political influence	Does the political situation influence the project?
E	Stakeholders	ES5	B	Company internal support	Is there internal support (management support) for the project?
E	Stakeholders	ES6	B	Required local content	What is the required local content?
E	Location	EL1	E	Interference with existing site	Do you expect interference with the current site or the current use of the (foreseen) project location?
E	Location	EL2	E	Weather conditions	Do you expect unstable and/or extreme weather conditions; could they potentially influence the project progress?
E	Location	EL3	E	Remoteness of location	How remote is the location?
E	Location	EL4	E	Experience in the country	Do the involved parties have experience in that country?

TOE	Sub-ordering	ID	Source L/E/B[1]	Elements defined	Explanation
E	Market conditions	EM1	E	Internal strategic pressure	Is there internal strategic pressure from the business?
E	Market conditions	EM2	B	Stability project environment	Is the project environment stable (e.g. exchange rates, raw material pricing)?
E	Market conditions	EM3	B	Level of competition	What is the level of competition (e.g. related to market conditions)?
E	Risk	ER1	B	Risks from environment	Do you consider the project being high risk (number, probability and/or impact of) in terms of risk from the environment?

[1]L = based on literature data, E = based on empirical data, B = based on both literature and empirical data.

Faezeh Mojtahedi

Communication and User Involvement in Complex Construction Projects

NTNU

Norwegian University of
Science and Technology