TEEMU VIHALA

Mobile news platform for construction communication:
An exploratory study of the possibilities and requirements

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Aalto University  
School of Engineering  
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**ABSTRACT OF**  
**MASTER'S THESIS**  

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Construction projects are complex in their nature and involve multiple different stakeholders who work together in an interdependent environment. Therefore, an effective communication of information is an essential requirement for construction projects. Many information and communication technologies (ICT) have been invented to manage the communication between the stakeholders, but errors and gaps remain. Communication can be addressed differently through news and collaboration systems which involve a wider spectrum of project team.

In response to this need, this study explored the possibilities and requirements of a news platform for construction communication. For this purpose, the study used a comprehensive literature review, an interview and a requirement questionnaire to specify possibilities. The literature review combined and adjusted beneficial attributes to construction industry from the news industry and communication platforms. The interview was used to explore the current communication difficulties, review the current ICT tools and to analyze and elicit possibilities. The questionnaire was used to validate the aggregated requirements.

The results of the thesis indicate that the news platform needs to be implemented together with an organizational change. This organizational change involves an additional stakeholder, who reports the news by collaborating with the traditional stakeholders in the project team. This reporting enables the benefits of the reporting without increasing the workload of the stakeholders. Finally, a possibilities and requirements table was compiled to aid with the future development of this news platform. It identifies the main considerations for platform developers and project teams.

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<tr>
<th><strong>Keywords:</strong></th>
<th>Information communication technologies, news platform, collaboration, organizational change</th>
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Tämän tutkimuksen tulokset osittavat, että uutisalustan käyttöönoton yhteydessä organisaatiota rakennetta tulee muuttaa lisäämällä ylimääräinen sidosryhmä projektorganisaatioon. Tämä toimii kommunikoiden sidosryhmien kanssa raportoimalla uutisia projektiin liittyen. Ylimääräinen toimija mahdollistaa uutisaluksen hyödylliset ominaisuuksia lisäämättä työmaarää nykyisille sidosryhmiille. Lopuksi taulukko mahdollisuuksista ja vaatimuksista kasatttiin helpottamaan uutisalustan kehitystyötä tulevaisuudessa. Taulukossa otettiin huomioon näkökulmia niin alustan kehittämiseen kuin sen käyttöönottoon liittyen.

Asiakirjat:  Tieto- ja viestintäteknologia, uutisalusta, yhteistoiminta, organisaation muutos
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Espoo, May 28, 2018

Teemu Viiala
# Abbreviations and Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ICT</td>
<td>Information and Communication Technologies</td>
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<tr>
<td>MBTI</td>
<td>Myer-Briggs Type Indicator</td>
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<td>SCM</td>
<td>Supply Chain Management</td>
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<td>KM</td>
<td>Knowledge Management</td>
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<td>BIM</td>
<td>Building information modeling</td>
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<td>IFC</td>
<td>Industry Foundation Classes</td>
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<td>IS</td>
<td>Information System</td>
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<tr>
<td>EDMS</td>
<td>electronic data management systems</td>
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<td>UGC</td>
<td>User Generated Content</td>
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<tr>
<td>NLP</td>
<td>Natural-language processing</td>
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<td>NLG</td>
<td>Natural-language generation</td>
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<td>RE</td>
<td>Requirement Engineering</td>
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<td>ARE</td>
<td>Agile requirement engineering</td>
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<tr>
<td>ASD</td>
<td>Agile software development</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strengths, weaknesses, opportunities and treats</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of things</td>
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<tr>
<td>LPS</td>
<td>Last Planner Sym.cm</td>
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Chapter 1

Introduction

In recent years, communication has become increasingly important in construction industry. New technological tools and processes are invented, and they need to be managed across the project stakeholders. The management of construction projects need to have more thorough communication among the different stakeholders to ensure the successful completion of a project.

Typically, construction project team involves tens of different stakeholders from various fields of expertise. This multi-disciplinary team focuses on delivering the project according to the agreed preset conditions. Communication difficulties can arise as stakeholders need to co-operate and work alongside each other during the project (Dubois & Gadde 2002, Buvik & Rolfson 2015).

A project can be characterized as a unique, once performed a set of interrelated tasks. This uniqueness is derived from the project characteristics of uncertainty and complexity (Baccarini 1996). The tasks in projects need to be performed in specific order in collaboration with professionals. During the tasks, a lot of information is communicated between the different stakeholders. Many information and communication technology (ICT) tools have been invented to manage this large amount of data (Wikforss & Löfgren 2007, Martínez-Rojas et al. 2015). Therefore, an adequate communication of this data is vital for the success of the project (Doloi 2012, p.277).

In the last decades, various electronic document management systems (EDMS) have been developed to manage the information in projects. These EDMS are usually company specific, and the institutional culture is reflected through the complex folder structure (Kähkönen & Rannisto 2015). Some of these systems aim to be dynamic communication networks to aid the communication. However, studies have shown that these networks do not usually provide the intended purpose and vision planned. Users opinions about these project networks is that they waste time, are too complicated to use, and the information is not easily accessible (Wikforss & Löfgren 2007). Moreover, these systems usually only try to replicate traditional archive system of paper documents (Mao et al. 2007).

More recent trend has been the development of integrated solutions for the system and design. After the development of industry foundation classes(IFC) standards, there has been much research done for collaborative design solutions. Building information modeling (BIM) has risen as a central technology and process for better collaboration among the stakeholders in construction projects (Froese 2010). BIM is a relatively new technology, thus requiring better communication about the possibilities in BIM is needed. Execution plan templates have been created to aid the BIM process in gen-
eral, such as templates stating project goals, processes, information exchanges and so on (Messner 2018). However, communication difficulties and gaps still remain (Sambasivan & Soon 2007, Neff et al. 2010, Chachere & Haymaker 2011, Bryde et al. 2013).

The literature review in this thesis indicates that past research is related to the existing information and communication technologies and management methods used in the construction industry. Communication issues are addressed from information point of view with current technologies. Information is stored in cloud-based servers, where it is available for project stakeholders. Standards are used to ensure that data integration between different data sources is compatible. Data is also harvested from one project to another for cohesion and insight. This insight is then utilized to encounter numerous problems in previous projects relating to cost, planning, risk management, safety, progress monitoring and quality management. These fields are essential to explore for better productivity of the fragmented nature of construction projects. They aim to unify aspects from project to project with the aid of technology (Martínez-Rojas et al. 2015). However, they do not provide solution for basic communication issues. Moreover, construction industry can be considered to lack behind in IT practices compared to other industries (Fulford & Standing 2014).

Management methods are trying to solve the trust issues between construction stakeholders. Early trust can enable more favorable condition for project (Buvik & Rolfesen 2015). Project partnering and alliance agreements are trying to enable collaborative atmosphere during construction projects. Project partnering aims to improve efficiency by forming a partnership over the project boundaries (Wilson Jr et al. 1995, Li et al. 2000). Project alliancing relies on incentives between the project participants to improve collaboration and project outcome (Kent & Becerik-Gerber 2010).

What is missing from the past studies is a unique view on communication in construction. Communication issues are needed to be explored through the primal point of view. News industry has managed the global information communication for centuries. Recently, social news sites have emerged as popular information distribution centers (Kaplan & Haenlein 2010). Construction projects could utilize the insights from news industries in project information distribution. The research of these insights and their feasibility is necessary for understanding the key attributes in the development of the platform. This thesis will provide a framework for the development of news communication platform. News platform can provide improved user based information communication in projects.

1.1 Problem statement

Communication has been addressed by many technological tools, but communication errors and gaps remain. These tools are solving some of the problems in communication process, but projects are still experiencing schedule overruns and additional costs due to communication failures. There is a need for tool that offers a different perspective for communication.
1.2. METHODOLOGY

The aim of this thesis is to determine the attributes to be included in news type of mobile platform for better communication between the stakeholders in construction projects. This platform would mimic some of the features from regular and social news sites, in which the user contributes to the platform. These features would include video news, automatic news, user-voting of posts, sub-categories, customization, collaboration points and filtering. In addition, an organizational structure change is proposed as an option for companies to aid with the implementation process of the news platform. This organizational structure change brings a reporter or a team or reporters into the project team to be responsible for some of the news reporting. Therefore, the stakeholders can only benefit from the usage of the platform without the need for contribution.

Objectives of the thesis:

- determine beneficial features for the platform from other industries
- identify communication problems that the construction industry is facing
- identify requirements based on these problems

The result of this research are valuable to industry practitioners and software developer in the development of communication platform

1.2 Methodology

The primary research method for this thesis is a literature review. After a profound research, questions will be developed for a qualitative research method. An interview is used for attaining deeper knowledge relating to the research questions in practice. This interview is a semi-structured interview. A workshop is organized after the interview session to validate some of the requirements which have arisen in the interview. This workshop is also used to attain more ideas relating to the news platform.

Research questions:

1. What beneficial features can be found from other industries?
2. What difficulties communication tools fail to address?
3. What are the key attributes to be included in a news platform for construction communication?
1.3 Scope

The idea of this thesis is to explore the possibilities and requirements in news platform for construction communication. These are explored with the focus on current news industry trends. Other possibilities exist, but these are not considered in this thesis. Construction projects can be divided into three phases: design, construction and maintenance phase. The scope of the thesis is limited to the construction phase. However, this does not mean that the platform is not compatible during the other phases. The platform characteristics and requirements are discussed in general terms. The actual usability of the attributes is determined when they are researched more thoroughly and tested in practice later on.

1.4 Structure of the Thesis

The rest of the thesis is divided into five chapters. Chapter 2 reviews the literature on communication and information technologies used in construction and news industry. Chapter 3 outlines some of the possibilities in news platform. Chapter 4 describes the two research methods used in the thesis. Chapter 5 discusses the results of the thesis by providing a selection table of the possibilities. Chapter 6 concludes the thesis by discussing the main attributes in the news platform. The figure 1.1 indicates the process of the thesis.
1.4. STRUCTURE OF THE THESIS

Figure 1.1: Overview of the thesis process
Chapter 2

Literature review

This chapter reviews the literature related to different communication interactions, communication technologies in construction and news industry trends. Exploring these fields is necessary for comprehensive understanding of the possibilities in the news platform as they provide the framework in which the platform operates. The review also enables more insightful question deployment for qualitative section.

This chapter is organized as follows. Section 2.1 presents communication in construction industry. It contains different types of communication between different stakeholders and the role of information in communication. The difficulties are also discussed through complexities in the industry. Section 2.2 reviews information systems and some of the current information and communication technologies. Finally, Section 2.3 analyzes the news industry aspect on communication by stating the current and upcoming trends.

2.1 Communication in construction

This section defines different types of communication. Communication can be defined as information transfer by some form of medium (Dictionary 2018c). By this definition, adequate communication is vital especially in construction industry for the success of projects. This section first introduces some of the main stakeholders during the lifecycle of construction process. A Proper comprehension of these stakeholders and their roles in construction project is critical for understanding the difficulties in communication as well as understanding the people affected by the platform. Section 2.1.2 presents different communication types in traditional communication. Traditional communication is explored in respect to different groups. Section 2.1.3 discusses the human interaction with machines which is essential background for proficient user interface design. Section 2.1.4 reviews the role of information in communication. In Section 2.1.5, the complexities are described for understanding the reasons behind communication difficulties. Finally, the communication difficulties are reviewed as the platform basic assumption demands solutions for current communication difficulties.

2.1.1 Construction industry stakeholders

A Construction project can involve hundreds of stakeholders during the evolution of the project. These stakeholders need to be managed properly for the success of project.
According to (Atkin & Skitmore 2008), the origins of stakeholder management in construction industry derive from Stakeholder theory. It was first introduced in the field of strategic management. Later, it was applied in other fields including construction management.

The construction industry stakeholders can be divided into primary and secondary stakeholders. These stakeholders can be further divided into levels depending on their responsibility (Harris 2010, p.51). Primary stakeholders are also called internal stakeholders, and they are in direct link with the company, thus depending much on the company activity. An example of these type of stakeholders can be owners, suppliers and employees (Atkin & Skitmore 2008). The Secondary stakeholders, also referred to as external stakeholders have indirect link with the company but may be influenced by its actions (Moodle et al. 2008). An example of this type of stakeholder can be neighbors or general public. Atkin & Skitmore (2008, p.549) states that construction management emphasizes the primary stakeholder relationship management, since they are more linked with the project with tasks such as site management and procurements. External stakeholder management is considered to be the business of facility development teams.

Doloi (2012) categorized the stakeholders into three groups: clients, consultants and contractors. According to Harris (2010, p.52), clients are grouped in the first level of primary stakeholders and can also be referred as promoters, patrons or customers. Clients major attributes in influencing project costs are client initiated variations and communication with contractor and design team. Clients are important stakeholders for the project outcome, since they can greatly influence the project cost and schedule during the design and construction phase (Doloi 2012). Therefore, clear communication between the client and contractors is needed for the success of project (Iyer & Jha 2005). From construction management perspective, clients can offer future job opportunities for the main contractor. Clients also need to participate in the communication process as a significant partner as their relationship with the main contractor is a requirement for fostering cooperation. Overall, a good relationship with the client is important to maintain for the success of the project (Cheung et al. 2006, p.54).

The second level of primary stakeholders include consultants, project managers, financial institutions, health and safety coordinators, contractors and designers. Consultants provide assistance to clients about the construction process. They need to possess an understanding about clients expectations about the design for achieving efficient design outcomes (Doloi 2012). The project manager is selected from construction management firm to be responsible of organizing the project team and delivering the project successfully. He is responsible for preparing the plans and coordinating design and construction work. General contractor manages the functions related to construction work. These functions include scheduling, procurements, supervision of site managers, engineers and subcontractors (Harris 2010, p.51). This management demands prominent communication skills for the general contractor, thus communication is considered an essential managerial requirement (Dainty et al. 2007, p.12).

The third level stakeholders include subcontractors, outsourced suppliers, ICT vendors, logistics and transport vendors. Subcontractors are usually managed by general con-
tractor, and they work according to the contract agreement with a general contractor (Harris 2010, p.52). The most basic project delivery method is design-bid-build. It means that the building is first designed, then subcontractors are selected according to the bids, which is followed by the construction process. The general contractor usually selects subcontractor based on the competitive tendering. General contractor should be aware when selecting the lowest tender price, since there might be a pricing error which can lead to trust breakdown and unease atmosphere in the project environment (Dainty et al. 2001, p.845). This can eventually result in a higher indirect cost of the project. General contractor also needs to decide whether outsource the trades or not. This is a complicated decision, since if the basic trades are being subcontracted, it may lower the costs but simultaneously coordination and quality aspects might be more difficult to achieve (Eccles 1981, p.356). Nevertheless, subcontracting enables less running expenses during a low period in the construction industry. According to Dainty et al. (2001, p.842-845) the general contractor usually prefers subcontracting because of the cyclic nature of construction. When using subcontractors, it is essential that relevant and accurate information is shared between the different parties for better project outcome.

The early phase of project implementation is a crucial part of the project, since it determines the project beginning. Sometimes some stakeholders can greatly influence the implementation of a project by supporting or opposing the project. Therefore, an adequate management of the concerns of the stakeholders can prevent conflicts and aid the project implementations. Olander & Landin (2005) analyzed reasons for a housing project to be delayed years because of inadequate stakeholder management. In the early phase of the project development, the project was controversial in many aspects, which enabled one minor stakeholder group, the residents of vicinity, to extend their power by influencing more power stakeholder group of the disputed aspects in the project. This resulted in rejection of building permit. Years later, the project was successfully completed as the plan was revised to be more parallel with interest of the powerful stakeholders. It was concluded that project management team needs to identify key stakeholders who can influence the project and manage their differing needs by adequate communication during the project (Olander & Landin 2005). This stands true also for the construction phase, since the project managers need to manage the main subcontractors and their combined communication as the project proceeds. Misunderstandings during the construction phase can lead to immerse problems leading to increase of cost and time (Sambasivan & Soon 2007).

Construction industry involves many professionals. These professionals need to cooperate during the project life-cycle for achieving a successful project outcome. Stakeholders have interest in the project, as they want to complete their agreed work as cost effectively as possible. Collaboration with other stakeholders is usually needed during this work.
2.1.2 Human to human interaction

One way of inspecting construction industry communication is by dividing it into a different group types. In this section, human-to-human interaction is discussed and the paragraphs are organized regarding the interaction group size. Dainty et al. (2007, p.16) divided construction communication into four different types; interpersonal communication, group and team communication, organizational communication and corporate communication. Interpersonal communication refers to communication conducted by two or more people. It is generally considered face-to-face interaction between participants. This type of communication happens in various situations during the life cycle of construction. For example, during the design phase, designers can communicate their ideas about the design by having face-to-face meetings. Likewise, in construction phase some information is delivered between the site manager and construction worker via interpersonal communication between the two participants. Interpersonal communication consists of activities such as listening, reading, interpreting non-verbal signs and body language. These activities can change in different cultures. Solely understanding language is not always adequate for understanding the underlying meaning of the messages. Also roles in society, such as profession or gender can define communication and interpretation in conversations (Loosemore & Lee 2002).

Group and team communication can be understood through understanding of the ways in which the groups form and develop. In construction, groups are formed for a set period to complete some specific task. As groups work together, they start to develop by understanding other members’ strengths, weaknesses, skills, abilities and knowledges. They will become more accustomed working together and eventually the group will develop into a team (Dainty et al. 2007, p.96-97). Tuckman (1965, p.396) defined group development to be four-stage process. These stages are forming, storming, norming and performing. In forming, group members establish relationships with other members of the group by the process of testing, which identifies boundaries of behaviors. Storming is the second stage and it can oppose the group performance by dispersion of relational values between the group members. After the storming stage is surpassed, comes norming. In norming, social cohesion is evolved and options can be expressed more openly. The final stage of performing means that group is integrated to working toward a task performance in more open manner.

This process of group development might be enhanced by providing balanced mix of personalities. Bradley & Hebert (1997) analyzed the effects of personality types to team success. The study utilized Myer-Briggs Type Indicator (MBTI) to categorize different personalities in the teams. MBTI is one of the most common personality type theory used in business. It categorizes people to 16 different archetypes. These types interact differently in basic working environment. Therefore, understanding workers personality can help in the team forming and development process. It was argued, that worker personality analysis together with understanding, is an important factor when forming effective teams. Understanding about others strengths and weaknesses can lead to better teams. Computers can also be the medium of communication between teams.
Today, computers can play a crucial role in communication between humans. When considering computer mediated communication, Postmes et al. (2000, p.366-367) suggested that social norms in groups act as a determinant of technology usage. This suggests that even though computers prevent some of the social cue that exists in traditional communication, the social norms still shape the interactions in groups. These social norms can be strengthened if a team has a certain shared belief, defined as a team psychological safety (Edmondson 1999, p.354). Team psychological safety means that each member of the group share a belief; the team is safe for interpersonal risk taking. This interpersonal risk taking signifies that the team will have mutual respect and trust among the members. In addition, no one embarrasses or punishes other team member for speaking up. This team communication is a complex phenomenon but if it is rigorously examined and perfected, it can lead to innovations and ability to solve cross-disciplinary problems. Behaviors for successful team forming were identified to be speaking up, experimenting, reflecting, listening intently and integrating. These characters of communication in teams can aid the individuals and organization in which the teams are located (Edmondson 2012).

Organizational communication can be managed in all different sizes of organizations. This management determines the information flow process and quality. In organizational communication, there are two different dimensions; internal and external. Internal dimension means the communication between project staff and central human resource management departments. This communication aids in monitoring employee behaviors, improves innovation solution implementation, integrates members and delivers proper information to staff. The external dimension encompasses the communication with outside of the organization. These parties can be local communities, trades unions, clients and suppliers (Dainty et al. 2007, p.129-130).

Corporate communication is closely related to external organization communication. Dainty et al. (2007, p.160) identified that corporate communication can mean different things to different companies. There are different priorities with aspects in corporate communication between academics and practitioners. However, a common consensus seems to be that a corporate communication emphasizes on communicating positive image according to the company’s objectives. This communication of positive image creates beneficial effects. According to Hooghiemstra (2000, p.64) corporate social reporting can create a competitive advantage by establishing a positive image, thus enabling other companies to do business and purchase its products. In modern technology driven culture, corporate communication can be seen to be democratized (Kietzmann et al. 2011, p.242). Corporate communication can happen with or without the company’s permission, as the social media has increased its influence.

### 2.1.3 Interactions with machines

This section introduces a human-to-machine interaction. First, the basic aspects of the interaction is discussed, then an user interface design requirements are introduced as they define the user-friendliness of the machine. Lastly, some future directions of human-to-machine interactions are briefly reviewed. Terms machine and computer are
used interchangeably to describing the machine side of the interaction.

Human-to-machine interaction has been discussed as long as machines have been around. The basic way of human-to-machine interaction has not changed considerably from the early definitions by Norman (1984). He defined four stages of human-to-machine interactions to be forming of intention, selecting an action, executing an action and evaluating outcome. Simplified, Intention forming means that the system needs to know an user intention. In addition, the user needs to form his intention according to an understandable form for the system. Selecting an action consists of selecting methods to be used in doing the intended task and selecting system commands. Help systems with help menus, search options and frequently asked questions have simplified the action selection process in modern systems (Dix 2009, p.44). Executing state comprehends the pointing of a cursor to the desired action. Evaluation basically means the action evaluation according to the input and possibly redoing the operation (Norman 1984).

Technology has advanced quickly in a modern society. This advancement has enabled more interactions with machines through the software that have been invented. Software is a tool designed to aid the human-to-machine interaction. These tools aim to help some processes of the work in everyday life. Different tools are usually designed separately, thus each of them require a learning process in the beginning. This learning process needs to be considered when humans design these tools. The reason for this lies in a human ability to leave a task altogether if it presents itself too complicated to learn. This abandonment and rejection of system use can lead to discouragement about the system in general and make the human return to an old and proven ways of working. Therefore, well designed system aids the working process and can even motivate the user (Dix 2009, p.20).

User interface design can greatly influence the experiment quality with machine. Nielsen (1995) identified ten different usability heuristics for user interface design. These heuristics are the most general principles for a designing interaction. Most of these heuristics are still relevant in user interface design. For example, the second point states that the system needs to match with a practical world concepts. Mary designed software use known symbols to represent common ideas such as a bell icon for notifications. In addition to user interface design, the experiment quality in an important aspect in the interaction with machines. Users are not satisfied if they can only use the system without it being fun or engaging experience. Therefore, systems need to be designed so that people want to use them (Dix 2009). The lack of proper design system can lead to various forms of user resistance (Ferneley & Sobreperez 2006).

Technological tools utilize computer screens to display information. Information can also be displayed on a mobile device screen. This information is controlled with a touch screen on mobile devices and with a mouse and a keyboard on computers. The future direction is suggested by Rautaray & Agrawal (2015, p.2) to be toward hand gestures. Mouse and keyboard are lacking in compatibility when interacting with 3D objects. A mouse with its two degrees of freedom only does a moderate job at mimicking the 3-dimensional space. Hand gestures are suggested as an alternative to controlling these interface devices. Hand gestures are already used in our daily lives.
during communication and pointing to things. Currently, different types of virtual and augmented reality software are being designed and used in construction industry to aid the design and construction process (Froese 2010).

### 2.1.4 The role of information in communication

Information can be seen as a key resource to manage the construction industry processes and operations. The processes and operations are all performed with the aid of information storage, transfer and management. Information and the technologies associated with it link the activities between processes. Information is processed in every phase of the project differently. In design phase, information is first outlined in verbal and textual formats. Then it is captured as a form of a document, which forms the basis for design solution. Design phase also involves other activities such as developing contract, procurement and financial strategy for a project team. These strategies are influenced by the design solution and the project team decisions. After the design phase of the project comes construction phase. The information from design phase is transferred into the project team. This project team then utilizes this information along with other inputs such as materials and a manual labor to construct the building. Construction phase also involves information exchanges between different stakeholders in the project. These stakeholders were defined in earlier chapter 2.1.1. These information exchanges need to be properly managed in projects to facilitate effective management of the project. Earlier days, the construction industry considered information as a generally supportive for operations. Information technology developments have elevated the role of information in the management of companies. Information is used to improve the decision-making process of managers and executives in related to different tasks in projects and a company level (Harris & McCaffer 2013, p.390-393).

Information types need to be considered for devising better management practices for addressing and exploiting them more efficiently. In respect to artefacts and records, information can be categorized into three categories: structured, semi-structured and unstructured information. Structured information has a routine nature whereas unstructured information consists of information, which changes in unsystematic manner. Semi-structured information include annual reports and project protocols, which are in some matter static while changing. Figure 2.1 presents examples of this division. An other dimension of information is knowledge. Knowledge refers to experiences, concepts, values, beliefs and working habits. Thus, it can be seen as more than information alone. Knowledge can be shared and communicated. Therefore, it can also be managed. Knowledge management means the processes of sustaining, renewing, sharing and applying knowledge to create value for a company. Knowledge management processes, in general terms, include strategy creation, which aims to create a flow of relevant knowledge in the organization. This relevant knowledge can include awareness, experience, skill, insight and know-how (Harris & McCaffer 2013, p.395-396).
2.15 Complexities

Earlier chapters defined the stakeholders involved in the communication process and the different kind of communication methods. Communication difficulties arise partly because of the characters of construction process as one of the most complex comparing to any other industry (Baccarini 1996). Complexities in the industry are indirectly responsible to communication difficulties, therefore these are first introduced and then the difficulties are discussed in more depth in the subsequent chapter (Senescu et al. 2012).

The complex nature of construction projects generates communication difficulties. This nature of projects is first discussed in this section for understanding the underlying reasons for communication difficulties. Complexity can be seen as a constitutive reason for communication difficulties (Senescu et al. 2012). Vidal & Marle (2008, p.1103) suggested that uncertainty in projects can proliferate as the nature of project is various with elements and interactions. He suggested that complexity of projects is what creates uncertainty. This was partly agreed by Perminova et al. (2008), who also argued that managing uncertainty in companies is what creates a better performance. Therefore, the communication difficulties are introduced through the project complexity and uncertainty.
The project nature of being uncertain and complex can lead to difficulties in delivering the project successfully. The Figure 2.2 below indicates the reasons for communication difficulties in general terms. This figure is based on different literature relating to complexity and project management and it works as a framework for understanding the reasons behind communication difficulties. Communication difficulties together with the management aspects can eventually lead to quality problems, cost increase and project duration increase (Vidal & Marle 2008).

![Diagram](image)

Figure 2.2: Underlying reasons for communication difficulties. Modified according to Baccarini (1996), Vidal & Marle (2008)

Construction projects can be categorized as a complex in terms of differentiation and interdependency. Differentiation in this context means the number of alternative elements such as tasks, components and stakeholders. Interdependence implies to the degree connectivity or interrelatedness between the elements. Complexity can also be divided into organizational and technological complexity which is well-established bifurcation (Baccarini 1996, Vidal & Marle 2008). Organizational complexity has a vertical and a horizontal dimension in differentiation. The vertical dimension refers to the organization hierarchy structure and the horizontal dimension to the division of organizational units and groups. In addition, the horizontal dimension comprises of tasks structure in respect to workforce. Workforce can be specialized in conducting a focused task, which requires less skills such as an assembly line worker. On the other hand, the worker can specialize in performing a wide range of activities, specific to a single profession. This personal specialization is more common in the construction industry. All these different organizational complexities, in turn, complicates the communication, as more stakeholders are considered in the process. Schwalbe (2011) stated that the communication pathways increase, as more stakeholders are involved in the project. The communication channels through which the stakeholders can communicate increases as
demonstrated in the equation below.

\[ \text{number of communication channels} = \frac{n(n - 1)}{2} \] (2.1)

The technological complexity in this context means the transformation process complexity. Transformation process converts inputs into outputs. Earliest division of this process was proposed by Hickson et al. (1969). He divided the technology into operations, characteristics of materials and characteristics of knowledge. Operation means the arrangement of activities related to workflow such as scheduling. An operation management has been later risen as a separate entity in management field and it aims to optimize the work practices for maximal efficiency (Dictionary 2018a). As more work practices are being optimized, communication of the proper methods and practices demands more comprehensive and accurate information distribution and control.

Characteristics of materials can refer in the modern construction management to procurement management or more broadly to supply chain management (SCM). It is the practice of managing and optimizing the interdependent supply chain to achieve an optimal efficiency and transparency of the system (Vrijhoef & Koskela 2000). More recently, there has been an increasing interest in the sustainable SCM focusing on environmental aspects to create a competitive advantage. Seuring & Müller (2008) indicated that missing or insufficient communication in supply chain could be a barrier in implementation of the sustainable supply chain. Company-overlapping communication, on the other hand, was recognized as a supporting factor for the sustainable SCM. This SCM also demands proper communication for achieving continuous improvements in the supply chain. For example, defects can occur in construction materials and information about these defects need to be delivered to material supplier in order to improve the material construction in a future.

Characteristics of knowledge is the knowledge used in the workflow (Hickson et al. 1969). In modern construction management, this can be comprehended as knowledge management (KM). Kamara et al. (2002) defined KM as a process to optimize organizational knowledge with tools and techniques. Communication issues can be addressed with the use KM. KM in itself does not lead to communication problems but the lack of knowledge can create communication problems. For example, client can have inadequate knowledge about the construction project process, which can result in unsatisfactory features in buildings, thus leading to quality defects later on.

These earlier defined complexities in organizational dimensions and transformation processes can easily be reasons, which are indirectly responsible to communication difficulties. Of course, they can also result in other problems such as increase in estimation difficulties and management difficulties (Vidal &-Marle 2008). Next, the communication difficulties are discussed more profoundly.
2.1.6 Communication difficulties

This section inspects communicational difficulties in the construction industry. The earlier chapters work as a framework for understanding the difficulties in the construction industry. Misunderstandings are the main result of communication difficulties. Communication problems can be divided in many different ways. First, a division from literature is proposed, and then a more thorough inspection is introduced based on different literature sources.

Baguley (1994) defined business-related misunderstandings and problems into five subsequent categories: a lack of clear objectives, faulty transmission, perception and attitude problems, environment problems, and Chinese whisper. A lack of clear objectives comprises the idea that person who transmits the message can have unclear idea about the intention of the message which can lead to confusion between the communicating parties. Faulty transmission can occur if the message is sent through improper medium or if the message is too dense with information and requires circumstantial understanding. Perception and attitude problems derive from different professionals' backgrounds to interpret information in different ways. Environment problems relate to distractions in the environment, lack of communication media and physical distance between the message sender and receiver. Environment problems are especially pronounced in construction industry since the decisions influencing multiple stakeholders are executed quickly during the construction phase of the project. Chinese whisper means the process of message distortion as it passes along to different stakeholders. In the construction industry projects, the message chain can be long and there can be many different organizational interfaces which might increase the possibility of message distortions (Dainty et al. 2007, p.27-28).

Next, the communication difficulties are divided into human communication factors and project environment factors. Table 2.1 summarizes these factors. This dichotomy is justifiable, since the earlier section division was according to group size in human-to-human communication. Therefore, this proceeds according to the earlier defined process. Human communication factors are related to traditional communication problems from a group and an interpersonal communication perspectives. The project environment factors comprehend the organizational and company difficulties in projects.

Human communication factors

Communication between humans can be divided into two basic processes: encoding and decoding. Encoding means the message creation and decoding refers to message interpretation (Burgoon et al. 2000, p.107). This paragraph inspects interpersonal communication difficulties. Communication difficulties can arise from a language-related dilemmas. When information is transferred between two people, the person talking needs to verbalize his thoughts into words as well as possible. If this person manages to do this unambiguously with words, which can be comprehended by a receiving person, then he has done most of his part of the communication. During this interaction, the receiver needs to listen attentively for understanding the true meaning of
2.1. COMMUNICATION IN CONSTRUCTION

<table>
<thead>
<tr>
<th>Group</th>
<th>Communication difficulty</th>
<th>Related difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human communication factors</td>
<td>• Encoding and decoding</td>
<td>• Lack of clear objectives</td>
</tr>
<tr>
<td></td>
<td>• Language and culture</td>
<td>• Faulty transmission</td>
</tr>
<tr>
<td></td>
<td>• Outsource</td>
<td>• Perception and attitude problems</td>
</tr>
<tr>
<td></td>
<td>• Technological solutions</td>
<td></td>
</tr>
<tr>
<td>Project environment problems</td>
<td>• Project delivery methods</td>
<td>• Environment problems</td>
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<tr>
<td></td>
<td>• Outsourcing</td>
<td>• Chinese whisper</td>
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<tr>
<td></td>
<td>• Technological solutions</td>
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</tr>
</tbody>
</table>

Table 2.1: Communication difficulties leads to misunderstanding (Dainty et al. 2007, Loosemore & Lee 2002)

The message. Sometimes listener needs to consider factors such as body language and hidden messages behind the words for more thorough understanding. Burgoon et al. (2000, p.106) stated that active, mindfulness information processing could make the listener more sensitive to the context and multiple perspectives that can be separated from the communication process. Writing and reading can be viewed as a skills to be acquired and achieved, compared to speech which comes naturally by listening (Liberman & Whalen 2000, p.192-193). Therefore, an inadequate writing and reading skills can result in a miscommunication.

During conversations, specialists often use particular language to describe things in their professional area. This language is often referred to as jargon (Wikforss & Löfgren 2007, p.339). The construction industry involves many distinctive professionals, thus there exists many different kind of jargon. It can be related to the speakers educational background, knowledge or experiences (Wikforss & Löfgren 2007, p.342). Misunderstandings can happen, if the communicating parties have different definitions for the same technical phrase. Dainty et al. (2007, p.29) stated that in some construction site, the architect understood that pipe size means the actual size of the pipe, including the insulation. For engineer, the pipe size meant the diameter of the pipe, excluding the insulation. Communicating parties thus need to take into consideration each other’s backgrounds when encoding a message. One way of listener to indicate that the message is understood, is to repeat it in own words.

Different cultural background can also affect the communication between people. Language forms the basics of communication. Without a common language, communication can become highly difficult. According to Loosemore & Lee (2002, p.520-521) study, non-native speakers were more reluctant to communicate with managers than native speakers, which meant that problems were either ignored or dealt with without consulting the managers. In addition, the managers had to issue instructions repeatedly, which decreased the productivity. Other common difficulty resulting from the lack
of common language was the formation of isolated groups between people with specific cultural background. Commonly, the managers communicated with the different ethnic minority speakers using a "cultural gatekeeper". This individual acted as translator for them when communication was necessary. However, the communication can lead to difficulties even with the formal understanding of the language. Formal understanding of language forms one part of the communication. The other part is non-standard form of communication, such as slangs, euphemisms and proverbs. (Ferraro & Briody 2017, p.65-67).

![Nationalities on high- or low-context continuum](image)

Figure 2.3: Nationalities on high- or low-context continuum (Ferraro & Briody 2017, p.58)

Communication in cultures can also be divided in respect to the value they base on words. Communication can be explicit or implicit depending on the cultural background. Explicit communication means the direct and exact communication whereas implicit communication demands the understanding of contextual background such as nonverbal behavior and nature of relationships. The figure 2.3 resembles differences in message transformation between cultures. Low context countries place a strong emphasis on words, meaning that a good communicator is supposed to say what they mean as precisely as possible. In high context cultures, the verbal message is only a part of the total communication context (Ferraro & Briody 2017, p.57-59).

**Project environment problems**

Project delivery approaches and contractual types effect communication. In traditional project delivery methods, project goals for different stakeholders can be in misalignment. The general contractor might expect the smaller subcontractors to be flexible in the project without considering the subcontractors own business aspects (Dainty et al. 2001, p.845). Subcontractors might have other projects going on at the same time, thus they need to be informed early on about changes in the project, in respect to time and resources. Project managers are responsible for informing about the changes in project and if this informing is disregarded, it can lead to severe problems.
Relationship building is one aspect that can complicate communication. Outsourcing of workforce has been common in the construction industry, since the seasonal variability of work (Dainty et al. 2001). This means that many boundaries need to be managed. These boundaries presents an additional work in communication process. This additional work complicates the role of managers, since the relationships need to be built with the new workforce. Edmondson (1999, p.379-380) stated that the history of a team is a factor shaping psychological safety, which is an aspect of team communication to promote performance as was discussed in Chapter 2.1.2. According to Buyik & Rolfsen (2015) early trust can be achieved if parties know each other prior project. This early trust enables favorable conditions for the project delivery. The inception of a partnering and an alliance agreements have been the application for companies to mimic the advantages of trust creation early on in the project.

Partnering is a cost effective method for providing quick results for a better project outcome through forming a partnership over the project boundaries (Wilson Jr et al. 1995). Although partnering can decrease problems in communication, its main focus is related to business aspects of the construction companies such as cost effectiveness and improved efficiency (Li et al. 2000). Some stakeholders have recognized that the benefits of partnering can reach to innovation and different levels of learning between the partnering stakeholders. These benefits were discussed by Barlow & Jashapara (1998) who concluded that they are the results of effective communication and information system, development of trust and presence of partnering champion. It seems that due to the multiple benefits of partnering, the alliance agreement was originated. The alliance agreements are similar to partnering but they are limited to a project environment. This limitation offers some of the benefits of partnering without the need for previous acquaintance of the stakeholders. Project aligning is a project delivery method, which aims to improve the project result by aligning incentives and goals. More commonly this method is referred as an integrated project delivery (IPD) (Kent & Becerik-Gerber 2010). Although there are improved project delivery methods and practices, traditional methods are still used and communication difficulties still remain (Franz & Leicht 2016).

Different companies have different practices for information delivery. Information is delivered to different parties through different communication methods. These communication methods depend on the characters of information, company’s practices and the stakeholders choices (Dainty et al. 2007, p.129). Some information can also be regarded as a company secret. Arnold & Javernick-Will (2012, p.511) studied different project management software systems and that study indicated that some of these systems are designed proprietary for a single company. This company is usually a general contractor, who then have access to the software whereas other contributing parties need to use other methods of information gathering such as emails and electronic media. This can complicate the information communication within the project. Technological practices have risen to deal with these company specific practices. Industry foundation classes (IFC) standards aim to integrate design plans. Building information modeling (BIM) technology tools are used to combine different design data for comprehensive utilization of this data (Froese 2010).
2.2 Information and communication in construction industry

This section reviews different systems and technologies for managing information and communication in construction industry. Harris & McCaffer (2013, p.398) argued that information and communication technologies (ICT) alone do not automatically accord a competitive advantage. Therefore, an information system is first introduced and then the possible tools to manage this information. There exists plenty of technologies, of which some are utilized in companies and others are not. Therefore, only an outlook to these technologies is introduced. Specifically ICT tools are relevant in the construction industry communication. These ICT tools can be categorized to stand-alone tools, computer-supported communication systems and integration tools (Froese 2010).

2.2.1 Information systems

Information systems are used to amplify the internally oriented information systems with external perspectives. Generally, information systems are internally focused, aiming to monitor operational activities. Sometimes information systems also use output data from previous projects such as cost estimates and programme for works. Construction executives can use executive information support systems to aid with the strategic process of information management (Harris & McCaffer 2013, p.397).

Information system (IS) strategy is needed for managing the different IS sources, information quantity, information capture and coordination of information in decision-making needs. IS strategy can also prevent misunderstandings between project management and site management. IS strategy need to consider the deployment and management of information. IS strategy recognizes information as a resource. This resource comprises of information related to acquisition, storage, creation and processing. These considerations generates knowledge for the project team for better achieving the objectives of the project. Information audit is an operation, which includes the exploration and monitoring of information flows and resources. Construction company need to determine the types, locations and relationships of information. The audit identifies aspects from different levels of the company. These aspects can include information resources, information resources for strategic advantage and IT investment options. Using information as an investment option can lead to innovation of technologies. Khanzode (2018) identified the most frequent information exchanges between different participant during the project by utilizing an algorithm, which inspected the file writing and reading activity. This resulted in development of software, which could foresee information breakdowns. In IS strategy, the outline of the processes need to be periodically monitored. This monitoring is described as periodic information audit. The requirements for this is timeliness, ease of access, ease of use, utility and quality. This audit enables company to ensure that the IS strategy is relevant to the business and operations. In big companies, construction information manager is needed to perform the functions that are required to establish and maintain IS (Harris & McCaffer 2013,
2.2.2 Information and communication tools

Harris & McCaffer (2013, p.401-402) divided information and communication technology (ICT) into three phases. The first phase aimed to achieve efficiency and cost savings in operational level by processing information faster compared to the manual processes. The technological tools aided processes such as accounting and bookkeeping, which were indirectly related to management of construction companies. The second phase was aimed to align the technology directly in support of management activities. The systems in this phase were stand-alone type of systems for various project process activities such as project planning, estimating and financial reporting. These systems proved to be less beneficial than originally predicted. The third phase, which is still evolving, integrated stand-alone systems for better strategic resource for construction companies. This phase also brought communication technologies to support the interactions in a supply-chain. Next, different technologies that have arisen in the third phase are discussed.

Design

New technologies are emerging into the construction industry during the digitalization of the world. The information and communication issues are being solved by concentrating on information modeling and standardization (Wikforss & Löfgren 2007). Nowadays, BIM is widely used in construction. BIM is visualization tool to represent a building in a multi-dimension space and at the same time it stands as a collaborative communication tool (Neff et al. 2010). Standardizations include IFC, which is widely used formal standard; first version was issued in 1997. It enables data transfer between different BIM software applications (Howard & Björk 2008). More resent trend is a multi-disciplinary collaboration between the project stakeholders. In design phase, this collaboration is amplified by BIM-server, which aims to promote collaboration in common workspace (Singh et al. 2011). In BIM, there is a need for defining the collaboration practices and goals among the project participants. BIM execution plan has been created for this purpose. BIM execution plan aims to combine all the relevant information for each party into one specific document. BIM execution plan contains BIM goals and uses for a project, execution processes, information exchanges, defines supporting infrastructure and implementation of BIM project execution planning (Messner 2018). Design solutions are also being linked to the practical environment. Virtual reality and augmented reality solutions belong in this mixed reality environment (Yang et al. 2013, p.49).
Communication

Communication technologies utilize Internet in message transfer medium. Different solutions for communication include instant messaging, Electronic mails, intranets and extranets. Electronic mail (E-mail) have been around from the inception of Internet. Its main benefit is the speed of message transfer. Messages are sent as seen convenient, and the recipient reads and responds when suitable. Intranets are used for communication and information distribution. Intranet is also a company specific database, which the project management can access during projects. Extranets differ from intranets by the ability to share parts of its information resources with other project partners (Harris & McCaffery 2013, p.407-408).

Other industries are also integrating working and communication. Example of other integration can be seen from software industry. Software industry is widely using a communication management tool, referred as a Slack. It integrates communication and information distribution into a one platform. Some construction companies are also adapting Slack into their projects (Egan 2018). The figure 2.4 below represents a typical workspace in the platform. Next, the section discusses the tool and its features.

![Slack Workspace](image)

Figure 2.4: Slack (Guides 2018)

Slack consists of workspaces where people can communicate different information with each other. Medium size companies usually have one workspace but multiple channels. These channels hold most of the conversations with teammates. Channels can be created for any type of groups in the company. When creating a new workspace, two basic type of channels, general and random, are automatically created. These channels include every person on the workspace. Channels can be categorized into three different types of channels: public, private and shared. Public channels are open to the entire
team whereas private channels are invitation only groups. Shared channels connect the workspace channel with another company’s workspace. Communication can also be direct. It means that two or more individuals can directly communicate with each other for faster discussions. However, most of the conversation should be located in public channels for transparent and searchable archive for the team’s work. Slack offers external application extensions. Applications can add functions to Slack. For example, a twitter extension offers updates from twitter back to Slack. Also, Google Drive files can be added directly to conversations (Guides 2018). There has even been discussion and great interest for integrating construction designing software to Slack (Egan 2018).

One of the key functions in Slack is a search function. It allows individuals to search relevant information. The search offers intelligent search options for advanced searches. One option is a deep search, which scans also the shared files, such as Google Drive or Dropbox documents for the specific words. Search results can be displayed and sorted according to categories (Guides 2018). The search feature is also powered by artificial intelligence for more intelligent searches. Even the name Slack is an acronym for "search log of all conversation and knowledge" (Newton 2018)

Data storage

Data storage and electronic data management systems (EDMS) combine company documents to one central database. The documents can be controlled, created and retrieved during the project life cycle. EDMS utilizes many technologies such as imaging and workflow mapping (Harris & McCaffery 2013, p.413). According to Kähkönen & Rannisto (2015, p.9) many of the current EDMS solutions are company-specific, thus there exists a large variety of them. This difference can lead to the inefficiency of data exchange. These current solutions can also be considered complex to use and inflexibility.

Some current solutions are utilizing data from previous projects toward better project outcome in future projects. Martínez-Rojas et al. (2015) reviewed different ICT tools, which provide access to data and take advantage of this access for tasks in a project management. These tasks are indicated in figure 2.5. The different technological solutions are indicated under the horizontal axis. The technological solutions include web-based technologies, ontologies, geographic information systems and tracking technologies.
2.3 News aspect of communication

This chapter introduces news industry perspective of information communication. The platform intends to resemble news industry view of information delivery; therefore, it is imperative to inspect the current trends and methods used by the news industry. Social media is discussed to provide the understanding of the functional activities in social news. Socials news are explored in the framework of information delivery and requirements as they shape the possibilities in the platform. In addition, the development of news automation is discussed as well as the computer science perspective as a background for understanding the context of automated news.

2.3.1 News Industry in change

This section reviews the changes happening in news industry. First, the news distribution is inspected focusing on interpersonal communication and comprehension. Then the transition period is described as more news are distributed over the Internet. Finally, the effects of social media on journalism is discussed.

News can be distributed through different medium. This medium changes over time as new means of distribution are invented. Basil & Brown (1994) studied the way news are distributed and shared between people. When news are received, the individual can either do nothing, seek additional information, pass the information to others who have or have not heard it or some combination of these. It was concluded that personally relevant news would more likely be discussed with others. They also argued that the source of the news does not affect the sharing of it. Individual comprehension of news was demonstrated to improve when they discussed the news with others (Robinson & Levy 1986, p.172). In addition, education background was found to influence the news comprehension.
Picard (2014, p.281, 277) stated that the idea of journalism is to separate fact from fiction and to provide information fairly with accuracy. Twentieth century of journalism, many news providers were influenced by institutional elites who determined the news organization focus. The focus was biased toward official statements at press conference and self-interests of institutions that served the needs of journalism. Moreover, the organizations were detached from society and did not co-operate with other news organizations. Today, these large and slow moving organizations are transforming their processes toward the future trends (Picard 2014, p.277-278).

Journalism can be seen to be in transition period. Some aspects are diminishing and others are emerging. Picard (2014, p.273,281) stated that the challenges that news agencies and newspapers are facing include saturated markets, peoples indifference about news, the effects of economic crisis and the impact of digital competitors. Saturated market is result of digitalization as more opportunities has risen for news distribution. The reason for peoples indifference about news can be the fact that they are busy with other digital distractions (Rogers 2018). These described challenges are some of the factors affecting traditional news agencies business strategies. Basic business strategy in news industry has traditionally been focused on gathering and producing the news. This trend is shifting toward distribution. News are being distributed across a variety of platforms with linkages to other providers. In addition, the regular people can comment on posts. More readers prefer reading the news in a digital form, thus the journalists are adjusting to the new conditions and provide the news in different digital forms. The content is also restricted to different levels of access. Free version provides the basic content with advertising as the main source of revenue, whereas the premium level offers more specialized news for a subscription fee (Picard 2014, p.276-278).

Social media and social networking sites are gaining attraction in the United States. According to Perrin (2015) report, the use of social media has increased in the last decade simultaneously with Internet users. Most active users of social media are young adult. In addition, social media has transformed the news industry as the structure of media technology has shifted. Social media sites can link news to the user. The content is not fact-checked or filtered by a third party thus it can be created and shared by virtually anyone with an Internet access (Allcott & Gentzkow 2017, p.211). This new trend of User Generated Content (UGC) on web sites can be linked to related idea of WEB 2.0. However, these two related concepts differ from each other as WEB 2.0 refers to the changed idea of utilizing World Wide Web. It can be considered the platform for social media. UGC on the other hand refers to the sum of ways in which people use social media (Kaplan & Haenlein 2010).

This UGC enables the easier inception of fake news. Readers need to be aware of the information they receive. Allcott & Gentzkow (2017, p.232-233) investigated the influence of fake news in the United States presidential elections. They concluded that many were affected by the fake news but the influence these news had on the outcome was minimal or non-existent. They also identified that some news mediators such as Facebook and Google are taking measures to remove fake news sites from their platform. In addition, Facebook tries to aid the reader to recognize the fake news by flagging potential false articles. The awareness of fake news can influence the reader’s willingness to consume news. Recent report suggests that relatively large portion of
people avoid news because of the negative effect on mood or because they can’t be certain about the news truthfulness (Newman et al. 2017). The next section discusses social media more thoroughly.

### 2.3.2 Social media

This section reviews the role of social media as a functional set of blocks. These blocks present the different activities in social media platforms. This leads to the comprehension of social news as part of this social media network.

News industry has always been influenced by technology. Traditional way of placing a reporter on the site has decreased after the ascent of technology. The leading reason for this is the availability of news in the Internet. Internet provides reporters the possibility to reproduce news from data collection (Pavlik 2000). Information availability and interconnectedness has created more possibilities for new types of collaborative ICT tools. These tools include content communities, social networking sites and other collaborative projects. Collaborative projects utilizes the group knowledge principle, which was discussed in chapter 2.1. The basic principle was that groups can perform better if their knowledge background complements each other (Kaplan & Haenlein 2010). Companies have also utilized the advancements of ICT in their marketing and brand creation. Social media is a widely used medium by an advertising media, although it is increasingly common that companies rather participate in the discussions and sharing of information rather than straightforward selling and advertising (Kaplan & Haenlein 2010). Next, social media functions are reviewed.

The figure 2.6 below represents the framework of social media to be divided into seven blocks. These blocks identify different functional activities in social media platforms. They enable easier comprehension of different function compositions in social media platforms.

Identity comprehends the user willingness to display information in the social media platform. Some social media platforms require full name and age whereas in others only nickname is required for usage. This is dependent on the aim of the platform. However, willingness to share private information does not automatically result in sharing this with everyone. Some of these platforms offer privacy settings, which determines the specific people that the data is shared with.

Conversation block represents the scope of communication in the platform with other users. Many social platforms aim to inspire communication between people. Conversation can be short similarly to a Twitter or longer such as in blogs. Sharing consists of the act of distributing and receiving content. It can be seen as a way of interacting with others in social media. The type of platform defines the way sharing takes place. For example, LinkedIn specializes in sharing of careers whereas in YouTube, the idea is to share personal videos with other users. Presence comprises of the idea of knowing if the other user is available in the real or virtual world. Some platforms the knowledge of this is in the center of focus whereas in others, this is an irrelevant fact. In virtual
world, this availability is indicated with a phrases such as available or offline. Moreover, social media platforms offer a mechanism to contact the other user personally. Relationships block means the association between two or more users. The association can be shared objects of sociality or friendship. Relationships can determine what and how information is exchanged between the users. Relationships can be formal or informal depending on the platform. Blogs allow users to develop relationships without a formal arrangement when LinkedIn requires the acceptance of both users. Reputation is the intensity to which users can identify each other’s status in the platform setting. Reputation can often have different meanings as in YouTube, reputation is based on the view counts or ratings. In Twitter reputation can be either the amount of followers or the amount of likes on the posts. Some social news have voting system to determine the reputation of the posts. Finally, the seventh block called groups represents the scope in which groups and communities can be generated. Some social media platforms such as Reddit emphasizes the community and sub-community forming ability (Weninger et al. 2013). Groups can also be created for different types of member relationships such as friends, fans or followers. Some resemblance to real life in-group creation can be seen in social media platforms, as groups can be open to anyone or secret groups. In secret groups, invitation is needed for involvement (Kietzmann et al. 2011).
2.3.3 Social news

This section explores popular social news sites and micro-blogging sites. They are explored in terms of features and functions. This provides the framework for different possibilities and requirements in the next chapter. Social news sites differentiate from social media because they do not emphasize identity and relationships (Kietzmann et al. 2011, p.246). Social news can provide insights into resent events in the world. For example, Twitter can be used to find discussions and summaries about resent event in media. Newman (2017) investigated Twitter activity after a United Nations Intergovernmental Panel on Climate 5th Assessment Report. He indicated that the most popular tweets focused on understanding the report.

Twitter

Kwak et al. (2010) categorized twitter as micro-blogging site. Anyone can create a twitter account and follow any other user. Users are not required to follow back. When you follow a user, you receive all the messages, also called tweets, the user posts. The tweets are limited to 140 characters per post. Hashtags '#' followed by word are used to indexing key words or topics. Hashtags can be included anywhere in a tweet. Hashtags enables users to search tweets related to a specific topic. Popular words become trending hashtags and can be seen in trending topics (Twitter 2018). The users can respond to other user tweets by pressing a comment icon under the user post. User can mention another user in a tweet by using an At-sign '@', followed by user identification address.

Reddit

At first glance, Reddit looks like a poorly designed website with random posts, threads, links and points. As you spend time on the front page, you might discover the benefits of the site such as 'self-correcting marketplace of ideas' (Silverman 2018). Reddit is a social media community in which users can post links to external websites or submit text to the community. Other users can then comment on these posts. These posts and comments can also be up or down voted, which determines the success of the post. The success of the posts is measured by points. The most successful posts access the front page where it can reach most of the Reddit users. The community also includes sub-communities also referred as subreddits. All of these described features were intended to capture and rank the diverse content in Web by a voting process. Originally, Redcit was supposed to present the best content available on the Web (Singer et al. 2014).

Users in Reddit are anonymous, which means that as a user, you do not need to reveal your actual identity, just your username. This possibility could create inappropriate messaging. Reddit has solved this issue by creating a standard messaging protocol and rules. In addition, moderators exist to sort messages according to sub-community rules. These moderators can be regular people who want to contribute as volunteers.
Also, if you create a new sub-community, you will automatically be the moderator of that community (Silverman 2018). Users receive karma points from posts or comments. When post is up-voted, the user receives karma in respect to the number of up-votes subtracted by down-votes. The benefits of karma points are that the users with large amount of it can contribute more often (Weninger et al. 2013, p.580). Personalization in Reddit allows users to subscribe to channels, which are most interesting to them. In mobile application, there exists two standard categories: home and popular. Home-category displays the most popular posts according to preselected sub-communities by the user. Popular-category, on the other hand, displays the most popular posts from all sub-communities.

One important feature in Reddit is related to the posts novelty. Reddit has inserted a time decay algorithm, which ensures that the front-page posts change frequently. This algorithm enables recently added posts rise to the front-page, although they contain less points than other front-page posts. For example, a 12-hour-old post need to have 10 times as many points as a brand new post.

Social news sites can provide interesting information since the news can be generated by the users. News are also fact checked by the users. One Reddit user hnerixh (2018) generated a graph based on search interest in Google Trends. Google Trends offer free data about the search results in the past. The figure 2.7 below presents different social networking sites. With a quick look at this graph, it seems to indicate the possibility of decreasing user activity on Twitter and Facebook. Nevertheless, when inspecting closer at this data, it is evident that more information is needed before drawing such a conclusion. That is where the commenting feature presents its benefits.

![The Life and Death of Social Networks](image)

Figure 2.7: Google trend search interest for different social media sites (hnerixh 2018)

Commenting can be considered as one of the key features in Reddit (Silverman 2018). When a post receives a certain amount of popularity, users tend to fact check and
inspect the post more carefully. This often leads to the discovery of flaws in the news headlining or other aspects of the news. Similar phenomena happened to this post presented in figure 2.7. For example, comments were asking about the missing axis labeling, the 100 percent representation and some provided further explanations for the graph. Eventually, it was evident that the only conclusion that could be drawn from this is the different search interest in respect to time for different social media sites. The y-axis only represents the current top search interest for the specific platform. Therefore, the truth that this graph is indicating is not the popularity or as described in the headline, 'the life and death of social networks'. One comment also indicated the fact that Facebook is bookmarked for people, thus, it will not appear in Google searches. Overall, this kind of participation by the users usually enables the truth to come out. This was also pointed out by Silverman (2018), who describe the process that users who want clarification about the subject usually up-vote comments with explanation. Therefore, these comments are brought to the top of the thread where they can be useful to other users.

2.3.4 News automation

Big news agencies are struggling to maintain profit as stories are taken from other publishers’ sites and rewritten (Pavlik 2000). This trend has opened a door to news automation. Automation has started from weather forecast reporting and proceeded to financial news. In recent years, automated journalism has even risen to cover some areas of written news reporting. Automated journalism suggests that the news are automatically generated by computer algorithm. Current news automation solutions range between simple code which fill in obtained numbers in a template and complex data analysis technology with embedded natural language generation technology(Graefe 2016, p.17-20)

Humans are progressively working together with computers; computers need to understand the natural language we create but they also need to generate the language we understand (Perera & Nand 2017). Therefore, the automated language generation has begun. Automated news need human to produce the algorithm, rest is left for the computer. Automated news usually comprises of stories in which data is clean and structured (Graefe 2016, p.14). Van Dalen (2012) indicated that computers perform properly when the information needs to be unbiased and informative. Automation has benefits when it covers stories, which would otherwise be discarded as too minor of a market. Example of this can be some news on local game reporting (Van Dalen 2012). Nowadays, it can even be hard to recognize the difference between some category of computer-written news and human-written news as Clerwall (2014) demonstrated in his study. The reason for this is argued by Van Dalen (2012) from the idea that many news are nowadays user generated, which leads to the decrease of quality in news in general.

Traditional news writing consists of basic steps of research, selection of main elements into the story, structuring the elements and writing of the story. These steps show resemblance of the tasks computers need for writing a news story, which are content
2.3. NEWS ASPECT OF COMMUNICATION

selection, structuring and sentence planning (Van der Kaa & Krahmer 2014). People need to communicate with the machines for it to interpret the language written by human. This presents some difficulties since many aspects need to be defined before proper language can be generated. This area of human to machine interaction has been first introduced in 1950 (Machinery 1950). Other notation of this interaction is human-computer interaction (HCI), human-machine interaction, man-machine interaction or computer-human interaction. In computer science, this interaction process is called natural-language processing (NLP). Computers use artificial intelligence and computational linguistics in NLP (Reiter & Dale 1997).

A process called natural language generation (NLG) is a subcategory of NLP which aims to create natural language based on non-linguistic information input. Perera & Nand (2017, p.2) argue that NLG has turned into its own category as much research is dedicated for its further exploration. NLG systems combine different knowledge to create reports, documents and other texts (Reiter & Dale 1997). In recent years, many companies have started to use NLG technologies to produce automated news for humans. (Latar 2015, Graefe 2016).

In media industry, credibility is comprehended as one of the most important aspects of quality. Joo Chung et al. (2010, p.672) studied credibility as source, message and media credibility. Clerwall (2014, p.8-9) combined previous research on credibility and quality in communication. The results indicate that most factors relate to the message and only some to the source. The word describing credibility and quality in news include well-written, factual, accurate, clear, coherent, concise, timely, relevant, creative, etc. Clerwall (2014, p.14) also conducted a small-scale research on the aspect of credibility of automatic news. The results indicated that there is no significant difference between automated and traditional news. This result is further strengthened by Van der Kaa & Krahmer (2014) research on credibility of machine written news. Both studies focused on generating automatic news on sports. Sports news are ideal area of automatic news generation since they need to be factual, clear and on time. All these parameters describe credibility in news as was earlier concluded. Machine generated news are also ideal for producing news with these parameters. Graefe (2016) defined some parameters, which are lacking from automated news; creativity and causality connection. These were not rated as important for sports news. Therefore, when measuring credibility, automated sports news can easily compete with traditional human-written news production. Some companies have developed algorithms which can produce different tones and narrative structures to the stories based on the audience (Latar 2015, p.4). It was also estimated that majority of journalistic news will be replaced by automated stories during the next ten years.

Automation of data intensive news is indicated to have potential for any news field. Many companies are adopting automatic news into their selection. Automatic news offers a way to produce standardized and informative news from structured data (Clerwall 2014). Automatic journalism will increase in the upcoming years but will never replace the human component in news writing. This is based on the idea that robot journalists lack the ability to feel empathy and understand complex cultural contexts (Latar 2015, p.13). Nevertheless, automated news will have a strong footing on any platform offering news services due to their ability to provide fast and accurate infor-
mative news cost-effectively.
Chapter 3

Possibilities and requirements

This chapter discusses the possibilities and requirements in the news platform for construction communication. The requirement gathering process is reviewed as it provides understanding for the requirement engineering process. It also justifies the methods used in the chapter 4. The possibilities are discussed in respect to earlier solutions from other industries. To address the research question 2 – What beneficial features can be found from other industries? – A literature review of chosen platforms was applied. The platforms were chosen according to their popularity and relevance to the topic. Other platforms could have been inspected as well, but since the scope of the thesis, these were chosen as a focus area. Possibilities are gathered from these chosen platforms.

This chapter is organized as follows. Section 3.1 presents different requirement gathering methods. It identifies requirement engineering process and agile requirement engineering. Section 3.2 explores two distinct possibilities for organizational structures. First option does not change the organizational structure whereas the second brings an additional stakeholder to organizations for aiding the implementation of the platform. In Section 3.3 the different possibilities in the platform are discussed from social news point of view. Then a schematic process drawing is applied to describe the news evolution process. In addition, other possibilities are introduced. Finally, Section 3.4 explores integration of other software. The potential for automatic news generation is explored in construction industry related to the news platform. Chatbots are also discussed as a potential feature in the platform.

3.1 Requirement gathering method

In this section, the requirements gathering methods are introduced as they can enable more scientific approach for requirement identification. Requirements can be gathered with many different methods. Agile requirement engineering and requirement engineering approaches provides the most suitable practices for requirement gathering. Requirements can be gathered with the use of techniques used in agile requirement engineering(ARE). ARE focuses on user-centered design where requirements are gathered during the whole development process (Schön et al. 2017, p.79-80). It is a process which is adjusted from requirement engineering(RE). Paetsch et al. (2003, p.1) stated that requirement engineering is a traditional software engineering process which relies on documentation on knowledge sharing. It aims to identify, analyze, document and validate the requirements for the developed system. It is also an iterative process which
demands co-operation with the user about the different type of requirements. This process is described in figure 3.1 below. The process consists of the following steps: the process of elicitating, understanding, specifying and validating the users’ requirements. In requirement elicitation, information is gathered from the users. This gathering can be conducted by interviewing, which is a traditional technique for information gathering. Other methods for information gathering can be joint application development, brainstorming, concept mapping or questionnaire. After the information is gathered with some technique, the it is used in requirement catalog. This requirement catalog demands a pre-decided technique for the specification of the requirements. Proper selection of this technique can make the users better understand the system. The requirements can be presented with multiple different perspectives such as with natural language, templates, scenarios, use case modeling or prototypes. Then the requirement catalog is presented to the users and the requirements are validated according to the user needs. This process can be repeated several times to find out inconsistencies or undefined requirement (Escalona & Koch 2004, p.194 199).

![Figure 3.1: Requirement engineering process (Escalona & Koch 2004, p.195)](image)

Paetsch et al. (2003, p.1-3) stated that agile software development (ASD) focuses on face-to-face collaboration with a customer. It is a code-oriented approach with characteristics of being adaptive to changing requirements during the development process, thus relying on people’s collaboration and expertise. It can be concluded that ASD perspective is people-oriented and not process oriented. ASD can be conducted with different methods such as extreme programming, agile modeling or scrum. According to (Highsmith & Cockburn 2001, p.6), ASD is derived from lean development. Lean development is originated from principles used in lean production in the Japanese automobile manufacturing process. Lean development goal is to complete the development process in shorter time, with less defects and lower budget. All these goals need to be achieved for lean development to happen. Agile requirement engineering is the way requirements are gathered during ASD process. It also uses artifacts for communication, elaboration and documentation of requirements in agile environment. Schön et al.
(2017, p.86-87) identified the most frequently used artifacts in ASD. These artifacts were user stories, prototypes, use cases and scenarios.

User story can be a multi-purpose description of user needs, product description, planning item or mechanism for creating conversation. User stories can be created by using a template: "As a (type of user) I want to (perform some task) so that I can (reach some goal)" (Patton & Economy 2014). Prototype is a sketch of a software application which helps the discussion with the user. Prototype can also be an informal drawing or a mockup. These aid in specifying features related to content, navigation and business logic. Use cases describe the system behavior in more technical and specific terms than user stories. Use cases can be comprehended as an action or event steps that are performed for a goal. Scenarios presents the interaction between the user and the system in textual form. The interaction is described in specific context (Schön et al. 2017, p.87)

3.2 Organizational structure

The platform can be implemented into different organizational structures. This chapter inspects two remarkably different possibilities. Easier implementation of the platform does not change the organizational structure. It solely brings the news platform into work site with different possibilities for usage. It relies on collaboration of the workers to contribute to the production of news into the platform. The other possibility changes the organizational structure by bringing in a reporter who can interview and report news to provide content into the platform. Both of these possibilities have their benefits and disadvantages. These, among others, will be discussed next.

3.2.1 Relying on stakeholders collaboration

The platform can be solely used withing the existing organizational structure. This would mean that the platform is implemented into the existing working practices of the workers. The figure 3.2 visualizes the platforms two basic functions: input and output. Input means the act of posting or reporting news. The worker can contribute to the news platform to report things happening in the work site. Also, other stakeholders such as managers can contribute to the news platform to provide schedule updates or news about upcoming events. Output means the act of reading or receiving the news that were contributed by the stakeholders. Output can not happen if there are no news about the project. Therefore, this process of input and output is highly dependent on the user contribution to the platform. This same idea can be seen with the so called WEB 2.0 platforms such as Facebook, Twitter and Reddit (Kaplan & Haenlein 2010, Kwak et al. 2010, Weninger et al. 2013).

The advantage of this kind of user contribution is that it gets the users involved in the management process of the project. The possibility for workers to post about
events and problems in site can give them the feel of control. The workers can all feel responsible of contributing to the success of the project. This idea of giving the workers responsibilities is derived from Toyota manufacturing process. According to (Shook 2010, p.66-67), in Toyota manufacturing process, the workers on assembly line knows precisely the work assignment. The worker also knows when there is a problem which can prevent him from completing the task. If such a problem occurs, the worker notifies the manager, who can then assist with the task. If the problem is not fixed in time, the worker can stop the assembly line until the problem is fixed. Traditionally in manufacturing, the assumption has been that the line never stops. This means that if a problem occurs, it can be marked and repaired later on. This can result in poor quality. The key principle in Toyota was to respect the people. Respect meant that all employees have the right to be successful at their job. Their job includes finding problems and making improvements. The managers need to provide the workers the means for these possibilities. These same concepts of thinking are utilized in this platform.

A worker in a construction project usually knows the part of work site he works at better than any other person. In construction industry, workers can already determine the way they want to do a certain task, since there are multiple of different methods to end up with a satisfactory outcome. This differs from traditional manufacturing, where the work practices used to be decided by the engineering department. After the manufacturing plant implementing the Toyota manufacturing process, the work
methods could be decided by the workers (Adler et al. 1999, p.51). In the construction industry, the platform could further increase the possibility for workers to contribute and act as a more valuable member of the project team.

This platform would provide the worker the means to notify or inform about problems in site. The worker could also make suggestions about possible improvements in the working practices by notifying the whole project team. These improvement ideas could then be discussed from different perspectives in the news thread by commenting. If the improvement idea would be feasible then it could be implemented. If not, then the reasons for the denial would be clear to the worker. These practices enables the construction site workers to contribute to the success of the project by giving them part of the control and responsibility.

For this kind of change to happen, a cultural shift is needed to happen. Cultural shift in which workers report problems and contribute to the success of the project. This shift also requires the proper tool and training. Shook (2010, p.68) stated that a manufacturing plant, NUMMI, experienced a cultural shift which changed the concept of problems. The factory applied Toyota manufacturing techniques into existing conditions. The main idea was to change the habit of blaming others for problems to focusing on solving the problems. This solution oriented approach toward problems enabled workers to solve the problems together with learning from the mistakes, thus changing their attitude toward them. Similar shift is needed to happen in construction industry. What makes this shift difficult, is that the exposed problems can sometimes be our own making. When someone exposes problems in our work, it might feel like a personal attack. However, workers need to recognize that reporting about problems is not the act of blaming and incriminating, rather the call for solutions. Change in this attitude needs to happen for people to report problems in the possible platform.

One way of solving this cultural shift is to invest in tools, training and to a committed leadership. Adler et al. (1999, p.65) indicated that without committed leadership, the production plant NUMMI, which utilized Toyota manufacturing process in United States, would have never succeeded in balancing with flexibility and efficiency. The plant invested in training of the managers. This investment paid off in the longer-term particular with indirect ways. This would indicate that for cultural shift to happen, the managers need to act according to the desired cultural shift in a committed way.

### 3.2.2 Organizational structure change

The figure 3.3 reflects the organizational change process related to the news writing and reading. It approaches the communication problem from another angle by adding an additional stakeholder, reporter, into the project team. This reporter interacts with the stakeholders to write news. For large projects, the reporter can be a reporter team, which can consist multiple of reporters with varying responsibilities. In the previous section 3.2.1, the collaboration actions of writing and reading by the stakeholders were requirement for the platform to be functional. By adding the reporter to the stakeholders, the project team is deducted from some of the writing actions but can
still benefit from the platform output by reading about event or problems.

![Diagram](image)

**Figure 3.3: Possibilities for usage**

With this organizational change comes the need to understand the role of the reporter. Some aspects are needed to be considered, such as the qualification to be a reporter and the different types of interactions with the workers. The basic assumption is that the reporter who interacts with the workers needs to have good communication skills with an ability to produce written text. On the other hand, if reporter only posts video news or news that do not require communication, other skills would be more essential. Other aspects can be considered from traditional journalism. Deuże (2005, p.446-447) stated that the basic traits or values of journalists are objectivity, autonomy, immediacy, ethics and public service. These traits can be seen as a beneficial for reporter in construction work site. In addition to basic traits, certain knowledge about the construction site processes could be needed. For example, traditional reporter might not know what are the important aspects to focus the effort of reporting. The extent of this reporter expertise in construction industry is difficult to determine without experimenting this concept in practice.

As visualized in the figure 3.3, there is an arrow between a stakeholder and a reporter. The arrow visualizes the interaction between the stakeholder and the reporter. The reporter can interview the worker by asking questions related to the completeness of work, problems in site or other important matter. The reporter can then write news about the discussed subjects, which other stakeholders can then read, like and comment
on. This process enables the contribution of workers without them needing to possess a good writing skills. Writing can be viewed as a skill to be acquired and achieved compared to speech which comes naturally by listening (Liberman & Whalen 2000, p.192-193).

Completeness of work information can be utilized for example in Last Planner System (LPS). Dave et al. (2015, p.6) studied current problems in implementing Last Planner into construction projects. One of the problems was the difficulty to track and monitor the progress. In this proposed platform, the reporter can collect the needed information and report it as a news or distribute it straight to the person managing the schedule. LPS together with a location-Based Management System offers a tool package for social and technical planning processes (Seppänen et al. 2010, p.53). This combination could be further supplemented, if the information for the schedule monitoring could be gathered with the reporter.

Both of these options can be reasonable for projects. This latter option conserves most of the benefits of the first option. In addition, it decreases the main stakeholders effort and need for the platform information input. It can also enable easier implementation of the platform as the reporters can support the platform usage. The disadvantage of the reporter is that it demands additional monetary investment, as a reporter needs to be employed and taught for the job.

### 3.3 Possibilities in the Platform

The reason news industry was chosen to resemble the platform characteristics was because it is highly influenced by technology and it has utilized the main information and communication technological advancements in the last centuries. Most of the people are familiar with platforms from social news industry. Dix (2009) stated that during the design, the focus should be on the users. Therefore, most of these characteristics are used in other platforms as it provides familiarity with the design and user interface. News industry has also an ideal background of information distribution to people. During the evolution of human, the demand for different kind of information delivery has increased. Now, global information is available to anyone with a computer or a mobile device (Pavlik 2000).

This next chapter describes the requirements and possible features to be included in the platform. Social news aspect will be discussed together with automatic news generation possibilities. These possibilities will be discussed with respect to the size of the project and usefulness of the feature.

#### 3.3.1 Social News

Next, possible features from social news platforms are chosen to represent the possible functional requirements. These ideas are derived from social news platforms such as
Twitter and Reddit.

The studied social news platforms enable everyone to contribute to the news. Similar possibility for the news platform would be feasible, since the collaboration of every level of people can provide insightful ideas for the project and problems can be fixed when they are first realized. This idea is presented in figure 3.4. In addition, the news can be generated by any stakeholder in the project team, thereby reducing the effects of Chinese whisper. This idea and its benefits were discussed in length in previous section 3.2. There could be problems when letting everyone use and contribute to the platform. Kaplan & Haenlein (2010, p.66) stated that some companies fear that the staff spends too much time on social media sites and company blogs compared to work. However, this fear is irrational, since the workers can already waste their time with different applications on their mobile devices. Other problems exist with data security as all the information cannot be available to everyone.

![Diagram of the news platform usage relating to some of the stakeholders in the project network](image)

Figure 3.4: Schematic visualization of the news platform usage relating to some of the stakeholders in the project network

Social media platforms also offer the possibility to vote and comment the news posts. In Reddit, the comment process creates a discussion hierarchy around the topic in subcategory (Weninger et al. 2013, p.580). Silverman (2018) argued that comments are the key in Reddit as they self-regulate the posting, which twitter is unable to do. Most popular posts that appear on the front page may not be legitimate and the comments can reveal the truth. Similar approach could be utilized in the proposed news platform for construction communication. These news posts could be visible according to a relevance. Relevance meaning the age of the post and the number of votes it has received. In Reddit, this has been solved with time decay algorithm, which values the recent news more than an old post with more votes (Silverman 2018).

Mobile interface seems to be a requirement for all the different social media platforms. Maybe even platforms in general. According to a statistic gathered by Chaffey (2018),
mobile interface design should be the first consideration when designing web experiences. Some countries such as India, Mexico and Indonesia have more than four times the smartphone usage compared to desktop. Nevertheless, desktop or laptop usage is still considerable in many western countries. Mobile devices are mostly used for application as over 80 percent of the time used was related to application usage. This statistic would indicate that the platform should be primarily designed for mobile. The general purpose of the platform is to be available in work site across the whole project team, thus mobile solution is the only viable option for such conditions. Below in figure 3.5 the possible mobile interface is represented. The limitations for this option are that it is needed to be downloaded, thus it increases the complexity for implementation of the platform. One possible solution could be to have a progressive web application. It would automatically prompt the user to add the application to their home screen after visiting the web site (Google 2018). This leads to the second criteria for design: browser supportive. Construction sites usually have site offices where laptops are used. The users could access the news platform straight from their browser without an external software. This makes the usage of the platform easier as it requires no additional download of a software. In addition, laptops have larger screens to view the news information.

![Figure 3.5: Visualization of possible interface](image)

Folder structure has been a problem in current data management software systems (Kähkönen & Rannisto 2015). Therefore, a proper categorizing of news is required for tackling such problems. News tagging will automatically categorize news into correct categories if a correct tag is given. This tagging allows users to specify the post without the need for searching a correct folder to add it in. This tagging can also be described as a meta-data input. Social news sites include this kind of tagging.
posibility. Search option is related to the tagging. Search option allows users to easily search for information relevant to the user by inserting key words. If every post is tagged, they can be located with the search function.

Social news sites offer subscription of categories based on a personal preference. There are different possibilities to view news. Only news that are in subscribed categories can be viewed, therefore only the news that are in the interest of the reader are viewed. Other possibility is to see all the resent news from every category (Silverman 2018). Some news can belong in multiple of categories depending on the tagging. In this platform, similar customization could be possible. When the user creates a user account, some categories are automatically subscribed based on the occupation and job description. Other categories can be added, based on the user preferences. In addition, news can be sorted based on aspects such as location, popularity or date. This sorting can also be refereed as a filtering.

Social news sites use moderators to filter inappropriate messages. For example, Reddit uses moderators who are selected among the users and they are responsible for filtering unsuitable news posts. In addition, Reddit administrators can interfere if necessary (Weninger et al. 2013, p.579-580). The difference with Reddit compared to the news platform is that in Reddit, the users are anonymous. This anonymity possibly creates more inappropriate messaging than in platform, where users need to post with their actual names. Nevertheless, a moderator in the news platform could be a feasible option. Kaplan & Haenlein (2010) indicated an approach that company could select a group of individuals whose work is to manage the social media. Similar possibility could be created for the news platform. Among each subcontractor group, one could be assigned to be responsible of the reporting and managing the groups messages. However, this would require a volunteer from each group, since forcing someone to accept such a responsibility might not work the way intended. If a reporter, or a team of reporters would be chosen, then such a matter would not need to be considered, since the reporter can handle the moderators responsibility.

The platform could include direct or private messaging to individuals and groups similarly to a Twitter and a Reddit. This possibility deducts the need to use another instant messaging applications for work-related private messaging.

Navigation in the application should be designed to be user friendly. Social news platforms use features such as static tool bars and swiping to left and right to see things such as categories or setting. The figure 3.5 represents the possible interface of the platform. This visualization was created by combining features from Twitter, Reddit and Slack interfaces. In this visualization, the categories could be viewed by swiping right. However, the navigational structure of the platform is not represented as it requires more thorough research.

Ineffective communication can be partly linked with problems related to multicultural and multilingual environments (Toor & Ogunlana 2008, p.395). A multiple language support with a translation possibility would address the multicultural problem in construction sites. Twitter has this possibility in the platform. The downside of this feature is the poor translation ability in some cases. But as natural language processes
3.3. POSSIBILITIES IN THE PLATFORM

develop, it will become more feasible in the platform. Many times, subcontractors in
construction site include people with varying levels of expertise in English language.
Normally, the language difficulties are handled with the so called 'cultural gatekeeper'
who works as a translator (Ferraro & Briody 2017, p.67). Similar possibility could
be applied for the platform. Stakeholders with better multi-language skills could aid
the translation process by changing the automatic translation if necessary. This action
could then be rewarded with a collaboration point system.

3.3.2 News posts

Different events occur in construction site. The figure 3.6 below represents a flowchart
of event evolution to news. In the beginning, there is some kind of event, which can
be a current state of the project, upcoming event or problem in site. The post can
be complemented with a file, link or a picture. After this step, a meta data needs to
be inserted. The platform should automatically suggest some categories based on the
most popular categories or recent categories. Some meta-data is needed to be inserted
before posting such as location and group. Also, individuals can be tagged. After
this process, the event becomes news. This news can then be commented, voted or
additional meta data can be inserted for more comprehensive categorization. Also,
the comments can be further commented and voted. This possibility ensures that the
news can become more packed with information as the conversation can sprout to new
directions.

This flowchart disregards other possibilities for users to contribute. These possibilities
can be to upload a short video about the project or upload a voice recording.

Figure 3.6: News evolution
3.4 Integration to other software

3.4.1 Automatic News

The news automation process is described in the figure 3.7 below. First, two different aspects relating to algorithm need to be considered before the implementation of automatic news. Then the possibilities for automatic news are discussed in relation to the platform. Finally, a SWOT analysis is composed for condensing some internal and external opportunities and threats.

![Diagram of Automatic News Process]

*Figure 3.7: Decision process*

Prerequisite for algorithm

Two different perspectives can be considered in the proposed platform for integration of the automated news. First, should the platform integrate some type of robotic news algorithm or should it be outsourced? This issue depends on factors such as the type of news to be generated. Does the generated news require to be top notch and is the
data easy to gather? Connectivity issues and data privacy also needs to be taken into consideration. Integrated robotic news writing algorithm embedded in the platform would be feasible if the usage would be minimal and simplistic. Automation of news data would include some basic information extraction into an existing template. This kind of automation algorithm would be relatively simple to produce (Graefe 2016).

If the automated news writing is outsourced, then more complicated algorithms can be utilized. The need for such a system would need to be justified based on the proposed use application in construction project. There are many automated reporting services in the world and more are emerging. Some of the biggest providers are Narrative Science, Automated Insights and AX Sematics. They offer a progressive and complex software for automatic writing of sporting events, product descriptions, hospital patient summaries or portfolio analysis (Graefe 2016, p.19). In addition, some of them support content creation for multiple languages. This language support might stand out as an important feature, since construction industry is becoming more multi-national. However, data security issues need to be considered because of outsourcing the data.

**Different uses**

Automated news in the platform can reduce the workload for construction managers. Dainty et al. (2007) stated that although managers have many responsibilities, much of their time in spent on communication. Managers are also humans, thus prone to forgetting. Therefore, any automation which reduces their workload can be seen as an improvement. The automation alternatives are divided into two categories. First category of sensors refers to an idea that news posts are generated according to the value of the sensor. Specific algorithm is created in planning phase, which results in news generation as the defined value is obtained. The second category means that posts are generated at specific time during the project. When project reaches some threshold, news related to this point of time are displayed.

One of the possible usage of automation news can include sensors and probes. Internet of things (IoT) devices are innovated rapidly into construction industry. Most of these devices are related to building facility management phase as a concept called Smart Buildings (Bilal et al. 2016, p.515). However, some devices also collect data during the construction phase concerning for example temperature, humidity and location.

Traditionally, moisture level from the concrete is collected by drilling a standard hole into a concrete, and then measuring the moisture level in the concrete after a specific time. This process is conducted with a subcontractor who visits the worksite according to the foreman’s notice, and conducts the measuring by hand. Report is created manually after the measurements are conducted. The process needs frequent manual measurements, which are coordinated by the foreman. These manual measurements offer only a reference mark for the moisture of concrete. Therefore, Ramirent has invented a circumstance IoT sensors which collect data from the room and concrete. This data is gathered with wireless sensors and delivered into their server. The data can be used to monitor the environment for providing the best circumstances for the
concrete drying process. Project managers and other stakeholders who have permission, can inspect the data by using the software offered by Ramirent (Anttila 2018). These sensors offer an innovative way to manage the moisture in concrete. However, there is some room for automation. In this news platform, the automatic news can be generated if the conditions become unsuitable for the concrete drying process. Also, as concrete reaches a humidity level which is suitable for the installation of floor layer, news can be generated automatically. The mandatory measurement report can also be generated with the aid of automatic news algorithm. These automations offer better quality, faster construction time and less work for the manager. Difficulties with this automation lies in the data availability from the sensors and the machine to machine interconnection.

Project phase automation

Other possible usage of automated news can be related to projects phases. News can be automatically generated as the project reaches certain predetermined phase in the project. The news generator automatically calculates time that has passed from a specific phase, and according to this information it generates relevant news. Phase updates are inserted during the project by project manager, since unexpected events can occur delaying the project. The type of automatically generated news can contain instructions for proper quality of construction, news on upcoming milestones and news on important predetermined events such as concrete delivery dates. The way these news posts can be produced is determined by template value insertion or by more advanced automatic content determination, based on a database. Combination of these can be an option as well.

The reason for automatically providing quality related news can be important, since the special nature of a construction industry. Each project has different stakeholders with altering expectations of quality. Quality terms are usually described for each project in the contract agreements and the subcontractors agree on delivering the service according to them. However, every subcontractor has their own way of working, which can differ substantially between companies. Quality is usually defined according to the requirements of regulatory agencies. However, customer may have his own expectations for quality, which can differ from the regulations. Therefore, standard quality terms need to be defined for each project separately. Arditi & Gunaydin (1997, p.236) argued that a building can meet the quality regulations and, simultaneously not the needs of the customer and vice versa.

Quality issues are regulated and inspections are carried out in every construction project. Regulations and rules guide the proper way of building. A book called Quality of construction work combines process guides and regulations from Ratu (Rakennustuotanto) and RYL (Rakennustöiden yleiset laatuvaatimukset) in Finnish construction industry (Rakennustieto 2017). This book is widely used as a quality measurement for construction work in Finland. The book is an extensive in information wise. Therefore, companies have generated their own compressed handbooks for quality, which offers a more concise quality notations related to a specific operation of construction. These
### 3.4. Integration to other software

#### SWOT analysis

<table>
<thead>
<tr>
<th>Strength</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Automation of information delivery to participants</td>
<td>● Implementation issues of new technology: Early resistance and difficulty to get working properly</td>
</tr>
<tr>
<td>● Remind subcontractors about important aspects: Conditions, quality, milestones</td>
<td>● Sensor data openness issues, difficult to combine systems</td>
</tr>
<tr>
<td>● Reduces communication issues, re-work, quality</td>
<td>● Heavy information input in planning phase</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Automation reduces management work load in construction phase</td>
<td>● Overload of (unimportant) news</td>
</tr>
<tr>
<td>● Successful implementation brings possibilities in future projects as the system is proved to be functional</td>
<td>● Bugs in the software</td>
</tr>
<tr>
<td></td>
<td>● Multi-language problems; translation difficulties and mistakes</td>
</tr>
<tr>
<td></td>
<td>● Security issues of data</td>
</tr>
</tbody>
</table>

Table 3.1: Analysis of the automation news

Handbooks are used by construction managers with varying frequency.

The way automation can be applied into quality is by automating quality instructions during the projects. Simple solution is to gather manually specific quality aspects, and generate news about them automatically during the project. This solution can turn out to be laborious if many aspects are considered relevant. A more complex solution for news automation can be derived from a quality regulation book or a company specific handbook. This complex solution demands a better understanding about natural language generation.

Although quality aspects are taken seriously, quality errors remain in construction industry. Quality defects lead to rework which decreases productivity. According to Rakennustieto (2017, p.29), quality requirements need to be reviewed with the worker before the work can begin. Nevertheless, site-managers might not always dedicate their time to do this quality requirements review process before work begins. The benefits for automatic quality news can aid the productivity by decreasing quality defects.

#### 3.4.2 Chatbot

Chatbots could provide to be useful in news platform. Chatbots are one aspect of computer mediated communication. They interact with humans through natural conversational language Hill et al. (2015, p.246). Bots are commonly used in different
platforms such as Slack, Facebook messenger and Telegram. The bots aid with information locating by answering questions presented for it. Different bots are included in slack and more can be created for better personalization in Slack. Different types of bots include response bots, notification bots and slash command bots. Response bots respond to predetermined questions with a defined message (Guay 2018). Similar types of bots could be used in the platform to answer common questions related to project characters, contact information or other relevant matters.

Notification bots in Slack watch another application for information. When new information appears in the application, the bot can automatically update about it, and post it to the Slack channel. Slash command bot can perform tasks based on the commands user inputs into the message. These bots can be customized for different purposes (Guay 2018). The proposed platform could utilize both of these bots. Notification bot could be used in the news automation. News can be automatically generated as the project reaches a milestone. Also, if modification is done to design, the notification bot could automatically detect this and post a news into a correct category.
Chapter 4

Research methods

The aim of this thesis was to explore the possibilities and requirements in a news platform for construction communication. This aim was achieved by triangulation of the data and methodology. The triangulation included a literature review, qualitative methods and a questionnaire. The literature review inspects research questions with the focus on discovering possible features from other industries. The first qualitative research method concentrated on the two research questions stated below. Qualitative methods aims to understand the underlying reasons in situations, thus it is good for comprehending communication difficulties and discovering possibilities (Heikkilä 2014, p.8). This qualitative approach relates to semi-structured interview. Semi-structured interviews are typically based on predetermined open-ended questions. In addition, other questions can appear during the interview process, which facilitate the meeting toward desirable direction (DiCicco-Bloom & Crabtree 2006). The second research method was a workshop which used post-it notes to collect ideas and considerations. It also aimed to clarify the requirements of the news platform with a Likert-scale questionnaire. The following research questions are addressed in this chapter.

- What difficulties communication tools fail to address?
- What are the key attributes to be included in a news platform for construction communication?

This chapter is organized as follows. Section 4.1 reviews an interview setting, data collection, results and findings from Länsimetro case study. These results are analyzed and utilized for preparing the material for the workshop. Section 4.2 reviews the workshop findings and discusses the results.

4.1 Länsimetro case study

Länsimetro is more than billion-euro subway project comprising 21 kilometers of underground subway line (Länsimetro 2018). This mega-project corresponds appropriately to the situation, since these type of projects can be considered difficult to manage in respect to numerous stakeholders, the dynamic project capacity and the diverse administrative structure (Mok et al. 2015, p.448). The difficulties in communication are prone to happen in such a mega projects with complex management issues.
To address the research question 2 – What difficulties communication tools fail to address? – Questions were constructed for discovering the underlying reasons for miscommunication in current construction projects. These reasons were then categorized into applicable categories and the results are discussed in respect to previous literature. To address the research question 3 - What are the key attributes to be included in a news platform for construction communication? - Questions were composed relating to the current communication tools in Länsimetro. In addition, the discoveries from literature were presented and evaluated based on the interviewee's insights from construction industry.

4.1.1 Setting

The chosen method for the qualitative study was an interview. An interview can be considered a good tool to gather requirements and possibilities about software tool, since it is traditional and frequently used method (Escalona & Koch 2004, p.196). The qualitative study was conducted in Länsimetro office building in Espoo. The interview was held on April 16, 2018. It started on Monday afternoon at 15:00 onward. The interviewees has some background working in a construction industry. Group dynamics was informal. Although, the fact that the meeting was recorded might have influenced the contribution of each parties. Moreover, the interviewees knew the subject of the thesis, which could have directed their attention toward specific communication difficulties.

The meeting was in three parts: two sets of questions and a presentation. This process is presented in figure 4.1. Two series of questions were formed for questions series. These were presented with PowerPoint presentation. First, questions were asked related to communication difficulties. Then, SWOT-analysis was utilized in questions related to their internal social media tool, Hailer. In the third part of the discussion, the news platform was presented according to the literature review and brainstorming sessions. Feedback was then received relating to the news platform. The interview was recorded, transcribed, categorized and analyzed. Next, the interview process is described in more detail.

4.1.2 Data collection

Data was collected by recording the meeting with mobile phone recorder. Before publication, the chapter was sent to the interviewees for ensuring that no sensitive data is published before the acceptance by the interviewees. Total duration of the meeting was two hours. The recordings were transcribed into written text. This text was 15 pages, containing little over 5000 words. Some sentences were compressed while trying to maintain the meaning of the message. In addition, the presentation part was not transcribed into the transcript. The process of transcribing took around seven hours. Some parts were re-listened for comprehensive understanding. Common themes and categories were recognized and combined after the transcribing process.
The discussion related to the communication difficulties revealed similar findings as literature review but with a different focus. The difficulties, which arose, are divided into three main categories: communication skill, communication motivation and technological aspect. The second series of questions was related to an internal social media tool called Hailer. The different aspects were interviewed with the aid of SWOT-analysis frame. Therefore, the different aspects could be easily grouped together. The aspects were sub-grouped into functional and non-functional requirements.

The possible platform was introduced in the second part of the interview. The interviewers could comment during the presentation. Then, feedback was received based on the presentation. Interviewees commented and reflected on different aspects of the platform and presented new ideas.

4.1.3 Results

This qualitative interview provided useful insights into the nature of construction projects in practice. As DiCicco-Bloom & Crabtree (2006) stated "The purpose of the qualitative research interview is to contribute to a body of knowledge that is conceptual and theoretical and is based on the meanings that life experiences hold for the interviewees". This qualitative interview enabled more pragmatic view to the research questions, than literature review alone. The first part of the interview is summarized in table 4.1. The difficulties are grouped into three categories: communication skill, communication motivation and technological view.
Table 4.1: Difficulties in communication based on the interview

Part 1 - Communication difficulties

Communication skill category comprises of traditional communication problems, which can arise in any industry. Expression problem means the problem to express ideas into words. Communicating this information can be difficult even for effective communicators. Writing problem belongs into this same category, since a writing skill is something to be acquired. For some construction industry stakeholders, this writing does not come naturally. The interview identified situations where producing simple sentences might prove to be difficult for some stakeholders as their expertise lies somewhere else. As information is multi-layered, recognizing the proper communication channel can be difficult.

Communication motivation comprises of things related to the willingness to communicate. Attendance in meetings is an important concern if the stakeholders want to express their ideas in the project. Difficulties can arise, if the opinions of relevant stakeholders are not taken into account. Widely discussed subject was information overload. The information needs to be categorized and the most important facts clearly stated in the message. There have been cases where useful information has been lost in the message or it has been "hidden" between other redundant information. Such situation can lead to extensive monetary expenses. In addition, contractual agreements can limit the
communication. The contractual agreements do not consider every possible communication scenario. Consequently, stakeholders can refer to the contractual agreements by saying that they have proceeded according to them. This kind of communication can be enough by the agreements but might not be enough for proper communication to happen.

Technological view -category refers to technological side of construction industry. Construction projects are complex environments with multiple of different technological tools. Therefore, information can get easily lost into this fussy technological domain. In addition, information need to be up to date. When some information is located, then question remains to whether the information is latest or if there are more resent versions of this information. Lastly, some stakeholders have an assumption that technologies can replace normal human-to-human communication. Project stakeholders can also assume that some relevant information they saved to a project bank or emailed with mass distribution, is now available to everyone. Thus, everybody must know about it. Consequently, when distributing relevant information, it needs to be verified as received and read by the other party. Otherwise, the communication process is not complete.

Part 2 - Social media tool

The second series of questions were related to a social media tool. The tool, Haile: was purchased because the organization was looking for something similar to intranet but not specifically intranet. Originally, the tool has been created for task management purposes. This option was removed from the platform because it did not support the organization needs. In addition, other information and communication tools used in a Finnish construction industry were presented during the interview. These included Sokopro, Confluence, Jira, Congrid and Sharepoint. Sokopro is a project cloud system, which offers information storing. Confluence is a team collaboration platform, which can integrate other tools such as Jira. Jira is a project management and task management software. Congrid is a task management software to aid the project manager in quality and safety management. Sharepoint is an intranet with mobile interface.

The table 4.2 describes the strengths, weaknesses, opportunities and threats of the social media tool called Hailer. These are further divided into functional and non-functional properties as earlier research recognizes this division (Escalona & Koch 2004, Glinz 2007, Chung & do Prado Leite 2009).

The platform was chosen partly because it offered intranet and conversations in one package. Slack was previously considered, but it lacked this option by default. Other positive aspects included information storage in the platform and the possibility to retrieve older messages with search function. This offered improvements compared to traditional communication with instant messaging and email. The mobile application was also considered easy to use and functional. With one click the basic interface was visible and swiping left or right enabled for general things or own subscribed categories. The possibility to subscribe to some topics was seen as a good function. The desktop
<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuctional</td>
<td>Fuctional</td>
</tr>
<tr>
<td>• Messages and information stored in the platform</td>
<td>• Basic structure: task need to be defined clearly</td>
</tr>
<tr>
<td>• Mobile app user-friendly</td>
<td>• Leaders example</td>
</tr>
<tr>
<td>• Works in browser</td>
<td>• Features: No message threads, formal only, informs if someone leaves the conversation</td>
</tr>
<tr>
<td>• Easy to add users</td>
<td>Non-functional</td>
</tr>
<tr>
<td>• Automatically suggests metadata tagging</td>
<td>• Not available to everyone</td>
</tr>
<tr>
<td></td>
<td>• Cost structure</td>
</tr>
<tr>
<td>Non-functional</td>
<td></td>
</tr>
<tr>
<td>• Intra and conversations in one package</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuctional</td>
<td>Non-functional</td>
</tr>
<tr>
<td>• Better Search option</td>
<td>• Information security issue</td>
</tr>
<tr>
<td>• Better information categorization</td>
<td>• Company reliability</td>
</tr>
<tr>
<td>• Ideas from Confluence</td>
<td></td>
</tr>
<tr>
<td>Non-functional</td>
<td></td>
</tr>
<tr>
<td>• Expansion to worksite</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.2: Analysis of the used Social Media tool

version works in a browser, which was considered as a requirement. When posting a new post, the platform automatically suggests some categories. This made the posts easier to categorize and prevented unclassified information to arise.

As earlier discussed, the platform was modified for the purposes of the organization. These modifications were needed because the platform was originally designed for different kind of usage. Eventually, some of the basic features of the original platform was removed such as the task management feature. In the end, the platform was working adequately for the purposes of the organization. Nevertheless, some problems remained. According to the interviewees, it was identified that for the success of this kind of platform, the company top management need to use the platform. Therefore, without the relevant stakeholders’ engagement in the platform, the usage may remain limited. Also, some other functional difficulties included the lack of message threads and the formality of the platform. These weaknesses limited the conversation spreading and willingness to contribute. The non-functional weakness was that the platform was not available to all stakeholders participating in the project. It was speculated,
that the tool could be useful among the construction site, since a large part of the
difficulties were solved there. One of the main reasons for not expanding the software
to the worksite was that the platform costs money for each additional user.

Expansion to worksite was considered as a possibility. The problems it would create
included things such as what part of the conversation would be in worksite compared
to design office. In addition, user groups and levels need to be defined and managed,
since thousands of people could use the platform. Functional opportunities included
improved information categorizing with better search option. Every information needs
to be classified and categorized. This would enable easier comprehension of the big
picture. One of the interviewees was closely familiar with platform called Confluence.
Many suggestions were related to the existing features in Confluence. These features
included conversation channels, to-do lists, meeting memos, connecting to other soft-
ware such as task management software and work-safety measurements. Confluence
also provided easier comprehension of the big picture.

The threat consideration needs to include the reliability of a platform and a provider.
When a new platform is implemented into the company workflow, it needs to work
according to the planned methods. For example, if the platform capacity exceeds and
it crashes, it could result in severe problems.

Part 3 - News platform

Next, the possible news platform is discussed. First, the positive aspects are stated and
then the considerations are listed. The interviewees considered the idea of informing
the workforce about the status of the site to be sensible. This way the worker does not
need to come to the worksite for nothing, if there is something hindering the work. In
addition, the interviewees considered the automatic sensor news, situation monitoring
and future event notification to be logical if it can be implemented into practice. The
possibility to react to news posts is a good thing, since currently news are generally
one-sided informing.

The possible considerations can be divided into three parts: General considerations,
features and integration. The general considerations of the news platform were related
to the usage: how to get most of the stakeholders using it? In other words, there
could be some part of the project team using the platform and the other not. This
idea was further emphasized by stating that a workload cannot increase among the
stakeholders. During the process of designing a new platform, the consideration needs
to focus on to a question: what can be deducted from the workload of stakeholders by
using the platform? In addition, the usage need to be rewarded rather than blaming
for not using it. In addition, the platform should somehow provide a real-time project
status with the aim of discovering the things that can prevent the future work.

The discussion about features included the up and down voting of news. It was regarded
as a possible threat. This was due to the fact that some news could be down-voted
because of personal reasons and generally disliking of the subject. This can result in
negative feelings toward the usage of the news platform. For example, news related to quality might not be considered as important as other news, even though they are certainly essential for the success of the project. In addition, the tagging of news with the generally used symbols '#' and '@' could be difficult to comprehend for some stakeholders. Discussion rose about having a moderator of some kind. Not all the information can get to everyone; therefore, there should be some types of user access levels similar to other systems.

Possible feature considerations were integration of other software or management practices. Congrid was identified to have some similar features as the proposed news platform, although it aims toward task management and work monitoring. Confluence had the possibility to integrate other tools such as Jira. For example, the meeting memo can be posted on Confluence and some specific words can be highlighted and sent to Jira. Then a task is created according to the highlighted words and a selected person receives a ticket concerning the task. Afterwards, when the task is completed, notification is sent to the original person. Management practices could also be integrated into the software. For example, Last Planner lookahead-plans could be posted to the project team. This would enable the whole project team to receive the notifications about the decided goals. In addition, the absent stakeholders would know about the decisions.

4.1.4 Analysis and findings

The discovered communication difficulties would suggest that the level of communication skill seems to limit the communication, since ideas can be difficult to express into speech. Moreover, Dainty et al. (2007, p.10) stated that the explicit knowledge represents only small part of the entire body of knowledge. Thus, the communication skill matters greatly in communication. The lack of communication skill can lead to miscommunication. This can further result in mistakes during the construction stage (Sambasivan & Soon 2007).

The motivation to communicate seems to be connected to the contractual agreement limitations. Dainty et al. (2007, p.27-28) defined business related communication problems into five categories, of which one was perception and attitude problems. It closely relates to communication motivation. Information overload can be seen as a motivation problem. It could also be considered partly skill and technological problem. Information can be available but the same time difficult to locate, thus it demands effort and skill and to find it. In addition, technological advances enable the information to be available in multiple of different locations, which leads to information overload. The value to communicate relevant information to the other project stakeholders was also recognized by Senescu et al. (2012, p.185) as an important issue.

These results suggest that in mega projects, such as Länsimetro, organizational structure change together with a suggested news platform might be the most viable option. This is because the stakeholders seem to be practice oriented together with communicating according to the contractual agreements. This practice orientation indicates
that the worker knows the practical construction skills but lacks the writing skill. This lack of writing can lead to the fear writing as it is easier to fail when something is unfamiliar. An additional reporter in worksite partly solves the communication skill difficulty, since the workers only need to communicate with the reporter by speech. The advantages are available for them without the need to do an extra effort of contributing by writing. This same idea is presented by Ardichvili et al. (2003, p.4), who stated that people are more willing to share information informally to their colleagues than write something to database.

The analysis of the social media tool called Hailer indicates that the success of any platform implementation into construction industry requires a wide understanding of construction field and its stakeholders together with organizational understanding. The tool offered some benefits for the communication department and the design team. However, it was noticeable that the platform was not used as it was intended by the developers, partly because it was designed for other industry purposes and partly because the relevant users did not use it. The designed functions in the platform were needed to be adjusted for the organizational specific needs. Therefore, some of the main aspects were not utilized and others emerged to be too formal or stiff. Another major dilemma was the pricing strategy of the platform. The platform was not widely utilized in other parts of the project because of the decided strategy of per-user pricing. These types of platforms can reveal their potential if they can be easily expanded to multiple of users. Campbell (2014) stated that the customers rarely value the number of users of the software, rather things such as number of files stored. Similar pricing structure is used in Slack, where customers are charged based on the storage room they require (Guides 2018). This way of pricing seems justifiable, since customers using Slack probably value the availability of information. For the proposed news platform, paying for the required cloud storage could be relevant pricing structure. This would enable the customer to include as many members as they want for users of the news platform.

The proposed news platform needs to consider multiple of different perspectives to be successful. The news platform needs to provide exciting content for everyone to prevent a situation, where some of the stakeholders are using the platform and other are not. Dix (2009) states, that the experience needs to be engaging and fun for the user. This idea could be used to tackle with the issue. The specific features could be personalization of categories together with fun and engaging material. This material could include different types of news, such as video footage, drone footage or audio news broadcast of the situation. For example, AaltoUniversity (2018) provides a web-camera footage of a worksite in Otaniemi. However, these types of news might require a change in projects organizational structure. This change would require a reporter team as part of the organization to provide such a diverse news reporting. This idea was discussed more thoroughly in preceding chapter.

Other method of involving the stakeholders is to define the communication channels in contractual agreements. This can be supplemented with training and support for understanding the different communications tools and their usage. It would improve the communication skill, since the correct communication channels can be recognized more easily. In addition, chatbots can be used to answer questions related to correct communication method. These chatbots can be integrated in the news platform. The
<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Input (reports)</th>
<th>Output (Checks)</th>
<th>Deducts work and advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subcontractors</td>
<td>Problems and work completes</td>
<td>Schedule updates and problems in work</td>
<td>Repair work, less informing to manager, knows about decisions</td>
</tr>
<tr>
<td>Managers</td>
<td>Schedule updates, other informing</td>
<td>Progress on site, check disruptions</td>
<td>Less individual informing related to schedule and project, no need to discover every defect and error</td>
</tr>
<tr>
<td>Design team</td>
<td>Changes in design</td>
<td>Progress on the site</td>
<td>No need to visit the site to realize the progress</td>
</tr>
</tbody>
</table>

Table 4.3: User benefits and contribution

Usage could also be supported by monetary benefits. Collaboration could therefore be encouraged by some kind of reward-based systems. Social news platforms encourage collaboration by offering collaboration points. Reddit uses karma-points which display the value users adds to the community Silverman (2018). Similar participation or collaboration point system could be included in the news platform with the possibility to reward the most active members. This collaboration point system could be transferred to the subsequent projects, thus creating added value for stakeholders resumes. In addition, the project managers could choose their subcontractors partly based on the collaboration points from previous projects.

This concept of deducting before adding new work could be further visualized with the table 4.3 below. It indicates three different type of stakeholders and their roles in reporting and reading the news related to the platform. Some of the advantages and deducted work are listed in the last column. The difficulty with information sharing becomes apparent, since the person recording the information is rarely the one who benefits from it (Eckert et al. 2001, p.44). Therefore, collaboration cultural change might be needed if the platform is implemented into the traditional project teams. The inputs in the table 4.3 can be disregarded if implementing with the other option of organizational change. This organizational change would utilize a reporter type of stakeholder to gather most of the inputs into the platform. This enables the main stakeholders solely benefits from using the platform.

The idea of enabling easier comprehension of real time project status was partly solved with the tool called Congrid. It provides situation picture of defects in the floor plan. The observations can be viewed based on different factors such as the responsible stakeholder or according to a date. Congrid allows to solve multiple of different problems with one platform. This platform is targeted exclusively to construction managers (Congrid 2018). Similar situation picture about the problems could be implemented into the platform. Each problem could be visible in the floor plan interface. One consideration could include the integration of such a tool.

The features included up and down voting of the posts. This idea is derived from Reddit, which is anonymous social news platform. However, option that is more sen-
sible is to have the basic one directional voting of thumb up, since the news platform is not anonymous. People can be seen less prone to post inappropriate material with their own name; thus, the down voting is not needed for material prioritizing. In addition, the platform is not aiming to offend anyone, hence only allowing positive reaction might create more accepting environment. Integration of other applications to the news platform is a subject to be discussed and further researched. The news automation and slack-bots were discussed earlier. Furthermore, other integration possibilities exist such as task management and work-safety applications. Integration with Last Planner practices could also be a possibility.

4.2 BIM breakfast -workshop

To address the research question 3 – What are the key features to be included in news type of communication platform for construction industry? – A workshop was applied. The workshop was chosen to test some of the ideas discovered in the interview. Quantitative approach was chosen to evaluate some of the previously mentioned requirements or possibilities. This quantitative approach included a requirement questionnaire to provide some insight into some of the features in the platform. The results of this survey are discussed in general terms, since the sample size was quite low.

4.2.1 Setting

The workshop was held on 27th of April in 2018. The event started at 9.15. Vishal Singh opened the event and after that I started with my presentation. In the presentation, I introduced communication difficulties based on the findings from Länsimetro interview. Afterwards, I presented the possibilities in the news platform. The presentation enabled understanding about the news platforms possibilities. The figure 4.2 illustrates the workshop process.

The feedback was gathered with a survey and with the use of post-it notes. Groups were able to discuss about the different aspects for around ten minutes. The requirement questionnaire included some of the most common requirements for the platform. The students were able to discuss about the idea together in groups before the questionnaire. This might have affected the results. Also, the quality of presentation could have affected the opinion of the survey results.

The workshop included students with different levels of experience from construction industry. Some had an experience from work, whereas other had only academic background. Total number of participants was 20, which included all who were present at the presentation. The questionnaire had a total of 12 questions. The questions can be seen from the figure 4.3.
4.2.2 Data collection and results

The data collection included two separate parts. The first part was a requirement survey, which was used for validating the requirements. In the second part, data was collected with post-it notes.

The requirement survey was used for validating the requirements. The questionnaire was composed as a five point Likert-scale. Total number of questions was 12. First ten of these questions were functional requirements and the last two were non-functional requirements. The figure 4.3 indicates the accumulation of answers for different questions in the survey. The numbers from one to five represents an option related to the requirement in question. The number one was strongly agree, the number two was agree, the number three was undecided, the number four was disagree and the number five was strongly disagree. The level of agreement can be seen from the figure 4.3. In general, the survey indicates that the questions were proportionately well understood and agreed on.

The group discussion data was collected with post-it notes for ideas and comments. These notes were organized in four different sections: interface, posts, automation and other. Most of the comments included the same concerns that were considered in previous chapters. Some post-it notes are not mentioned, because of the difficulty to comprehend the meaning.

Interface included comments about the simplicity of interface, data moderation, data access and permission. The ideas were about signing colors for tasks as writing can be time consuming. Another idea was about the possibility to not include chatting in the news platform.

Posts included comments about the authority to post, security and the possible miscommunication if the message is automatically translated. The ideas were related to the posting familiarity and making the posting process as straightforward as possible. Automation included comments about monitoring the automation, variety of data type, data manipulation and data storage. The Ideas included integration of information and automatic image analysis. The other section included comments related to
motivation to use, document control, universal usage and acceptance of application. One idea was to include these features in BIM common platforms.

In the end of the discussion, the participants commented on the idea of changing the organizational structure by introducing a reporter into the project team. They commented on the eligibility requirements of reporters, the bias of reporting, the demand and supply of information, the nature of dialog and the economic benefits. In addition,
questions rose about the type of projects that this solution can be beneficial. Ideas included a notion that the reporters can be subcontractors and that there should be benefits for the news reader to encourage the usage.

4.2.3 Analysis and findings

This quantitative study provides a direction for the possible requirements of the news platform. However, the group size was too small for reliable conclusions to be drawn from the questionnaire. In addition, the group diversity did not meet the requirements of a proper qualitative method. Nevertheless, this requirement survey can give some guidelines for the requirements. Next, the survey findings will be discussed and the ideas from the post-it notes will be addressed in more depth.

The requirement survey indicates that the questions were proportionately well understood and agreed on. The most understood and agreed requirement was related to data categorizing as everybody gave an answer and the mean was the lowest. The first question accounted for the lowest level of agreement. It stated that everyone can contribute to the news. This question divided opinions, as some discussion groups disagreed and some fully agreed with this question. One possible reason can be that the question was not unambiguous. The participants could have interpreted this as in everyone, not only the project team. Other reasons can be that the groups discussed things related to data security, which resulted in biased opinion among the discussion group. However, as this survey just gathered opinions in qualitative manner, these speculations are only possible reasons and cannot be concluded as definite reasons. As (Heikkilä 2014, p.8) stated that a qualitative research is good at mapping the existing situation but is unable to adequately investigate the reasons for them. Nevertheless, this requirement survey was combined with post-it note feedback and ideas. This feedback indicated issues such as security and management of the posts. These ideas could have shaped the participants views toward limited user contribution possibility.

The post-it notes gathered many of the similar, already discussed matter into to sight. The reason for this could be that the presentation was unable to present all of the different views due to the time limit of the presentation. Other reason could have been the fact that these are actually important matters. Nevertheless, some of these concerns are discussed next, with the focus on the news ideas.

The idea about signing colors for task was presented in the post-it notes. Similar idea is used in platform called Congrid. However, in this news platform; this idea is not further discussed as it is not aiming to be a task management platform. Excluding chatting feature could be a possibility as it would drive the usage toward common groups and contributions. However, this chatting possibility enables the private messaging in the platform as it can sometimes be obligatory to send private message to a member in project team. In addition, without this option the private messaging would be utilized from other platforms, thus complicating the communication by dividing the information between various platforms. An idea rose about posting similarly to other platforms. However, the posting option in the news platform can already be considered
straightforward and related to previous familiar platforms. The posting process was described in the possibilities chapter. One idea was the possibility to integrate the news platform features in BIM common platforms. However, it would change the idea substantially, as then the platform would not be as easily open to everyone as the costs of the platform increases. In meta-data input, automatic image analysis could be utilized. This idea would definitely be useful as the platform could automatically suggest categories based on the taken image.

Data access and permissions are concerns to be accounted for, as it arose in the previous interview study. Some news threads need to be accessible to only some members of the team and these permissions needs to be controlled by a member of the project team. In a case of organizational change, the reporter team can handle the access rights as well as the reporting and data moderating. Otherwise, some moderator needs to be assigned for the job. However, in large projects, this permission control can be a full-time job. Motivation to use is definitely an important matter, unfortunately no additional ideas were incepted in the workshop. Universal usage of this platform would facilitate to more motivation to use. This is because in such a systems critical mass can have a positive effect (Rauniar et al. 2014). In addition, the collaboration point system was discussed in chapter 4.1.4 and it could promote usage.
Chapter 5

Results and discussion

This chapter discusses the results of the thesis and the possible implications for practice. First, the justification for the news platform is presented. The challenges are discussed as they will complicate the implementation process. Lastly, the possible future directions are discussed, since this news platform requires more effort before it can provide the presented benefits.

Construction industry is scattered as it involves many professions with their own organizational technological solutions. Many times, these solutions are designed for the specific need of a organization and can be considered as a company secret (Kähkönen & Rannisto 2015). In addition, the tools rarely achieve a universal usage, partly because they are expensive to implement into the project practices. Moreover, these tools are mostly designed for the specific purpose and individual stakeholders needs. Communication tools lack the universal and broad perspective of involving every member of the project team. Therefore, there is a need for cost effective solution that can offer a new perspective on communication. This challenge was addressed with a perspective to news industry. This thesis explored the possibilities and requirements of a news platform. This platform should consider aspects related to the development of the platform as well as the project implementation.

This news platform would provide the stakeholders the possibility to inform the relevant parties about news related to the project. The platform aims to be a collaborative information channel for the whole project team. This all-embracing collaboration enables the different opinions to present themselves, allowing the team to better comprehend the interrelated and interdependent system of a project. It can also be argued that better communication among the project stakeholders can lead to better work satisfaction (Michie & Williams 2003, p.7).

Difficulties in the development and implementation

The platform development and implementation process includes many difficulties. These two processes are discussed with solution oriented way. The difficulties need to be addressed but not focused on, since there will always be difficulties in every solution. The attitude toward them need to be positive as it fosters better problems solving ability than negative attitude (Lyubomirsky & Nolen-Hoeksema 1995, p.188).

Many things can be considered when developing a technical tool. Before the tool can be developed, requirements need to be selected according to the platform characteristics.
Requirement engineering process has been the main process for requirement gathering. In recent years, agile requirement engineering has emerged as it focuses on the user during the development process (Schön et al. 2017). This user-centric process needs to be considered, when developing the news platform. This enables the development of features that are useful for the user, thus focusing on the aspects that the user values. The findings of this thesis do not consider this process, as the aim was to gather the requirements and possibilities. However, this agile requirement engineering process could be a useful method to study and test this concept further.

The composition of the development team can play a crucial part in the success of the platform. Edmondson (2012) identified successful behaviors or team forming to be speaking up, experimenting, reflecting, listening intently and integrating. These aspects could be emphasized in the team forming process to aid the platform development process.

The construction industry is cyclic in its nature. This creates different demands for different times. Therefore, even the least motivated workforce needs to be employed into the construction projects. There is a worldwide saying that "a bad workman blames his tools" (Dictionary 2018b). It refers to the culture of blaming a mistake or failure to the things which are used for work. Similar type of a culture can be present in construction industry. This can negatively affect on the implementation of the news platform. The news platform can be considered as a thing to blame on the difficulties and problems. For example, a worker can make a wrong conclusion about some news in the platform resulting in a mistake. The worker can then blame the news platform for not being unambiguous. However, these workers can always be present in workplaces. Therefore, the focus needs to concentrate on the solutions.

Implementation can be a difficult issue to tackle. Opposition will exist when companies change their working practices. This opposition partly exists because people are habit oriented, and changing the habits can lead to disarray. Nilsen et al. (2012) stated that repeated behavior can often be difficult to change. This is a fundamental aspect in human behavior, and it cannot be changed, thus methods should be invented to make this practice easier. When implementing an IT technology, previous experience with computers can be beneficial. Hartmann & Fischer (2009, p.363) stated that the people with low computer skills may resist the implementation, but the resistance is reduced if they are involved in the implementation process. Thus, involving the project stakeholders can lead to successful implementation of a technology. In addition, the top management needs to use the platform as was recognized in the Länsimetro-case study. Incentive models can be used to aid with the platform usage (Harris & McCaffer 2013, p.117).

All in all, the technical solution needs to fit into the organization and to the minds of workers. Currently, the work force in construction industry might be too reluctant to adapt a solution which mimics popular social news sites. However, in the near future this workforce will retire and new generation will take its place. Consequently, the changes will happen in due time.
## Future possibilities

Automated news were discussed from two perspectives: sensor news and project phase news. This automation requires a proper understanding about the algorithms required in the news development. Sensor news include news that are automatically created based on the sensor data. Project phase news are created based on the project phase and the schedule information input to the system. Chatbots are also closely related to automation as algorithms used in chatbots are the fundamental of automation. Guay (2018) argued, that chatbots are the big new thing as they are a core part in popular communication platforms. Hence, these chatbots should be further studied as their role could be an integral part of the news platform as well.

The figure 5.1 indicates the different solutions suitability for different project sizes. This figure is an indicative model for understanding the future possibilities for the news platform. For small projects, there exists only few communication channels between the project participants. Therefore, implementing a news platform might not be worth the posting effort. In medium size projects, solely implementing the platform could be sensible, since more events are prone to happen. An additional reporter in medium size projects could increase the costs of the project substantially, making the organizational structure change unprofitable. Nevertheless, some training and support would be needed if the stakeholders are not previously familiar with the news platform. In large projects, organizational structure change together with the platform would be the most viable option, since there is a lot of moderating need. The interview in Länsimetro also supports this finding.

![Selection matrix based on the project size](image)

The benefits for this additional stakeholder are not limited to the construction projects. In addition to the benefits for the project, organizational change can utilize reporters from news industry. News industries are experiencing an oversupply of reporters be-
cause of the development of the Internet and more recently, the social news (Kaplan & Haenlein 2010). This oversupply can be utilized in construction project reporting. These reporters can even create new subcontracting companies for construction projects. The reporters can be considered good at writing and reporting about the current events. In addition, the basic traits of journalists include objectivity and immediacy (Deuze 2005, p.446-447). Therefore, they will be perfect candidates for this new subcontracting position. This combination of a news and construction industry can advance the industry, since the journalists can offer new perspectives to the traditional stakeholders in the construction industry.

During the implementation part of the platform, the leadership needs to be effective for change to happen. According to Senge et al. (2015, p.29), system leaders aim to create conditions for change to happen rather than try to make change to happen. Therefore, this additional stakeholder can provide new conditions for the previous stakeholders in the construction industry. Consequently, leading to change in communication habits.

Human side of communication derives from the natural communication problems of encoding and decoding. This can be difficult to overcome with just a help of technical platform, since communication inputs and outputs are highly dependent on people’s understanding of wider spectrum of information about the world and themselves. In this regard, solving the communication issues solely with technical solution might not fix this multifaceted problem. Nevertheless, many believe that communication in construction can be further improved in respect to clarity and information availability (Arnold & Javernick-Will 2012, Wikforss & Löfgren 2007). Therefore, the news platform together with organizational change could ensure the best means of furthering the development of clear and trouble-free communication.
Chapter 6

Summary and conclusions

The aim of the thesis was to determine the attributes to be included in a news type of a mobile platform for better communication between the stakeholders in construction. These features were identified, discussed and grouped into a possibilities and requirements table, which identified some of the main attributes for the platform developers and project organizations.

This thesis poses the following research questions:

1. What beneficial features can be found from other industries?
2. What difficulties communication tools fail to address?
3. What are the key attributes to be included in a news platform for construction communication?

The research question 1 was addressed using a literature review. It mainly explored ideas from news industry and communication technologies. The research question 2 was addressed using a qualitative research method for understanding the current practical problems in the construction industry. This method was an interview of two practitioners from the construction industry, and it revealed three categories of difficulties: communication skills, communication motivation and technological views. In addition, it provided new ideas for the platform. The research question 3 was explored through a workshop to validate the requirements. During the workshop, participants filled in a questionnaire concerning some of the incepted requirements.

The figure 6.1 combines the different possibilities into a table. The texts in boldface describe the identified requirements from the workshop. The table provides considerations for the platform developers in the development process of the news platform. In addition, the project team perspective is considered when implementing such a platform.

Platform developers

The platform developers need to consider various aspects related to interface, features, integration and a pricing model. A mobile interface can be considered as a requirement, together with similarities from other platforms. These enable faster learning and easier adaption of the news platform. The basic assumption is that all the project stakeholders can participate. This participation includes the possibility to contribute and collabo-
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<td>- Cultural shift</td>
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<td>- Price incentive for collaboration</td>
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<td>- Reporter/team of reporters</td>
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<td>- Collaboration point</td>
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Figure 6.1: Possibilities and requirements

rate by posting, commenting and reacting to the news. Arnold & Javernick-Will (2012) argued that there is a recent trend toward more collaborative management software in construction projects. Therefore, this collaborative participation is acceptable for the news platform.

One of the findings from the interview was data categorization. Every post or piece of information needs to be categorized for an easier discovery. This categorizing indicates that the news need to include meta-data, which aids with information locating. Information locating was one of the difficulties discovered in the interview. Private messaging can be found from each of the examined platforms, thus it can be seen as a requirement. Private messaging enables sensitive information distribution through the same platform. In addition, the news platform aims to be usable among the whole project team, which can be composed of a multilingual crowd. Therefore, a multi-
language support with a translation possibility was a requirement. People also value
information, which is related to their own work. Therefore, customization of the plat-
form needs to be possible. This customization will also address the communication
issue related to information overload. Information overload was identified in the liter-
ature review as well as in the interview.

Many of the current platforms include integration of other tools and applications.
Integration offers the ability to connect the platform with existing or new tools that
previously offered beneficial functions for the company. This possibility was explored
through the following approaches: automated news, project management software,
chatbots and project management practices.

Automated news can reduce the need for manual updating. Automated news are inves-
tigated from two different perspectives: sensor news and project phase news. Sensor
news offer automated news when a sensor obtains a certain value. Project phase news
can offer news related to the upcoming events or milestones in the projects. Other pos-
sibilities exists, such as automatic news related to quality issues. Project manage-
ment software can also be integrated into the news platform similarly to other platforms in
construction industry. This integration can bring useful possibilities from other tools
in the industry. Chatbots are closely related to news automation. Chatbots are one
aspect of computer-mediated communication and use natural language to communi-
cate. Chatbots can be used for different purposes such as to answer common questions
related to project characters. Management practices, such as Last Planner integration,
is a possibility. It could enable better information flow between the project team and
the weekly meetings. In the end, all of these integration possibilities requires consid-
erations regarding aspects, such as data security, compatibility with the other tools in
respect to data type and openness of data formats.

During the interview in Länsimetro, a crucial aspect was discovered related to the
pricing model of the platform. Pricing needs to be favorable towards additional user
if aiming for wide usage in organizations. Therefore, the pricing business model needs
to focus on different things than charging for each additional user. One possibility is
to price the platform for storage and integrated features. A similar pricing model is
used in Slack, which is a widely used communication platform in different industries.
This type of pricing would automatically place the value in components valued by the
customer. This would enable organization-wide access for the customer without the
fear of paying for nothing.

**Project teams**

Project teams have two possible directions for implementing the news platform: tradi-
tional organization or organizational change. These both have their advantages but
the interview findings indicate toward organizational change as the most viable option.

Traditional organization implies to an idea that the organization structure would not
change during the implementation of the news platform. The news would be produced
by the stakeholders in the project team. The news platform would be implemented into the working practices of the company. This requires a high management effort and commitment as the news platform needs to be used in all levels of the project for it to be useful. Management also need to manage the news message moderation and the user access levels. Cultural shift need to happen among the workers in the construction industry, similar to the production plant which utilized Toyota manufacturing process (Adler et al. 1999, p.65). This cultural shift aims to change the workers attitudes toward problems to more solution-oriented approaches together with learning from the mistakes. It would facilitate toward willingness to report news and more collaboration in the news platform. In addition, the posting of news should not be limited to well thought out and lengthy messages as it can reduce the collaboration activity among the stakeholders (Ardichvili et al. 2003, p.4).

Organizational change refers to an idea, in which the organizational structure is changed by an additional stakeholder. This stakeholder could be called a reporter or a team of reporters. This reporter collaborates with rest of the project team in such a way that accurate news can be produced and delivered to the news platform. The other stakeholders can still contribute to the news platform, but the content is not limited to their contribution, since the reporter posts most of the news. In addition, there is a less management effort needed, as the reporters can be responsible for the moderating of the news. This solution addresses the recognized writing problem in communication skills category.

When implementing a new solution to a workplace, there usually is some training and support for the usage (Gagnon et al. 2012). Consequently, both of the proposed solutions would probably require some training for the usage. Organizational structure change requires less training need, as the reporters handles most of the news input to the platform. In addition, the reporters can train the other stakeholders with the usage as the project proceeds. A contractual agreement modification was proposed as one solution for addressing the implementation of the news platform. This stems from the research finding of communicating according to the contractual agreement limitations.

Limitations and future research

The possibilities and requirements for the news platform were composed according to a few common platforms and two relatively small case studies. These case studies gave only indicative results for the requirements of the news platform. In addition, the findings regarding communication difficulties were derived from a literature review and from one interview. Therefore, more difficulties in communication can exist. However, concentrating on discovering more difficulties might not be the correct direction as companies will have their own procedures, the information is still going to be located in many locations and the stakeholders will have different communication abilities.

A sensible option for future work would be to either validate the requirements further or to develop a prototype according to the thesis findings, and test this prototype. The requirements can be validated with more carefully planned requirement survey, since
the one used in this thesis was short and included only a small group of participants (n=20). The other option of prototype development could utilize an agile requirement engineering process of involving the end-user. This process would validate the requirements further during the development process.


